



Accounting Analysis Journal

<https://journal.unnes.ac.id/journals/index.php/aaaj>



Why Innovation Matters More Than Disclosure for Firm Value in Indonesian ESG Leaders?

Rintan Nuzul Ainy¹✉, Navaya Helena², Lu'lu' Nafiati³

^{1,2,3}Department of Accounting, Faculty of Economics and Business, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

ARTICLE INFO

Article History:

Received October 22, 2025

Revised November 29, 2025

Accepted August 26, 2026

Published September 4, 2026

Keywords:

Emission Disclosure; Green Innovation; Eco-Efficiency; Environmental Performance; Firm Value

ABSTRACT

Purpose: The study examines whether carbon emission disclosure, green innovation, and eco-efficiency affect firm value differently, and whether environmental performance mediates these relationships, among Indonesian ESG-listed firms.

Methods/Study design/Approach: The quantitative study analyzes a balanced panel of 32 firms listed on the ESG Sector Leaders IDX KEHATI index with 96 firm-year observations in 2021–2023 using PLS-SEM with bootstrapped confidence intervals. Carbon emissions disclosure and green innovation are measured using content analysis; eco-efficiency is measured using ISO 14001 certification; environmental performance is measured using PROPER ratings; and firm value is measured using Tobin's Q.

Result/Findings: Green innovation significantly increases firm value, while carbon emission disclosure significantly decreases it; eco-efficiency has no significant effect. Environmental performance does not significantly affect firm value directly, nor does it mediate any of the three relationships tested.

Novelty/Originality/Value: The study is among the first to jointly test compliance-based (disclosure and certification) and capability-based (innovation) sustainability practices within a single PLS-SEM framework for ESG-listed Indonesian firms, distinguishing between the credibility of the signals each sends to investors. It contributes evidence that environmental performance does not function as a market-valuation channel.

©2026 The Authors / Published by UNNES. This is an open-access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>)

INTRODUCTION

In today's business landscape, sustainability has evolved from being a voluntary corporate initiative to an essential component of long-term business strategy. Companies are now expected not only to generate profits but also to minimize their environmental footprint and contribute to global sustainability objectives. This shift is largely driven by increasing regulatory requirements, investor expectations, and growing consumer awareness of environmental responsibility. As a result, firms are adopting various sustainability initiatives, such as carbon emission disclosures, green innovation, and eco-efficiency, to strengthen their market position and enhance long-term value creation (Chairani & Siregar, 2021; Laela et al., 2024; Li et al., 2022; Rasyad et al., 2024; Sari et al., 2024). These efforts are no longer viewed as optional but as key determinants of corporate success, influencing business resilience, investor confidence, and financial performance (Fuadah et al., 2022; Helmina et al., 2022; Melinda & Wardhani, 2020). Companies that effectively incorporate sustainability into their business strategies tend to be more attractive to investors,

¹✉ E-mail: rintan.ainy@act.uad.ac.id

Address: Jln. Jend. Ahmad Yani, Tamanan, Banguntapan, Bantul, Daerah Istimewa Yogyakarta 55166, Indonesia.

particularly in emerging markets where Environmental, Social, and Governance (ESG) adoption is still in its developmental stages (Alexander, 2024; Rahmaniati & Ekawati, 2024).

The relationship between sustainability initiatives and firm value has been a focal point of contemporary research. Carbon emission disclosures, for instance, enhance transparency and corporate accountability, leading to improved investor trust and higher firm valuation (Fuadah et al., 2022; Ruth et al., 2023; Savitri & Abdullah, 2023; Yuliandhari et al., 2023). Green innovation, which encompasses the development of environmentally friendly products, services, and processes, not only supports global climate policies but also provides firms with a competitive advantage by improving operational efficiency and reducing costs (Laela et al., 2024; Rahmaniati & Ekawati, 2024). Similarly, eco-efficiency, an approach that emphasizes optimal resource utilization and waste minimization, has been associated with cost savings and operational stability, making it a crucial factor in financial sustainability (Firdaus et al., 2024; Putra & Budastra, 2024; Rasyad et al., 2024). Given the interconnected nature of these sustainability dimensions, firms that effectively integrate them tend to experience greater financial stability and long-term growth (Alexander, 2024).

Yet the abundance of prior research on firm value does not mean the dependent side of this relationship is well understood. Existing studies on firm value as an outcome variable have largely tested it against a single sustainability predictor at a time, under the implicit assumption that any environmentally responsible practice should raise market valuation through the same mechanism. When findings on firm value diverge across studies, some showing positive effects (Choi & Luo, 2021; Desai, 2024), others null or non-significant (Yuliandhari et al., 2023), and others are significantly negative (Choi & Luo, 2021; Matsumura et al., 2014), it remains unclear whether the inconsistency reflects a measurement limitation of firm value itself, a theoretical limitation, or a genuinely different valuation process operating in emerging markets compared to the developed-market settings where most firm-value theory originates. This study therefore treats firm value not as a settled outcome awaiting one more predictor, but as a variable whose relationship to sustainability practice still needs to be re-examined through a more precise theoretical lens, specifically whether the type of practice generating the environmental signal changes how that signal is priced.

