

Integrating Environmental Performance and Environmental Cost into Firm Value: Managerial Ownership Role

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Abstract—This study investigates whether environmental performance and environmental cost affect firm value among energy-sector firms listed on the Indonesia Stock Exchange, and examines managerial ownership as a moderating variable, controlling for profitability and firm size. Using panel data regression combined with moderated regression analysis (MRA) in EViews 13 on a purposive sample of 22 firms over 2020–2024 (110 firm-year observations), the baseline model explains 63.95% of the variation in firm value (adjusted $R^2 = 0.639$), rising to 72.67% (adjusted $R^2 = 0.727$) once managerial ownership and its interaction terms are added, with both models jointly significant at the 1% level ($p = 0.000$). Neither environmental performance ($\beta = -0.891$, $p = 0.344$) nor environmental cost ($\beta = 0.009$, $p = 0.423$) significantly affects firm value. Managerial ownership significantly moderates the relationship between environmental performance and firm value ($\beta = -10.719$, $p = 0.000$), albeit negatively, contradicting the hypothesized reinforcing effect, whereas its moderating effect on the relationship between environmental cost and firm value remains insignificant ($\beta = 1.034$, $p = 0.101$). These findings suggest the Indonesian capital market has yet to fully price sustainability disclosures, and that concentrated managerial ownership can weaken, rather than strengthen, the value relevance of environmental performance. Theoretically, this study extends environmental accounting literature by evidencing a governance-contingent market response to sustainability information within an integrated moderation framework rarely tested jointly in the energy sector. Practically, it offers corporate managers and investors an empirically grounded basis for evaluating environmental management and ownership structure in strategic and investment decision-making.

Keywords: Environmental Performance; Environmental Cost; Firm Value; Managerial Ownership

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1. INTRODUCTION

The rapid pace of industrialization, a key driver of global economic growth, has also been recognized as a contributing factor to Indonesia's economic development. However, the majority of domestic economic activity remains heavily dependent on the exploitation of natural resources, particularly within the coal, petroleum, and natural gas mining subsectors. The energy sector's substantial contribution to economic growth is accompanied by considerable environmental risk, as inadequate management may result in heightened carbon emissions, land-use change, and ecological degradation (Diharjo & Manik, 2023). Against this backdrop, corporate objectives have gradually shifted from a narrow focus on profit maximization toward a broader consideration of social and environmental responsibility (Almaeda, Pramuda, & Setiawan, 2023). Sustainability performance is increasingly viewed as a key driver of firm value, a view that continues to warrant further empirical scrutiny.

Within environmental accounting, the effectiveness of a firm's environmental management is commonly reflected in two interrelated dimensions, namely environmental performance and environmental cost, whose relationship remains theoretically ambiguous and empirically inconsistent, thereby warranting further scholarly attention. On one hand, a firm's environmental performance can be understood as the degree to which its operational conduct aligns with statutory environmental standards, capturing how effectively it anticipates, contains, and remedies the ecological repercussions of its production processes. On the other hand, environmental cost captures the financial commitment a firm makes toward safeguarding the surrounding ecosystem, manifested in outlays intended to curb waste output and preserve long-term environmental integrity (Renaldi & Anis, 2023). Taken together, the disclosure of both dimensions, whether embedded in annual reports or dedicated sustainability reports, functions not merely as a compliance signal but as a strategic mechanism through which management reinforces organizational legitimacy among key stakeholders, including investors, regulators, and the broader public.

In the Indonesian context, corporate environmental performance is formally assessed through a five-tier color rating scheme, ranging from black and red for non-compliant firms to blue for firms meeting minimum statutory requirements, and green or gold for those exceeding baseline regulatory thresholds. This evaluation mechanism, known as the Corporate Performance Rating Program in Environmental Management (PROPER), is administered by Indonesia's Ministry of Environment and Forestry and functions as the principal annual benchmark for gauging firms' seriousness in discharging their environmental obligations. Government records point to a steady rise in both the number of participating firms and the share attaining green or gold status (Kementerian Lingkungan Hidup dan Kehutanan, 2022), an indication that PROPER has evolved from a mere compliance exercise into a reputational asset that firms actively pursue in its own right.

Following Hapsoro and Adyaksana (2020), environmental cost refers to the financial resources a firm commits toward preventing and containing the ecological harm caused by its business activities. Such expenditure has been shown to influence the sustainability of a firm's business processes and to reflect the extent of its efforts to control the adverse environmental impacts of its operations (Subaida & Pramitasari, 2023). Accordingly, environmental cost is increasingly regarded not merely as a drain on resources but as a form of corporate investment in environmental preservation and regulatory compliance, thereby strengthening investor confidence in the firm's long-term business sustainability (Hapsoro & Adyaksana, 2020).

Despite the growing weight placed on environmental management, empirical evidence on how environmental performance and environmental cost feed into firm value remains far from settled. On one hand, firms' sustainability commitments appear to build investor trust, with stronger environmental performance translating into higher firm value (Gunawan & Berliyanda, 2024). On the other, Subaida and Pramitasari (2023) find no significant effect at all, attributing this to the long horizon over which such benefits typically materialize, a null result echoed in the Indonesian manufacturing context by Hapsoro and Adyaksana (2020), who similarly find that environmental performance fails to significantly influence firm value, arguing that investors still weigh financial performance more heavily than environmental performance when assessing firm prospects. Focusing specifically on energy-sector firms, Hasan and Wijayanto (2025), consistent with Gunawan and Berliyanda (2024), report that the PROPER rating carries a positive and significant effect on firm value, with the market rewarding firms that show a credible commitment to managing their environmental impact more generously.

Evidence on the effect of environmental cost is also mixed, with prior studies reporting negative, insignificant, and positive associations. At one end, Hapsoro and Adyaksana (2020) treat environmental cost as a burden the market penalizes, eroding perceived profitability; at the other, Renaldi and Anis (2023) read cost disclosure as a transparency signal that the market rewards as evidence of genuine sustainability commitment. Budiono and Handoko (2025) and Subaida and Pramitasari (2023) complicate the picture further, finding no significant link between environmental cost (or environmental management accounting more broadly) and firm value, regardless of whether Tobin's Q or price-to-book value is used as the valuation proxy.