Despite the recognized benefits of sustainability, research findings on its financial impact remain inconclusive in emerging markets, largely because prior studies have not distinguished among qualitatively different types of sustainability practices. Environmental accounting research distinguishes between symbolic practices and substantive practices, those that embed environmental improvement into organizational processes and generate verifiable competitive advantage (Clarkson et al., 2008; Deegan, 2002). Carbon emission disclosure and eco-efficiency certification (ISO 14001) are primarily symbolic or compliance-based. They communicate adherence to societal expectations and regulatory norms but do not inherently build the innovation capability that creates durable market value. Green innovation, by contrast, is a substantive practice. It embeds environmental improvement into product and process development, generating resources that are valuable, rare, and difficult to imitate (Barney, 1991; Hart et al., 2003). This symbolic-substantive distinction predicts that the three practices should generate asymmetric investor responses and that environmental performance may function differently as a value-transmission mechanism depending on whether it is produced through compliance or capability. Three specific gaps follow. First, there has been no prior research in Indonesia that simultaneously examines compliance-based practices that measured by carbon emission disclosure and eco-efficiency, and capability-based practices that measured by green innovation, within a single framework to assess the distinct market signals conveyed by these practices. Second, the mediating role of environmental performance across all three pathways, and whether it amplifies or suppresses the value signal from each type of practice, has not been tested. Third, this distinction has not been examined in the context of ESG index-listed Indonesian firms, where investor ESG awareness is still developing and compliance signals may be interpreted as liabilities rather than responsibilities (Chairani & Siregar, 2021; Ruth et al., 2023).

In Indonesia, ESG adoption is progressing steadily, yet challenges persist in fully integrating sustainability into corporate strategy. The ESG Sector Leaders IDX KEHATI Index was introduced to highlight firms that exhibit strong ESG commitments, offering a valuable opportunity to explore how sustainability practices affect firm value in the Indonesian context. This index, rather than the broader IDX or other sustainability indices such as SRI-KEHATI, is chosen specifically because its constituent firms are pre-screened for demonstrated ESG commitment: they are not merely Indonesian listed firms but firms already recognized as environmental and social leaders. This provides a stricter and more conservative empirical test. If even ESG Sector Leaders fail to show a value-enhancing relationship between environmental performance and firm value, the result is unlikely to be an artifact of including poorly performing or non-committed firms in the sample and instead points to a more fundamental feature of how the Indonesian market prices environmental signals (Laela et al., 2024; Rasyad et al., 2024). However, research suggests that many Indonesian companies continue to focus more on compliance-driven sustainability efforts, such as mandatory carbon disclosures, rather than proactive sustainability initiatives

like green innovation (Alexander, 2024; Putra & Budastra, 2024). While global studies link sustainability practices to enhanced firm value, emerging evidence suggests that Indonesian investors may place greater emphasis on innovation-driven sustainability strategies rather than compliance-oriented measures (Rahmaniati & Ekawati, 2024). Moreover, the mediating role of environmental performance remains underexplored, particularly in dynamic yet less-regulated economies such as Indonesia (Savitri & Abdullah, 2023; Yuliandhari et al., 2023). These gaps call for an integrated study that tests all three sustainability practices concurrently, accounts for their environmental performance pathways, and situates the analysis within the specific institutional context of Indonesia's ESG index-listed firms.

This study is grounded in a single unifying theoretical framework, signaling theory. Signaling theory holds that, under information asymmetry between managers and external stakeholders, firms voluntarily communicate private information through observable signals, and that the market response to a signal depends on its perceived credibility (Connelly et al., 2011; Spence, 1973). Every variable in this study is conceptualized within a single logic: carbon emissions disclosure, green innovation, and eco-efficiency are signals that firms send to the market; environmental performance is a derived signal generated by those practices; and firm value is the market's pricing of the credibility of those signals. The central theoretical claim of this study is that the three signals are not equally credible because they differ in how they are produced. Two well-established literatures explain this credibility gap as sub-mechanisms within the signaling framework rather than as competing theories. First, compliance-based signals. Societal expectations and regulatory norms primarily drive carbon emissions disclosure and ISO 14001 certification. The logic developed in the legitimacy-theory literature (Deegan, 2002; Patten, 1992; Suchman, 1995). Because compliance-based signals can be produced without a corresponding change in underlying capability, they are inherently less costly to fake and therefore carry lower signaling credibility (Clarkson et al., 2008; Dhaliwal et al., 2011). Second, capability-based signals such green innovation are produced by developing resources that are valuable, rare, and difficult to imitate. The logic developed in Resource-Based View literature (Barney, 1991; Hart et al., 2003). Because capability-based signals require durable organizational investment that competitors cannot easily replicate, they are inherently more costly to fake and therefore carry greater signaling credibility. This single signaling logic, differentiated only by signal credibility, generates all nine hypotheses tested in this study. H_1 - H_3 predict that all three practices signal environmental performance; H_4 - H_6 predict that the three signals are priced differently by the market according to their credibility; and H_7 - H_9 predict that environmental performance, as a derived signal, transmits each practice's value differently depending on whether the practice that produced it was compliance-based or capability-based.

To address these gaps, this study examines whether compliance-based sustainability practices such as carbon emission disclosure, eco-efficiency, and a capability-based practice such as green innovation generate different market signals, and whether environmental performance converts either type into firm value, among Indonesian firms listed on the ESG Sector Leaders IDX KEHATI. Prior Indonesian studies have examined one or two of these practices in isolation. Fuadah et al. (2022) and Yuliandhari et al. (2023) examine eco-efficiency and firm value; Helmina et al. (2022) examine ISO 14001 certification and environmental performance; Laela et al. (2024) and Savitri & Abdullah (2023) examine carbon disclosure and financial outcomes; and Amalo & Husen (2024) examine green innovation through an RBV lens. Each of these studies examines a single practice, assumes a positive value pathway, and does not theorize the substantive difference between compliance-driven and innovation-driven environmental efforts. This study departs from that tradition in three ways. First, it applies the symbolic-substantive distinction to generate differential directional predictions for the three practices, rather than uniformly predicting positive effects. Second, it tests whether environmental performance amplifies or suppresses the value signal from each, rather than assuming it is a universal positive bridge. Third, it does so in an ESG index context, where firms are selected precisely because of their environmental commitment, providing a stricter test of whether demonstrated environmental quality is rewarded by investors in Indonesia's developing ESG market.

The purpose of this study is to yield significant insights for both corporate management and policymakers. By demonstrating how sustainability initiatives contribute to firm value, this research offers practical recommendations for businesses aiming to strengthen their sustainability strategies while maintaining financial performance. The study also provides empirical evidence to assist policymakers in developing ESG regulations that encourage meaningful integration of corporate sustainability. As ESG considerations continue to shape the global financial market, understanding how sustainability efforts translate into financial performance in an emerging economy such as Indonesia is crucial to ensuring long-term economic resilience and environmental sustainability (Fuadah et al., 2022).

Carbon emission disclosure is a strategic signal: by communicating their carbon footprint, firms align with societal expectations and demonstrate regulatory accountability (Deegan, 2002; Patten, 1992). Under Signaling Theory, the disclosure process requires firms first to collect, audit, and report emissions data, thereby building internal monitoring systems and focusing managerial attention on environmental outcomes (Connelly et al., 2011). Companies that choose not to disclose risk face heightened regulatory scrutiny and

weaker internal accountability for environmental outcomes (Hassan et al., 2021). Studies show that firms engaging in carbon emission disclosure strengthen their environmental governance and adopt cleaner technologies, as the disclosure process itself drives internal improvement (Fransisca et al., 2024; Laela et al., 2024). This is especially relevant in emerging markets, where disclosure systems are still maturing, and reporting plays a constructive role in shaping corporate environmental behavior (Fransisca et al., 2024). Carbon emission disclosure is therefore expected to be positively associated with environmental performance.

H₁: Carbon emission disclosure positively affects environmental performance

Green innovation involves developing and adopting eco-friendly technologies, processes, and products that reduce environmental harm while improving resource efficiency (Fanda & Damayanti, S, 2024; Li et al., 2022; Sari et al., 2024). Unlike carbon disclosure, green innovation is a capability-based signal. It requires firms to build valuable, rare, and difficult-to-imitate resources rather than simply reporting existing information (Barney, 1991; Hart et al., 2003). Because building this capability is costly and cannot be achieved through reporting alone, the resulting environmental performance gains are mechanically tied to real operational change rather than disclosure choice. Firms that fail to innovate face reputational risk and stricter regulatory scrutiny over time (Helmina et al., 2022), while firms that proactively build green innovation capability achieve higher environmental performance metrics, including reduced emissions and more sustainable resource management, because the capability itself directly produces those outcomes (Oriska & Kusumawardani, 2024). Firms that successfully implement green innovation outperform peers in sustainability rankings precisely because the signal and the underlying environmental capability are the same thing (Savitri & Abdullah, 2023).

H₂: Green innovation positively affects environmental performance

Eco-efficiency refers to a company's ability to create more value while using fewer resources, minimizing waste, emissions, and energy consumption without compromising productivity (Yuliandhari et al., 2023). In this study, eco-efficiency is operationalized through ISO 14001 certification, a credential that, like carbon disclosure, is a compliance-based signal. It certifies adherence to an external environmental management standard (Deegan, 2002; Patten, 1992) rather than directly measuring a unique organizational capability. Even so, achieving certification requires firms to implement documented environmental management systems, which mechanically improve monitoring and reporting of environmental outcomes. Companies that fail to pursue certification risk regulatory scrutiny and weaker internal environmental controls (Helmina et al., 2022), while certified firms consistently perform better in environmental audits because certification itself requires the systems that generate measurable performance (Fikriyah & Wiyanti, 2023). Eco-efficiency is therefore expected to be positively associated with environmental performance.

H₃: Eco-efficiency positively affects environmental performance

Under Signaling Theory, voluntary disclosure reduces information asymmetry between managers and outside investors by providing observable evidence of a firm's environmental management practices (Connelly et al., 2011; Spence, 1973). When a firm discloses its carbon emissions, it signals to the market that it monitors, manages, and is accountable for its environmental impact, information that investors would not otherwise have access to. Clarkson et al. (2008) show that environmental disclosures backed by verifiable performance data generate positive market responses, as such disclosures lower the perceived environmental and regulatory risk that investors must price into firm valuation. Dhaliwal et al. (2011) similarly demonstrate that voluntary nonfinancial disclosure reduces firms' cost of equity capital by lowering information asymmetry between managers and investors. Luo & Tang (2014) find that voluntary carbon disclosure lowers firms' cost of capital, evidence that the market rewards firms for the transparency that disclosure provides. By disclosing emissions, firms in the IDX KEHATI ESG Sector Leaders index signal their commitment to environmental accountability to a market that increasingly values such transparency, reducing investor uncertainty and thereby enhancing firm value.