The moderating role of managerial ownership fares no better in terms of consensus. In mining-sector firms listed on the IDX between 2020 and 2022, Umami, Lukita, and Astriani (2024) found managerial ownership to meaningfully strengthen how both green accounting and environmental performance translate into firm value, which they interpret as support for internal governance sharpening the payoff from environmental management. Salam and Afriyenti (2025), studying the same sector but over 2019–2023, arrive at the opposite conclusion: managerial ownership moderates neither environmental performance nor environmental cost, since the share of equity management holds does not necessarily reflect a genuine commitment to environmental stewardship or stakeholder communication. Taken together, these contradictory results suggest that managerial ownership's value as a governance mechanism in this context is far from settled, and that its effectiveness likely depends on the sector and period under study.

Taken together, this body of conflicting evidence leaves a research gap that is particularly consequential for energy-sector firms, given their direct exposure to environmental risk and their standing within Indonesia's sustainability regulatory framework. Moreover, prior studies have generally examined environmental performance and environmental cost in isolation, over relatively short observation periods, and have thus fallen short of offering a comprehensive account of their joint influence on firm value within a single, integrated research model. The present study seeks to address this gap by positioning managerial ownership as a moderating variable, on the premise that the effectiveness with which environmental management translates into firm value is substantially contingent on the strength of a firm's internal governance.

Motivated by these empirical patterns and the research gap outlined above, this study pursues two objectives: first, to examine the effects of environmental performance and environmental cost on the firm value of energy-sector firms listed on the Indonesia Stock Exchange (IDX) over the 2020–2024 period; and second, to determine whether managerial ownership moderates these relationships. Profitability and firm size are incorporated as control variables to account for the influence of firm-specific characteristics on firm value. This five-year observation window was deliberately chosen to span a period marked by considerable economic variation (the pandemic shock, the ensuing recovery, and the subsequent stabilization of growth), thereby offering a richer view of how these relationships behave under differing economic conditions.

This study is expected to yield both theoretical and practical contributions. On the theoretical side, it extends the environmental accounting literature by furnishing empirical evidence on how managerial ownership moderates the relationship among environmental performance, environmental cost, and firm value, a nexus that remains relatively underexamined and inconsistently reported within the energy sector. On the practical side, the results offer corporate management an empirical foundation for formulating environmental management policies oriented toward long-term value creation, while providing investors an additional lens, grounded in environmental performance, environmental cost, and ownership structure, through which to evaluate firm prospects and inform investment decisions.

2. RESEARCH METHODS

This study employs a quantitative research design grounded in secondary data drawn from sample firms' financial statements, annual reports, and sustainability reports. Environmental performance is proxied using PROPER assessment

outcomes published by Indonesia's Ministry of Environment and Forestry. The sample is confined to energy-sector firms listed on the IDX over the 2020–2024 period. All data were processed in EViews 13 and analyzed through Moderated Regression Analysis (MRA) to test the direct effects of environmental performance and environmental cost on firm value, as well as the moderating role of managerial ownership. Sample firms were selected via purposive sampling based on the criteria in Table 1:

Table 1. Sample Selection Criteria

No	Description	Observation Data
1	Energy-sector firms listed on the IDX during the 2020–2024 period	91
2	Energy-sector firms that conducted an Initial Public Offering (IPO) after 2019	(27)
3	Energy-sector firms that did not disclose information or participate in the PROPER rating program during the study period of 2020–2024	(38)
4	Energy-sector firms that did not disclose their environmental cost during the 2020–2024 period	(4)
Number of Firms in the Sample		22
Number of Observations (sample size × 5 years)		110

2.1 Theoretical Framework

2.1.1 Legitimacy Theory

Legitimacy theory, a perspective originally advanced by Suchman, posits that a firm's continued survival depends not solely on its financial outcomes but also on society's perception of the appropriateness of its conduct: legitimacy is fundamentally a matter of perceived alignment between an organization's behavior and the values and expectations prevailing within its social environment (Ghozali, 2020). Firms that neglect social and environmental responsibilities risk facing pressure from the public, regulators, or investors, which can ultimately threaten their operational continuity. Because the energy sector carries substantial environmental risk arising from resource exploration and extraction activities, firms in this sector must continuously safeguard their public legitimacy through responsible environmental management. Building on this premise, Deegan's contention that the disclosure of social and environmental information constitutes a principal strategy through which firms sustain such legitimacy remains a central tenet of this stream of literature (Ghozali, 2020). Strong environmental performance and transparent management of environmental cost can therefore be regarded as efforts to meet stakeholder expectations, which in turn strengthens a firm's relationship with its social environment, reduces external pressure, and contributes to an increase in firm value.

2.1.2 Signaling Theory

Signaling theory, pioneered by Spence within the context of labor markets, proposes that parties possessing greater access to information are motivated to signal their quality to less-informed counterparts in order to narrow that information gap. This logic has since been extended to the relationship between firms and investors, where management, holding superior internal information, is motivated to convey that information to reduce information asymmetry surrounding investment decisions. Signaling theory further explains how firms transmit signals to users of financial statements, with such signals reflecting management's actions in pursuit of shareholders' objectives (Ghozali, 2020). In this study, environmental performance can serve as a favorable signal of a firm's environmentally responsible operational practices, enhancing investor confidence. Environmental cost disclosed by a firm can likewise signal its commitment to managing environmental impact, as such disclosure reflects management transparency and efforts to mitigate long-term environmental risk. Taken together, stronger environmental performance and greater transparency in environmental cost disclosure represent robust positive signals to investors, a combination expected to translate into higher firm value.