H₄: Carbon emission disclosure has a significant effect on firm value

Within the same signaling logic, green innovation is expected to generate a positive market response precisely because it is costly and difficult to fake. Building a valuable, rare, and difficult-to-imitate resource (Barney, 1991; Hart et al., 2003) such as a new eco-friendly product line or process requires sustained capital investment that cannot be conjured through reporting alone, which is what makes the signal credible to investors (Connelly et al., 2011; Spence, 1973). Research shows that green innovation allows firms to differentiate themselves and attract environmentally conscious investors (Sari et al., 2024), and that firms integrating green innovation experience higher market valuations as investors recognize the innovation signal

as evidence of durable strategic capability rather than mere compliance (Putra et al., 2025). Green innovation is therefore expected to be positively associated with firm value.

H₅: Green innovation positively affects firm value

Eco-efficiency, measured here through ISO 14001 certification, signals to the market that a firm has implemented a formal, externally verified environmental management system (Deegan, 2002; Patten, 1992). Under Signaling Theory, certification provides outside investors with independently verified evidence of environmental management quality that is otherwise difficult to observe (Connelly et al., 2011). Prior research shows that eco-efficient practices lower operational costs and improve profitability when they reflect genuine resource optimization (Dihardjo & Hersugondo, 2023), and that firms with stronger environmental management systems attract environmentally conscious investors and gain reputational advantages (Rahelliamelinda & Handoko, 2024). Because certification requires firms to document and standardize their environmental management processes, it serves as a credible signal of reduced operational and regulatory risk, thereby enhancing firm value.

H₆: Eco-efficiency positively affects firm value

Carbon emission disclosure is expected to enhance environmental performance by generating internal monitoring systems and managerial accountability for emissions outcomes. Under Signaling Theory, environmental performance represents a further, independently verifiable signal that reinforces the credibility of a firm's initial disclosure: a firm that discloses its emissions and subsequently demonstrates measurable improvement in its PROPER environmental performance rating provides investors with concrete, harder-to-fake evidence that the disclosure reflects genuine management effort rather than impression management (Clarkson et al., 2008; Ye et al., 2023). This additional verification reduces investor uncertainty about the firm's environmental risk profile beyond what disclosure alone can achieve, thereby strengthening the positive relationship between carbon emission disclosure and firm value. Environmental performance is therefore expected to mediate the relationship between carbon emission disclosure and firm value.

H₇: Environmental performance mediates the relationship between carbon emission disclosure and firm value

Green innovation is expected to enhance environmental performance by embedding environmental improvement directly into a firm's products and processes. Under Signaling Theory, environmental performance constitutes a second, independently verifiable signal of the same underlying innovation capability: a firm that builds green innovation capacity and subsequently demonstrates measurable improvement in its PROPER environmental performance rating provides investors with concrete confirmation that the innovation has produced real environmental outcomes, not merely the appearance of innovation (Connelly et al., 2011). This reinforcing signal strengthens investor confidence in the firm's underlying capability beyond what the direct green innovation signal alone can convey, thereby amplifying the positive relationship between green innovation and firm value. Environmental performance is therefore expected to mediate the relationship between green innovation and firm value.

H₈: Environmental performance mediates the relationship between green innovation and firm value

Eco-efficiency is expected to enhance environmental performance by requiring firms to implement documented environmental management systems, as evidenced by ISO 14001 certification. Under Signaling Theory, environmental performance offers a further, independently verifiable signal that reinforces the credibility of certification: a certified firm that also demonstrates measurable improvement in its PROPER environmental performance rating provides investors with concrete evidence that certification reflects genuine operational change rather than a purely procedural credential (Ye et al., 2023). This additional verification strengthens investor confidence in the firm's environmental management quality beyond what certification alone can convey, thereby reinforcing the positive relationship between eco-efficiency and firm value. Environmental performance is therefore expected to mediate the relationship between eco-efficiency and firm value.

H₉: Environmental performance mediates the relationship between eco-efficiency and firm value

Based on the theoretical foundations and hypothesis development discussed, this study proposes a conceptual framework illustrating the relationships among carbon emissions disclosure, green innovation, eco-efficiency, environmental performance, and firm value. Figure 1 presents the research framework that examines both the direct and indirect effects of sustainability practices on firm value.