2.1.3 Agency Theory

Agency theory, originally framed by Jensen and Meckling through the lens of a contractual bond between owners (principals) and the managers they entrust (agents) to run the business on their behalf, holds that the two parties often pursue divergent personal interests, giving rise to conflicts of interest, commonly termed agency conflicts, in which management is inclined to prioritize its own short-term interests over shareholders' goal of maximizing the firm's long-term value (Ghozali, 2020). To address this misalignment, Averio (2020) suggests that an independent auditor can serve as an external mechanism bridging the interests of principals and agents. Internally, managerial ownership offers a complementary mechanism: when managers hold an equity stake in the firm, their interests as agents gradually align with their interests as owners, a convergence expected to steer management decisions toward long-term value creation and, ultimately, higher firm value (Ghozali, 2020).

2.2 Research Hypotheses

2.2.1 Environmental Performance

Environmental performance, as reflected in the PROPER rating, illustrates a firm's ability to comply with regulations and manage the impact of its operations responsibly. Drawing on legitimacy theory, strong environmental performance helps

firms meet social expectations while reducing regulatory risk, thereby enhancing investor confidence. Okta, Suaidah, and Antasari (2022), Gunawan and Berliyanda (2024), and Hasan and Wijayanto (2025) find that superior environmental performance is positively associated with firm value, as it also builds corporate reputation and credibility among investors. Based on the discussion above, the first hypothesis is formulated as follows:

H₁ Environmental performance has a positive effect on firm value.

2.2.2 Environmental Cost

Environmental cost refers to the financial outlays a firm incurs to prevent, mitigate, and remedy the environmental externalities generated by its operating activities (Hidayat, Ismail, Taqi, & Yulianto, 2023). Drawing on legitimacy theory, such cost commitments can be interpreted as a manifestation of the firm's endeavor to conform to societal norms and thereby preserve its social license to operate. In this vein, Renaldi and Anis (2023) furnish empirical support that environmental cost is positively associated with firm value, as proxied by Tobin's Q. Building on this line of argument, the second hypothesis is advanced as follows:

H₂ Environmental cost has a positive effect on firm value.

2.2.3 Managerial Ownership

Evidence on managerial ownership's function as a moderating variable remains mixed. In their study of mining firms listed on the IDX between 2020–2022, Umami et al. (2024) find that managerial ownership amplifies the effect of both green accounting and environmental performance on firm value, arguing that as managerial shareholding rises, environmental information is transmitted more effectively as a positive signal to investors, a pattern consistent with agency theory's emphasis on aligning agent and principal interests. Conversely, Salam and Afriyenti (2025), examining mining firms over the 2019–2023 period, find no moderating effect of managerial ownership on either the relationship between environmental performance and firm value or the relationship between environmental cost and firm value, reasoning that because PROPER ratings are set exclusively by the Ministry of Environment and Forestry as an external authority, the level of managerial shareholding has no bearing on these assessment outcomes or on how the market responds to them. This divergence points to an unresolved question concerning the moderating function of managerial ownership within the nexus of environmental performance, environmental cost, and firm value, particularly for energy-sector firms and periods not covered by the two studies cited above. Managerial ownership is therefore retained in this study as an internal governance mechanism hypothesized to strengthen this relationship, leading to the following hypotheses:

H₃ Managerial ownership strengthens the positive effect of environmental performance on firm value.

H₄ Managerial ownership strengthens the positive effect of environmental cost on firm value.

2.3 Conceptual Framework

The conceptual framework illustrates the hypothesized effects of environmental performance and environmental cost on firm value, with managerial ownership as the moderating variable and profitability (ROA) and firm size as control variables, as shown in Figure 1.

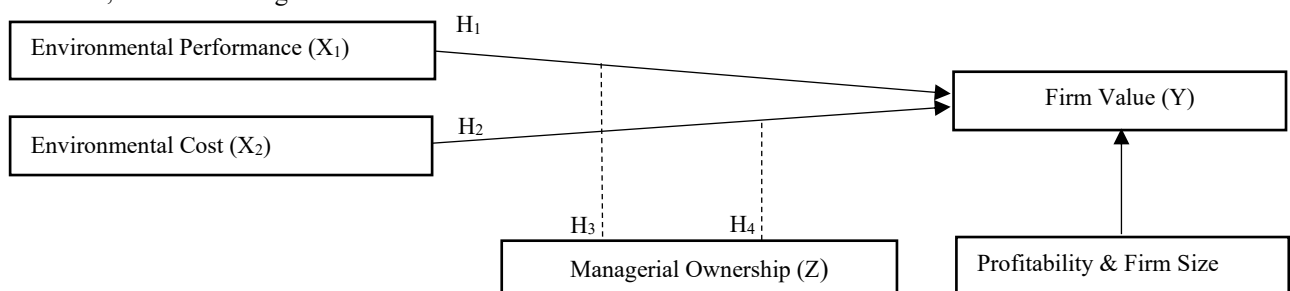


Figure 1. Research Conceptual Framework

2.4 Operational Definitions and Variable Measurement

2.4.1 Firm Value

Investors continuously reprice a firm's shares in light of its operating performance and perceived growth trajectory, and this collective market judgment is what firm value is meant to capture (Hapsoro & Adyaksana, 2020). This study follows the approach of Budiono and Handoko (2025), Hapsoro and Adyaksana (2020), and Haryono, Hasanudin, and Widiarto (2025) in operationalizing this construct through Tobin's Q, derived as follows:

$$\text{Tobin's } Q = \frac{\text{MVE} + \text{Total Liabilities}}{\text{Total Assets}} \quad (1)$$

Notes: MVE = Market value of equity, obtained by multiplying the year-end closing stock price by the number of shares outstanding. Total Liabilities, Total Assets = taken from year-end balance sheet figures. A Tobin's Q value above 1 indicates that the market values the firm's assets above their book value, whereas a value below 1 indicates the opposite.