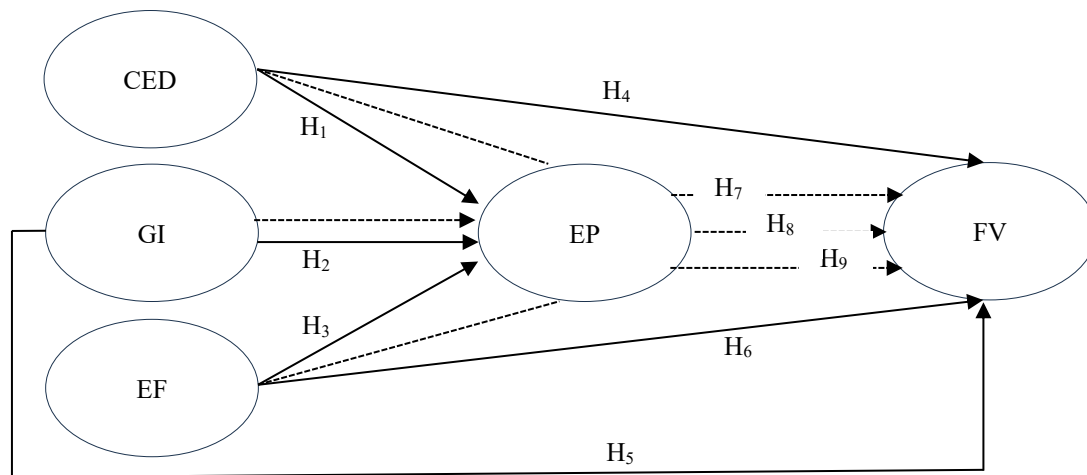


Figure 1. Research framework

—————→ : direct effect
 - - - - -→ : indirect effect

CED : Carbon Emission Disclosure
 GI : Green Innovation
 EF : Eco-efficiency

EP : Environmental Performance
 FV : Firm Value

METHOD

This study employs a quantitative research design using secondary data analysis to examine how environmental performance mediates the relationships among carbon emissions disclosure, green innovation, eco-efficiency, and firm value. The unit of analysis is 96 firm-year observations. Given its explanatory nature, the research employs PLS-SEM to identify and validate causal relationships, thereby providing deeper insights into the interconnections between sustainability practices and financial performance. The research population consists of companies listed in the ESG Sector Leaders IDX KEHATI between 2021 and 2023. A purposive sampling method is applied, selecting firms that meet the following criteria:

1. The company published annual and sustainability reports during the study period.
2. The company disclosed environmental-related information, which includes carbon emissions, green innovation, and eco-efficiency.
3. Financial data for the firm is available in IDX databases.

After applying these criteria, the final sample comprises 32 companies observed over 3 years, yielding 96 firm-year observations. This sample size meets the minimum requirement for PLS-SEM analysis, which recommends at least 10 times the most significant number of structural paths directed to any construct (Hair et al., 2019). The total number of samples obtained through the sample selection process is presented in Table 1.

Table 1. Sample selection process

Criteria	Number of Firms
Firms listed in the ESG Sector Leaders IDX KEHATI index at least once during 2021–2023	55
Less: incomplete sustainability report coverage in at least one year	(5)
Less: missing PROPER environmental performance ratings	(2)
Less: incomplete financial data in the IDX database	(2)
Final sample (firms)	32
Years observed per firm	3
Total firm-year observations	96

Source: Processed secondary data (2024)

PLS-SEM is selected over covariance-based SEM (CB-SEM) for three reasons. First, the sample of 96 firm-year observations is small to medium relative to the number of estimated paths, violating the large-

sample distributional assumptions required by CB-SEM (Hair et al., 2019). Second, several constructs in this model, particularly carbon emissions disclosure and green innovation measured via content-analysis indices, are not expected to follow multivariate normality, a condition PLS-SEM does not impose. Third, this study is partly exploratory in character, testing a multi-mediator model that has not been examined in the IDX KEHATI context, where PLS-SEM's variance-based estimation is well suited (Ringle et al., 2020). The model specification includes five latent constructs: carbon emissions disclosure, green innovation, eco-efficiency, environmental performance, and firm value. No additional control variables are included in the PLS-SEM model; the study acknowledges that the absence of temporal year and sectoral industry controls is a limitation, as Tobin's Q valuations may vary with macroeconomic conditions over time and with asset intensity across sectors. This is addressed in the limitations section. The details of operationalization of variables are presented in Table 2.

Bootstrapping was used to test the significance of direct, indirect, and total effects because PLS-SEM does not assume multivariate normality, unlike the maximum-likelihood estimation underlying CB-SEM (Hair et al., 2019). The procedure repeatedly resamples the original dataset with replacement to generate an empirical sampling distribution for each path coefficient and indirect effect, which is especially important for mediation testing, since indirect effects are typically non-normally distributed even when the underlying variables are not. Following Hair et al. (2019) and Streukens & Leroi-Werelds (2016), 5,000 subsamples were used to ensure stable and replicable percentile confidence intervals.

Table 2. Operationalization of variables

Type	Variable (Symbol)	Definition	Proxy / Measurement
Independent	Carbon Emission Disclosure (CED)	The extent to which firms disclose their carbon emissions and mitigation strategies.	Content analysis across five dimensions (18 disclosure items); scored 1 if disclosed, 0 if not, expressed as a percentage of items disclosed (Bae Choi et al., 2013). $CED = \frac{\text{Total disclosed items}}{\text{Total disclosure items}} \times 100\%$
Independent	Green Innovation (GI)	A firm's development and application of environmentally friendly technologies.	Content analysis of annual and sustainability reports (4 indicators); scored 1 if disclosed, 0 if not, expressed as a percentage of indicators disclosed (Agustia et al., 2019). $GI = \frac{\text{Total disclosed items}}{\text{Total indicators}} \times 100\%$
Independent	Eco-efficiency (EE)	A firm's ability to create more value while using fewer resources.	Binary proxy based on ISO 14001 certification: 1 if certified, 0 if not (Aviyanti & Isbanah, 2019).
Mediating	Environmental Performance (EP)	A firm's effectiveness in reducing its environmental impact.	PROPER rating issued by Indonesia's Ministry of Environment (ordinal scale 0–5).
Dependent	Firm Value (FV)	The market valuation of a company.	Tobin's Q ratio (Hardiyansah et al., 2021). $\text{Tobin's Q} = \frac{\text{Market Value of Equity} + \text{Total Liabilities}}{\text{Total Assets}}$

Source: Compiled from various sources (2026)

RESULTS AND DISCUSSIONS

Before reporting hypothesis test results, descriptive statistics, variable distributions, and model diagnostics are necessary to assess the statistical credibility of the findings. Table 3 reports descriptive statistics for all variables across 96 firm-year observations. Carbon emissions disclosure (CED) ranges from 0.222 to 0.889 (mean = 0.638, SD = 0.117), indicating moderate but variable breadth of disclosure. Green innovation (GI) is relatively high and narrowly distributed (mean = 0.787, SD = 0.145). Eco-efficiency (EE) is binary (ISO 14001 certification: 57.3% certified, 42.7% not certified). Environmental performance (EP) is heavily zero-inflated: 54.2% of observations carry a PROPER score of 0, with the remainder distributed across scores 3, 4, and 5 (mean = 1.740, SD = 1.975). Firm value (firm value, Tobin's Q) ranges from 0.274 to 3.776 (mean = 1.277, SD = 0.673), with positive skewness (1.776) reflecting a right-skewed distribution. Shapiro–Wilk tests reject normality for all five variables ($p < 0.05$ in each case), which corroborates the choice of PLS-SEM over CB-SEM and the use of bootstrapping to estimate indirect effects.

Table 3. Descriptive statistics

Var.	N	Mean	Median	SD	Min	Max	Skewness	Kurtosis	SW-W	SW-p
CED	96	0.638	0.611	0.117	0.222	0.889	-0.567	1.006	0.959	0.005
GI	96	0.787	0.750	0.145	0.500	1.000	-0.015	-0.121	0.747	<0.001
EE	96	0.573	1.000	0.497	0.000	1.000	-0.300	-1.951	0.629	<0.001
EP	96	1.740	0.000	1.975	0.000	5.000	0.397	-1.589	0.745	<0.001
FV	96	1.277	1.042	0.673	0.274	3.776	1.776	3.535	0.826	<0.001

Source: Processed secondary data (2024)

Table 4 presents the Pearson correlation matrix. Among the predictors, environmental performance shows the strongest correlations with eco-efficiency ($r = 0.464$, $p < 0.01$), green innovation ($r = 0.392$, $p < 0.01$), and carbon emissions disclosure ($r = 0.347$, $p < 0.01$), consistent with the directional expectations in H_1 – H_3 . Firm value correlates positively with green innovation ($r = 0.244$, $p < 0.05$) and negatively with carbon emissions disclosure ($r = -0.186$, $p < 0.10$) and eco-efficiency ($r = -0.106$, ns). Notably, the correlation between environmental performance and firm value is negative ($r = -0.123$), signaling that higher environmental performance does not automatically accompany higher market valuation in this sample, a pattern consistent with the non-significant direct and mediated effects of environmental performance on firm value reported later. Variance inflation factors (VIF) for all predictors fall well below the conventional threshold of 5.0: carbon emissions disclosure = 1.14, green innovation = 1.19, eco-efficiency = 1.28, environmental performance = 1.57. Multicollinearity is therefore not a concern for the path estimates.

Table 4. Pearson correlation matrix

Variable	CED	GI	EE	EP	FV
CED	1.000	0.174	0.141	0.347***	-0.186*
GI		1.000	0.218**	0.392***	0.244**
EE			1.000	0.464***	-0.106
EP				1.000	-0.123
FV					1.000

Source: Processed secondary data (2024)

Model fit was assessed following Henseler et al. (2015) and Hair et al. (2019). Because the structural model is fully recursive, with every hypothesized path from carbon emission disclosure, green innovation, and eco-efficiency to environmental performance and firm value estimated, the model-implied correlation matrix reproduces the empirical correlation matrix in Table 4 exactly, yielding a standardized root mean square residual (SRMR) of 0.000, well below the conventional 0.08 threshold. Result in Table 5 shows that the model explains 36.3% of the variance in environmental performance ($R^2 = 0.363$, adjusted $R^2 = 0.343$) and 14.9% of the variance in firm value ($R^2 = 0.149$, adjusted $R^2 = 0.112$). Blindfolding-based Q^2 values of 0.311 for environmental performance and 0.034 for firm value, both above zero, indicate that the model has predictive relevance for both endogenous constructs, although this relevance is comparatively modest for firm value.