2.4.2 Environmental Performance

An entity's environmental performance can be gauged by how closely its operational practices adhere to the principles of ecological preservation (Haryono et al., 2025; Koeshardjono, Perwirasari, & Fazira, 2025). In this study, the construct is proxied by the PROPER rating score issued annually by the Ministry of Environment and Forestry, a measurement approach also adopted by Subaida and Pramitasari (2023), Aprianti, Yuniarti, and Riswandi (2023), Haryono et al. (2025), and Koeshardjono et al. (2025). To facilitate statistical analysis, the five-tier PROPER classification is transformed into an ordinal scale, summarized in Table 2:

Table 2. PROPER Rating Criteria

No	Color	Description	Score
1	Gold	Excellent	5
2	Green	Very good	4
3	Blue	Good	3
4	Red	Poor	2
5	Black	Very poor	1

Source: Ministry of Environment and Forestry (Kementerian Lingkungan Hidup dan Kehutanan, 2022).

2.4.3 Environmental Cost

Environmental cost refers to the economic resources a firm commits to preventing, controlling, and mitigating the environmental impacts arising from its operating activities (Hidayat et al., 2023). This variable is measured using the environmental cost-to-net income ratio (Budiono & Handoko, 2025; Hapsoro & Adyaksana, 2020; Haryono et al., 2025; Subaida & Pramitasari, 2023).

$$\text{Environmental Cost Ratio} = \frac{\sum \text{Environmental Cost}}{\text{Net Income After Tax}} \quad (2)$$

Notes: Total Environmental Cost = accumulated cost a firm allocates to environmental management, as disclosed in its annual and sustainability reports. Net Income After Tax = taken from the firm's income statement for the same fiscal year. A higher ratio indicates a greater share of profit allocated to environmental management.

2.4.4 Managerial Ownership

Managerial ownership captures the share of a company's stock held by those inside its management ranks (directors and board members alike) and is commonly treated as a mechanism that aligns managerial and shareholder interests (Sapitri & Fajriana, 2025). This variable is measured as follows:

$$\text{Managerial Ownership (MO)} = \frac{\text{Managerial Shares}}{\text{Total Shares Outstanding}} \times 100\% \quad (3)$$

Notes: Managerial Shares = total number of shares held by directors and the board of commissioners at fiscal year-end.

2.4.5 Profitability

Profitability is included as a control variable because it reflects a firm's ability to generate earnings from its operating activities and indicates management's effectiveness in utilizing corporate resources (Alifian & Susilo, 2024). Controlling for profitability accounts for the effect of firms' earnings-generating capacity on firm value, following Renaldi and Anis (2023). Profitability is proxied by return on assets (ROA):

$$\text{RoA} = \frac{\text{Net Income}}{\text{Total Assets}} \times 100\% \quad (4)$$

Notes: Net Income = obtained from the firm's income statement for the corresponding fiscal year. Total Assets = obtained from the firm's balance sheet for the corresponding fiscal year.

2.4.6 Firm Size

Firm size is included as a control variable to account for the effect of firm-size differences on firm value, following the approach of Renaldi and Anis (2023). Firm size is measured as follows:

$$\text{Firm Size} = \ln(\text{Total Assets}) \quad (5)$$

Notes: Total Assets = taken from the firm's year-end balance sheet.

2.5 Mean-Centering Procedure and Construction of Interaction Terms

Before forming the interaction terms, all independent and moderator variables were mean-centered, a standard step (Aiken & West, 1991; Hayes, 2022) that curbs artificial multicollinearity introduced by multiplying variables together, while leaving the underlying regression relationships and coefficients unchanged:

$$X_C = X - \bar{X} \quad (6)$$

where X_C denotes the mean-centered value of the variable, X is the original variable value, and $\bar{X}$ is the variable's mean. This procedure was applied to the three variables listed in Table 3.

Table 3. Mean-Centered Variables

Variable	Symbol	Mean-Centered Symbol
Environmental Performance	EP	EP_C
Environmental Cost	EC	EC_C
Managerial Ownership	MO	MO_C

Interaction terms were then formed by multiplying each mean-centered independent variable by the mean-centered moderating variable:

$$EPMO = EP_C \times MO_C \quad (7)$$

$$ECMO = EC_C \times MO_C \quad (8)$$

The EPMO and ECMO interaction terms were subsequently used to test the moderating effects through Moderated Regression Analysis (MRA), as specified in Equation (9) for Model 1 and Equation (10) for Model 2:

$$Y = \alpha + b1EP_C + b2EC_C + b3ROA + b4FIRM_SIZE + e \quad (9)$$

$$Y = \alpha + b1EP_C + b2EC_C + b3MO_C + b4EPMO + b5ECMO + b6ROA + b7FIRM_SIZE + e \quad (10)$$

Notes: In Equations (9) and (10), Y denotes firm value, α is the constant, and $b1$ to $b4$ (Model 1) and $b1$ to $b7$ (Model 2) are the regression coefficients. EP_C and EC_C represent environmental performance and environmental cost after mean centering, respectively, while MO_C represents managerial ownership after mean centering. ROA and $FIRM_SIZE$ represent profitability and firm size, both included as control variables. $EPMO$ and $ECMO$ are interaction terms, formed by multiplying EP_C and EC_C , respectively, by MO_C , and e is the error term.

3. RESULTS AND DISCUSSION

3.1 Research Results

3.1.1 Descriptive Statistics

Table 4. Descriptive Statistics

	Y	EP	EC	MO	ROA	FIRM SIZE
Mean	1.571123	3.654545	1.235742	0.051456	0.128613	30.26352
Median	0.984521	4.000000	0.013462	0.002167	0.073351	30.53336
Maximum	12.91819	5.000000	77.57435	0.675614	0.616346	32.76456
Minimum	0.643832	2.000000	-1.364207	0.000000	-0.259939	26.57320
Std. Dev.	1.955259	0.759483	7.782033	0.144386	0.161801	1.563148
Observations	110	110	110	110	110	110

Table 4 summarizes descriptive statistics for the 110 firm-year observations that make up the study sample. Firm value, proxied by Tobin's Q, displays considerable dispersion, spanning 0.643832 at the low end to 12.91819 at the high end, with a mean of 1.571123 and a standard deviation of 1.955259, pointing to substantial heterogeneity in how the market prices sample firms. For environmental performance, an average score of 3.654545 across a 2.000000–5.000000 range suggests that most firms in the sample sustained at least a "good" PROPER rating throughout the observation period. Environmental cost presents a markedly wider spread, from -1.364207 to 77.57435, with the standard deviation (7.782033) exceeding the mean (1.235742) by a considerable margin; this pattern is plausibly explained by a subset of firms recording net losses in certain fiscal years, which inflates the cost ratio for those observations. Managerial shareholding, by comparison, is generally thin across the sample: the mean of 0.051456 and standard deviation of 0.144386, against a maximum of 0.675614, indicate that only a small number of firms feature meaningfully concentrated managerial ownership, with most reporting negligible or no managerial shares at all. The two control variables round out the profile: return on assets averages 0.128613 (SD = 0.161801) across a -0.259939 to 0.616346 range, while firm size (measured as the natural logarithm of total assets) averages 30.26352 (SD = 1.563148) between 26.57320 and 32.76456, reflecting a sample composed predominantly of large, established energy firms.

3.1.2 Panel Regression Model Selection

Two panel data regression models are estimated in this study (a baseline model and a second model that incorporates the moderating variable), and model selection tests were conducted separately for each.

Table 5. Panel Regression Model Selection Results

Test	Model 1	Model 2
Chow Test	0.0000	0.0215
Hausman Test	0.0074	0.0001
Lagrange Multiplier Test	-	-
Selected Model	<i>Fixed Effect Model (FEM)</i>	<i>Fixed Effect Model (FEM)</i>

Model selection for the panel regressions proceeded through the Chow and Hausman tests, summarized in Table 5. For Model 1, both tests point unambiguously toward the Fixed Effect Model (FEM): the Chow test rejects the Common Effect Model (CEM) at $p = 0.0000$, while the Hausman test subsequently rules out the Random Effect Model (REM) at $p = 0.0074$, both well below the conventional 0.05 threshold. Because CEM had already been eliminated at the Chow-test stage, the Lagrange Multiplier test, which is only informative when choosing between CEM and REM, added no further diagnostic value and was accordingly omitted. Model 2 yields the same conclusion through an identical sequence of tests, albeit with different probability values: $p = 0.0215$ for the Chow test and $p = 0.0001$ for the Hausman test, again rejecting CEM and REM in favor of FEM. Given that both specifications converge on the same estimator, FEM is adopted as the estimation approach for Model 1 and Model 2 alike.

3.1.3 Multicollinearity Test

Table 6. Multicollinearity Test Results

Model	Maximum Correlation	Criteria	Result
Model 1	0.588135	< 0.80	No Multicollinearity
Model 2	0.936499	< 0.80	Multicollinearity Detected

As reported in Table 6, Model 1's maximum correlation of 0.588135 remains below the conventional 0.80 threshold, indicating no evidence of multicollinearity. This result suggests that the correlations among the independent variables in the primary model remain within an acceptable range and do not substantially overlap in explaining the variation in firm value. In contrast, Model 2 exhibits a maximum correlation of 0.936499, which exceeds the 0.80 threshold, indicating that the model incorporating the moderating variable suffers from multicollinearity. This elevated correlation arises from the inherent relationship between the interaction terms and their constituent variables, a condition commonly encountered in Moderated Regression Analysis (MRA) due to the mathematical nature of multiplying variables when constructing interaction terms. Although the mean-centering technique was applied to mitigate this correlation, the test results indicate that the correlation among variables in Model 2 remains at a relatively high level. Such multicollinearity in models incorporating moderating variables represents a structural consequence commonly documented in studies employing MRA and does not preclude the use of the model for hypothesis testing, given that the primary focus of Model 2 lies in the significance of the interaction term coefficients as indicators of moderating effects, rather than in estimating the pure individual effects of the independent variables.

3.1.4 F-Test

Table 7. F-Test Results

	Model 1	Model 2
F-statistic	8.732660	11.351210
Prob(F-statistic)	0.000000	0.000000

The overall fit of both specifications was assessed via the F-test, reported in Table 7. Model 1 returns an F-statistic of 8.732660 ($p = 0.000000$), comfortably clearing the 0.05 significance threshold, which indicates that Environmental performance, Environmental cost, and the two control variables (ROA and Firm Size) collectively account for a significant share of variation in Firm value and that the baseline specification is therefore adequately fitted. Adding Managerial Ownership and its interaction terms (EPMO and ECMO) in Model 2 does not undermine this joint significance; if anything, the F-statistic rises to 11.351210 ($p = 0.000000$), confirming that the fuller set of predictors (EP, EC, MO, EPMO, ECMO, ROA, and Firm Size) remains jointly significant and that Model 2 is likewise well specified for the analysis that follows.

3.1.5 Coefficient of Determination (R^2) Test

Table 8. Coefficient of Determination (R^2) Results

	Model 1	Model 2
R-squared	0.722145	0.796908
Adjusted R-squared	0.639451	0.726703

The adjusted R^2 statistic offers a more conservative gauge of explanatory power than its unadjusted counterpart, since it penalizes the inclusion of additional predictors that do not meaningfully improve model fit, a property particularly relevant when comparing a baseline model against one augmented with interaction terms. Table 8 shows that Model 1,

comprising Environmental performance, Environmental cost, and the control variables, accounts for 63.95% of the variation in Firm Value (adjusted $R^2 = 0.639451$), leaving roughly a third of the variation (36.05%) attributable to determinants not captured by the present specification. Introducing Managerial ownership as a moderator, through the EPMO and ECMO interaction terms, lifts this figure to 72.67% (adjusted $R^2 = 0.726703$) in Model 2, an improvement of nearly nine percentage points that points to a substantive, not merely marginal, gain in explanatory power once the moderating mechanism is taken into account. This upward shift across specifications lends support to the decision to model managerial ownership as a moderator rather than treating its role as negligible.

3.1.6 t-Test

Partial hypothesis testing was carried out via the t-test at the conventional 0.05 significance level, with a p-value below this threshold taken as evidence of a statistically meaningful effect and a p-value at or above it interpreted as failure to reject the null hypothesis of no effect. Beyond estimating these direct coefficients, the same test was applied to the interaction terms in Model 2, thereby serving the dual purpose of evaluating both the independent variables' partial effects and the extent to which managerial ownership moderates the hypothesized relationships.