Table 5. Model fit and predictive relevance indices

Construct	R^2	Adjusted R^2	Q^2 (blindfolding)
Environmental Performance (EP)	0.363	0.343	0.311
Firm Value (FV)	0.149	0.112	0.034
Overall model fit (SRMR)	0.000	-	-

Source: Processed secondary data (2024)

Note: The overall model fit statistic (SRMR) is reported in the table above. An SRMR of 0.000 indicates that the structural model is fully recursive and saturated (every possible path among the constructs is estimated), so the model-implied and empirical correlation matrices coincide by construction.

The findings in Table 6 reveal that carbon emissions disclosure significantly affects environmental performance ($\beta = 0.2325$, $p = 0.003$), suggesting that firms that disclose their emissions are more likely to implement sustainability measures and improve their environmental outcomes, thereby supporting H₁. This suggests that firms that engage in carbon disclosure tend to achieve better environmental outcomes. However, the effect size indicates that disclosure alone provides only moderate improvements and likely works alongside other sustainability initiatives.

Similarly, Green innovation demonstrates a substantial positive effect on environmental performance ($\beta = 0.9123$, $p = 0.001$), providing strong support for H₂. The coefficient indicates that investments in eco-friendly technologies and sustainable processes yield considerable environmental benefits. Companies prioritizing innovation in sustainability appear to achieve more tangible environmental improvements than those focusing primarily on disclosure or compliance.

Among the three variables, co-efficiency exhibits the strongest positive effect on environmental performance ($\beta = 1.4728$, $p < 0.001$), confirming H₃. The highly significant coefficient indicates that firms that demonstrate efficient resource utilization and waste minimization achieve the greatest gains in environmental performance. This underscores the practical importance of operational efficiency measures in advancing corporate environmental objectives.

Table 7 shows the direct influence of sustainability practices on firm value. Consistent with the non-directional framing of H₄, carbon emissions disclosure is negatively associated with firm value ($\beta = -0.0574$, $p = 0.039$), confirming H₄ is significant with negative direction. This finding is theoretically consistent with the dual-signal nature of carbon disclosure acknowledged in H₄: in an emerging-market context where ESG awareness is still developing, disclosure of emissions can function as a signal of environmental liability and anticipated compliance costs rather than as evidence of responsible management, thereby suppressing rather than enhancing investor valuations.

Table 6. The direct effects of carbon emissions disclosure, green innovation, and eco-efficiency on environmental performance

Hypothesis	Relationship	Coefficient	Std. Error	z-value	p-value	Result
H ₁	CED → EP	0.2325	0.0779	2.98	0.003	Supported
H ₂	GI → EP	0.9123	0.2872	3.18	0.001	Supported
H ₃	EE → EP	1.4728	0.3333	4.42	0.000	Supported

Source: Processed secondary data (2024)

Note: The z-value reported in this table is the test statistic for each path coefficient (the coefficient divided by its bootstrap standard error), used to judge statistical significance under the standard normal distribution. It is conceptually related to, but not identical to, a z-score, which standardizes a single raw observation relative to a distribution's mean and standard deviation.

In contrast, green innovation demonstrates a strong positive effect on firm value ($\beta = 0.4139$, $p = 0.004$), supporting H₅. The coefficient indicates that investors value firms' commitment to environmental innovation, likely viewing such investments as indicators of forward-thinking management and competitive positioning. Green innovation appears to differentiate firms, leading to higher market valuations.

Eco-efficiency does not significantly influence firm value ($\beta = -0.1133$, $p = 0.570$), thereby rejecting H₆. Despite their strong contribution to environmental performance and resource efficiency, these measures do not appear to directly affect investor valuations. This suggests that while eco-efficiency improves operational outcomes, these improvements may not be sufficiently visible or material to influence market perceptions of firm value.

Table 7. The direct effects of carbon emissions disclosure, green innovation, and eco-efficiency on firm value

Hypothesis	Relationship	Coefficient	Std. Error	z-value	p-value	Result
H ₄	CED → FV	-0.0574	0.0278	-2.07	0.039	Supported (significant, negative direction)
H ₅	GI → FV	0.4139	0.1419	2.92	0.004	Supported
H ₆	EE → FV	-0.1133	0.1992	-0.57	0.570	Not Supported

Source: Processed secondary data (2024)

Note: The z-value reported in this table is the test statistic for each path coefficient, used to judge statistical significance under the standard normal distribution. It is conceptually related to, but not identical to, a z-score, which standardizes a single raw observation relative to a distribution's mean and standard deviation.

Table 8 presents the mediation analysis results using bootstrapped indirect effects (5,000 iterations, 95% percentile confidence intervals). Environmental performance does not demonstrate a significant direct

effect on firm value ($\beta = -0.055$, $p = 0.256$), indicating that higher PROPER ratings do not independently translate into higher Tobin's Q in this sample. The bootstrapped indirect effect analysis shows that none of the three indirect effects are statistically significant. For the green innovation-firm value relationship (indirect effect = -0.050 , $SE = 0.041$, 95% CI $[-0.122, 0.044]$, $p = 0.226$), environmental performance does not significantly mediate the relationship, leading to rejection of H_8 . Although the green innovation $\rightarrow$ environmental performance path is positive and the environmental performance $\rightarrow$ firm value path is negative, so that the point estimate of the indirect effect is negative, the wide bootstrap confidence interval crossing zero indicates this net effect is not statistically distinguishable from zero at conventional levels. Environmental performance likewise does not significantly mediate the relationships between carbon emission disclosure and firm value (indirect effect = -0.013 , 95% CI $[-0.042, 0.009]$) or between eco-efficiency and firm value (indirect effect = -0.081 , 95% CI $[-0.278, 0.051]$), leading to rejection of H_7 and H_9 . Across all three pathways, the non-significant indirect effects suggest that whatever environmental performance improvements these practices generate are not recognized by the market as value-relevant signals in this sample. Investors appear to respond to the direct signals from carbon disclosure and green innovation on their own terms, rather than to the environmental performance outcomes these practices produce.