Table 9. t-Test Results

Variable	Model	Coefficient	Sig.	Hypothesis (Expected Direction)	Result (Significance & Direction)
EP_C (H ₁)	1	-0.891427	0.3443	Positive (+)	Not Significant
EC_C (H ₂)	1	0.008534	0.4225	Positive (+)	Not Significant
MO_C	2	-5.411500	0.0233	Not hypothesized	Significant, negative direction (-)
EPMO (H ₃)	2	-10.718690	0.0000	Strengthening (+)	Significant, negative direction (-)
ECMO (H ₄)	2	1.034111	0.1005	Strengthening (+)	Not Significant

Table 9 summarizes the outcome of hypothesis testing across both models. Neither of the two direct effects proposed in Model 1 finds support: EP_C falls well short of significance ($p = 0.3443$), as does EC_C ($p = 0.4225$), leading to the rejection of both H₁ and H₂. Model 2 tells a more differentiated story. Managerial ownership itself (MO_C) emerges as a significant, negative predictor of Firm value ($\beta = -5.411500$, $p = 0.0233$), a direct effect the study did not originally hypothesize but one that nonetheless warrants attention. Among the interaction terms, EPMO stands out as the sole statistically significant moderator ($\beta = -10.718690$, $p = 0.0000$), though its negative sign runs contrary to the strengthening effect posited under H₃, which is consequently rejected: managerial ownership dampens, rather than reinforces, the link between Environmental performance and Firm value. ECMO, by contrast, fails to reach significance ($p = 0.1005$), offering no evidence that managerial ownership conditions the relationship between environmental cost and firm value, and H₄ is rejected on the same grounds. Across all five tests, EPMO is thus the only relationship to register a statistically detectable effect, and notably one whose direction departs from theoretical expectation.

3.2 Discussion

3.2.1 The Effect of Environmental Performance on Firm Value

H₁ finds no support in the data: the coefficient on environmental performance is negative (-0.891427) and statistically indistinguishable from zero ($p = 0.3443$, well above the 0.05 cutoff), running directly counter to the positive relationship posited. This null result suggests that PROPER ratings, at least among the energy-sector firms sampled here, have not yet acquired sufficient credibility to function as a pricing signal that investors act upon. One plausible reading is that non-financial indicators such as PROPER scores continue to occupy a peripheral role in how Indonesian capital markets form valuation judgments, with financial fundamentals still commanding disproportionate weight in investor decision-making. This tendency may be reinforced by a disclosure gap: when environmental achievements are not consistently substantiated through annual-report narratives, investors are left with little independent basis to verify their materiality, which in turn erodes whatever influence such performance might otherwise exert on firm value. The pattern documented here is broadly consistent with Hapsoro and Adyaksana (2020) and Subaida and Pramitasari (2023), both of whom likewise report a statistically null relationship between environmental performance and firm value.

3.2.2 The Effect of Environmental Cost on Firm Value

A different picture might have been expected for environmental cost: its coefficient does carry the hypothesized positive sign (0.008534), yet at $p = 0.4225$, the effect is statistically indistinguishable from zero, and H₂ is not upheld. What this null result most plausibly reflects is a gap between magnitude and meaning: the positive direction is present, but the effect is too small for the market to register it as a pricing-relevant signal. Two forces likely combine to produce this outcome. On one hand, environmental cost may still be interpreted by investors as a near-term charge against profitability rather than a credible down payment on future legitimacy or risk reduction. On the other, the fragmented way in which firms report environmental expenditure (scattered across annual reports and separate sustainability disclosures, often with inconsistent methodology) denies investors the kind of comparable, verifiable information needed to factor such costs into valuation with any confidence. This joint explanation is corroborated by Subaida and Pramitasari (2023) and Budiono and Handoko (2025), whose samples likewise show environmental cost carrying no discernible weight in firm valuation,

a convergence that strengthens the inference that Indonesian investors, at least for now, continue to anchor their pricing decisions in profitability and growth metrics rather than in environmental expenditure data.

3.2.3 The Moderating Role of Managerial Ownership on the Relationship between Environmental Performance and Firm Value

Unlike the two direct effects discussed above, the interaction term EPMO produces a result too pronounced to dismiss: its coefficient of -10.71869 is significant at $p = 0.0000$, confirming that managerial ownership does condition the relationship between environmental performance and firm value, yet it does so by dampening the link rather than amplifying it, the reverse of what H_3 anticipated, and the hypothesis is rejected on those grounds. It is worth noting that this moderating effect is tested independently of the direct effect's significance: within the logic of Moderated Regression Analysis, a moderator can meaningfully alter the slope of a relationship even when that relationship's average, unconditional magnitude is statistically indistinguishable from zero, since the direct coefficient in Model 1 captures the effect at the sample mean of managerial ownership rather than across its full range. The significant EPMO coefficient therefore indicates that the relationship between environmental performance and firm value is conditional rather than uniformly absent: weak or negligible at low levels of managerial ownership, but increasingly negative as managerial shareholding rises. Substantively, this means that as insiders hold a larger stake in the firm, the market appears to place progressively less weight on that firm's environmental achievements when forming its valuation. Agency theory supplies a ready account for this reversal: expanding managerial shareholding concentrates decision rights over corporate policy, including how environmental accomplishments are managed and communicated, in the hands of the very people whose short-term incentives may not align with shareholders' longer-term interests, so that what should function as a favorable signal risks being filtered, delayed, or diluted before it reaches the market. A sector-specific consideration compounds this dynamic: because energy firms already carry heightened environmental risk, investors may interpret concentrated managerial ownership as reducing the independence of internal oversight, and respond more cautiously to environmental disclosures even when the underlying PROPER rating is strong. Notably, this finding diverges from Salam and Afriyenti (2025), who, examining mining-sector firms over 2019–2023, detect no moderating effect whatsoever, an outcome they attribute to PROPER ratings being determined solely by the Ministry of Environment and Forestry, leaving no channel through which managerial shareholding could influence the assessment. The contrast between the two studies is itself instructive: it suggests that the moderating capacity of managerial ownership is neither fixed nor universal, but instead contingent on sector characteristics, the period examined, and the governance configuration of the sample at hand.

3.2.4 The Moderating Role of Managerial Ownership on the Relationship between Environmental Cost and Firm Value

ECMO tells a quieter story than its counterpart EPMO: the coefficient is positive (1.034111), aligning directionally with what H_4 proposed, but at $p = 0.1005$ it narrowly misses conventional significance, and the hypothesis cannot be retained. As with the EPMO interaction, the non-significance of EC_C's direct effect in Model 1 does not preclude a genuine conditional relationship from existing across levels of managerial ownership; however, unlike EPMO, the ECMO coefficient itself fails to reach significance, indicating that no such conditional pattern is empirically detectable in the present sample. The sign is at least suggestive: it hints that managerial shareholding may nudge the market toward valuing environmental cost information more favorably, but the evidence is too weak to treat this as a genuine moderating effect. Agency theory again supplies a candidate explanation, though from a different angle than before: managers holding equity may still be tethered to compensation structures built around near-term performance, giving them little reason to prioritize the kind of environmental spending whose payoff typically materializes only over a longer horizon. This incentive misalignment is likely compounded by a data problem: environmental cost figures are reported unevenly across annual and sustainability disclosures, denying investors a consistent basis for pricing this information regardless of how much equity sits with management. Salam and Afriyenti (2025) reach a matching conclusion for mining-sector firms, similarly finding no moderating role for managerial ownership in the relationship between environmental cost and firm value relationship; their interpretation, namely that ownership alone cannot substitute for more deliberate management and communication of environmental cost to stakeholders, applies with equal force to the pattern observed here.

4. CONCLUSION

Taken together, this study demonstrates that environmental performance and environmental cost, when examined as independent predictors, do not exert a statistically significant effect on firm value, indicating that capital-market participants continue to rely predominantly on conventional accounting-based signals rather than fully internalising environmental information as a value-relevant input. A more nuanced pattern emerges once managerial ownership is incorporated as a moderating variable: managerial ownership significantly, albeit inversely, conditions the relationship between environmental performance and firm value, such that a larger managerial equity stake attenuates rather than reinforces the valuation relevance of environmental performance. This finding lends empirical support to agency-theoretic reasoning, whereby concentrated managerial shareholding may compromise the perceived independence of corporate oversight and diminish the credibility with which environmental achievements are communicated to investors. By contrast, managerial ownership does not significantly moderate the relationship between environmental cost and firm

value, indicating that this governance mechanism has not yet functioned as a channel through which the market reinterprets environmental expenditures. The principal contribution of this study is to demonstrate, within a single empirical framework, that managerial ownership moderates the market's valuation response to environmental performance and environmental cost asymmetrically, thereby providing evidence that governance structures do not condition sustainability-related value relevance uniformly across different dimensions of environmental engagement. This finding advances the literature on ownership, sustainability, and firm value, which has predominantly treated environmental performance and environmental cost as a single, undifferentiated construct, by empirically disentangling their distinct interactions with managerial ownership and thereby offering a more granular theoretical account of how ownership structure shapes market interpretation of corporate environmental engagement. Several limitations, however, warrant consideration. The model's relatively modest explanatory power indicates that firm value is shaped by determinants beyond those examined in this study. Furthermore, operationalising environmental cost as a ratio to after-tax net income may generate distorted estimates for loss-making firms, as a negative denominator can artificially depress or invert the ratio despite substantive environmental investment having genuinely occurred. The reliance on secondary data drawn from a single industry over a limited observation period further constrains the generalisability of the findings. Future research is therefore encouraged to scale environmental cost against total assets or revenue rather than net income, to complement the PROPER rating with alternative environmental performance proxies such as ESG scores or carbon emission intensity, and to incorporate additional governance variables, including institutional ownership, board independence, and environmental disclosure quality, as moderating or control variables. Extending the analysis to environmentally sensitive sectors beyond energy, such as manufacturing or basic materials, and conducting longitudinal or cross-sector comparisons, would further enrich understanding of the relationship between sustainability and firm value.

5. DECLARATIONS

5.1 Author Contributions

Conceptualization: L. and T. A.;

Methodology: L. and T. A.;

Software: L. and T. A.;

Validation: L. and T. A.;

Formal Analysis: L. and T. A.;

Investigation: L. and T. A.;

Resources: L. and T. A.;

Data Curation: L. and T. A.;

Writing Original Draft Preparation: L. and T. A.;

Writing Review and Editing: L. and T. A.;

Visualization: L. and T. A.;

All authors have read and agreed to the published version of the manuscript.

5.2 Data Availability

The data presented in this study are available on request from the corresponding author.

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5.4 Institutional Review Board Statement

Not applicable.

5.5 Informed Consent Statement

Not applicable.

5.6 Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

5.7 Generative AI and AI-assisted Technologies in The Writing Process

The authors used Generative AI to improve the writing clarity of this paper. They reviewed and edited the AI-assisted content and took full responsibility for the final publication.

REFERENCES

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Sage Publications.

- Alifian, D., & Susilo, D. E. (2024). Pengaruh Profitabilitas, Likuiditas, Ukuran Perusahaan Dan Struktur Modal Terhadap Nilai Perusahaan. *Owner*, 8(1), 46–55. <https://doi.org/10.33395/owner.v8i1.1914>
- Almaeda, T. R., Pramuda, A. V. D., & Setiawan, D. (2023). Perkembangan Penelitian Carbon Disclosure di Indonesia. *Reviu Akuntansi Dan Bisnis Indonesia*, 7(1), 109–133. <https://doi.org/10.18196/rabin.v7i1.17607>
- Aprianti, S., Yuniarti, R., & Riswandi, P. (2023). Kinerja Lingkungan terhadap Nilai Perusahaan Dimediasi Kinerja Keuangan. *Jurnal Riset Akuntansi Dan Auditing*, 10(2), 35–46. <https://doi.org/10.55963/jraa.v10i2.536>
- Averio, T. (2020). The analysis of influencing factors on the going concern audit opinion – a study in manufacturing firms in Indonesia. *Asian Journal of Accounting Research*, 6(2), 152–164. <https://doi.org/10.1108/AJAR-09-2020-0078>
- Budiono, S., & Handoko, J. (2025). Pengaruh Akuntansi Manajemen Lingkungan, Inovasi Hijau, dan Biaya Lingkungan Terhadap Nilai Perusahaan. *Nominal: Barometer Riset Akuntansi Dan Manajemen*, 14(2), 194–214. <https://doi.org/10.21831/nominal.v14i2.82949>
- Diharjo, D. F. M. W., & Manik, Y. B. S. (2023). Life Cycle Assessment a Coal Mining in East Kalimantan. *JST (Jurnal Sains Dan Teknologi)*, 12(3), 613–621. <https://doi.org/10.23887/jstundiksha.v12i3.68103>
- Ghozali. (2020). *25 Grand Theory: Teori Besar Ilmu Manajemen, Akuntansi dan Bisnis*.
- Gunawan, B., & Berliyanda, K. L. (2024). Pengaruh Green Accounting, Pengungkapan Emisi Karbon, dan Kinerja Lingkungan Terhadap Nilai Perusahaan. *Reviu Akuntansi Dan Bisnis Indonesia*, 8(1), 33–50. <https://doi.org/10.18196/rabin.v8i1.22027>
- Hapsoro, D., & Adyaksana, R. I. (2020). Apakah Pengungkapan Informasi Lingkungan Memoderasi Pengaruh Kinerja Lingkungan Dan Biaya Lingkungan Terhadap Nilai Perusahaan? *Jurnal Riset Akuntansi Dan Keuangan*, 8(1), 41–52. <https://doi.org/10.17509/jrak.v8i1.19739>
- Haryono, D. M., Hasanudin, M., & Widiarto, A. (2025). Pengaruh Green Accounting, Kinerja Lingkungan, dan Corporate Social Responsibility Terhadap Nilai Perusahaan. *Reviu Akuntansi Dan Bisnis Indonesia*, 9(3), 468–483. <https://doi.org/10.18196/rabin.v9i3.25809>
- Hasan, M. F., & Wijayanto, R. (2025). Pengaruh Inovasi Hijau, Investasi Lingkungan, Manajemen Lingkungan Dan Kinerja Lingkungan Terhadap Nilai Perusahaan. *Jurnal Ekonomi Trisakti*, 5(2), 877–886. <https://doi.org/10.25105/v5i2.23699>
- Hayes, A. F. (2022). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford Press.
- Hidayat, I., Ismail, T., Taqi, M., & Yulianto, A. S. (2023). The Effects of Environmental Cost, Environmental Disclosure and Environmental Performance on Company Value with an Independent Board of Commissioners as Moderation. *International Journal of Energy Economics and Policy*, 13(3), 367–373. <https://doi.org/10.32479/ijeep.14159>
- Kementerian Lingkungan Hidup dan Kehutanan. (2022). *Hasil Penilaian PROPER 2021–2022: Peningkatan Jumlah Peserta dan Peringkat Kinerja Perusahaan*. Retrieved from <https://proper.menlhk.go.id/proper/>
- Koeshardjono, R. H., Perwirasari, D. A., & Fazira, E. (2025). Pengaruh Penerapan Green Accounting dan Kinerja Lingkungan terhadap Nilai Perusahaan dengan Profitabilitas sebagai Variabel Moderating. *EKOMA: Jurnal Ekonomi, Manajemen, Akuntansi*, 4(3), 5046–5053. <https://doi.org/10.56799/ekoma.v4i3.6771>
- Okta, S. L. J., Suaidah, I., & Antasari, D. W. (2022). Pengaruh Pengungkapan Akuntansi Manajemen Lingkungan, Biaya Lingkungan, dan Kinerja Lingkungan terhadap Nilai Perusahaan Selama Masa Pandemi. *JCA (Jurnal Cendekia Akuntansi)*, 3(2), 112–127. <https://doi.org/10.32503/akuntansi.v3i2.3189>
- Renaldi, A., & Anis, I. (2023). Pengaruh Pengungkapan Biaya Dan Kinerja Lingkungan Terhadap Nilai Perusahaan : Studi Empiris Pada Perusahaan Industri Manufaktur Di Indonesia. *Jurnal Ekonomi Trisakti*, 3(2), 3853–3862. <https://doi.org/10.25105/jet.v3i2.18216>
- Salam, S., & Afriyenti, M. (2025). Pengaruh Kinerja Lingkungan dan Biaya Lingkungan terhadap Nilai Perusahaan dengan Kepemilikan Manajerial sebagai Variabel Moderasi. *Jurnal Eksplorasi Akuntansi (JEA)*, 7(3), 944–960. <https://doi.org/10.24036/jea.v7i3.2818>
- Sapitri, Y., & Fajriana, I. (2025). Kepemilikan Manajerial, Kepemilikan Institusional, dan Corporate Social Responsibility Pada Nilai Perusahaan. *Solusi*, 23(1), 74–89. <https://doi.org/10.26623/slsi.v23i1.11261>
- Subaida, I., & Pramitasari, T. D. (2023). Kinerja Lingkungan, Biaya Lingkungan, dan Pengungkapan Lingkungan terhadap Nilai Perusahaan. *Ecoducation: Economics & Education Journal*, 5(2), 161–172. <https://doi.org/10.33503/ecoducation.v5i2.3464>
- Umami, R., Lukita, C., & Astriani, D. (2024). Penerapan Green Accounting dan Kinerja Lingkungan terhadap Nilai Perusahaan dengan Kepemilikan Manajerial sebagai Variabel Moderasi Perusahaan Sektor Pertambangan BEI 2020-2022. *COSTING: Journal of Economic, Business and Accounting*, 7(5), 2692–2708. <https://doi.org/10.31539/costing.v7i5.12136>