Carbon Emission Disclosure and Environmental Performance

The positive relationship between carbon emission disclosure and environmental performance is consistent with the compliance-based signaling logic developed in hypothesis 1 (Deegan, 2002). When companies publicly report their emissions, they face heightened stakeholder scrutiny, creating internal pressure to improve environmental management practices. Fransisca et al. (2024) demonstrated that Indonesian firms with comprehensive carbon disclosure frameworks tend to implement more robust environmental governance systems. The disclosure process itself appears to catalyze organizational change, as managers recognize that transparent reporting must be backed by genuine environmental improvements to maintain credibility.

Table 8. The mediation effects of environmental performance

Hypothesis	Relationship	Coefficient	Std. Error	p-value	95% CI	Result
	EP $\rightarrow$ FV	-0.055	0.0483	0.256	[-0.152, 0.035]	
H_7	CED $\rightarrow$ EP $\rightarrow$ FV	-0.013	0.013	0.317	[-0.042, 0.009]	Not Supported
H_8	GI $\rightarrow$ EP $\rightarrow$ FV	-0.050	0.041	0.226	[-0.122, 0.044]	Not Supported
H_9	EE $\rightarrow$ EP $\rightarrow$ FV	-0.081	0.083	0.330	[-0.278, 0.051]	Not Supported

Source: Processed secondary data (2024)

Note: The 95% CI reports the percentile bootstrap confidence interval for each indirect effect, computed from 5,000 resamples. A mediation is treated as statistically supported when this interval does not contain zero.

Carbon Emission Disclosure and Environmental Performance

The positive relationship between carbon emission disclosure and environmental performance is consistent with the compliance-based signaling logic developed in hypothesis 1 (Deegan, 2002). When companies publicly report their emissions, they face heightened stakeholder scrutiny, creating internal pressure to improve environmental management practices. Fransisca et al. (2024) demonstrated that Indonesian firms with comprehensive carbon disclosure frameworks tend to implement more robust environmental governance systems. The disclosure process itself appears to catalyze organizational change, as managers recognize that transparent reporting must be backed by genuine environmental improvements to maintain credibility.

However, the negative effect of carbon disclosure on firm value presents an interesting paradox. While Signaling Theory predicts that transparency can enhance firm reputation when the signal is credible (Connelly et al., 2011), a plausible interpretation is that carbon disclosure may operate differently in the Indonesian context. This finding aligns with Liu et al. (2023), who observed that carbon disclosure can paradoxically signal environmental vulnerabilities rather than corporate responsibility, particularly when not accompanied by evidence of emissions reduction. A plausible interpretation is that, in an emerging-market context with evolving ESG norms, investors may perceive carbon disclosure as a potential indicator of regulatory exposure or upcoming compliance costs rather than as a signal of responsible management, especially given the evolving nature of environmental regulations in emerging markets. Oriska & Kusumawardani (2024) found that the financial benefits of carbon disclosure materialize only when firms demonstrate substantive progress in reducing their carbon footprint. The mere act of disclosure, without accompanying evidence of mitigation efforts, may raise concerns rather than build confidence. This creates a dilemma for firms: transparency about environmental challenges is necessary for operational improvement and stakeholder trust, yet this same transparency may expose vulnerabilities that concern short-term

investors. This tension appears particularly acute in emerging markets, where ESG awareness is still developing, and investors may not yet distinguish between disclosure as accountability and disclosure as risk exposure. The strong positive effects of green innovation on both environmental performance and firm value underscore its strategic importance. From a Resource-Based View perspective, green innovation represents a valuable, rare, and difficult-to-imitate capability that provides sustained competitive advantage (Amalo & Husen, 2024). The findings suggest that investments in environmentally friendly technologies and processes generate dual benefits: reducing environmental impact while enhancing market valuation.

Green Innovation as a Value Driver

The environmental benefits of green innovation are substantial. Companies developing cleaner production methods, eco-friendly products, or renewable energy solutions naturally achieve better environmental performance metrics, including reduced emissions and improved resource efficiency. Sari et al. (2024) documented how green R&D investments lead to measurable reductions in greenhouse gas emissions and energy consumption. Similarly, Helmina et al. (2022) found that firms with active green innovation programs consistently achieve higher environmental performance scores, particularly when innovation efforts are embedded within broader sustainability strategies. The positive valuation effect of green innovation reflects the fact that sustainability initiatives differentiate firms in competitive markets, where environmental responsibility influences consumer choices and business relationships. Laela et al. (2024) demonstrated that firms with strong green innovation portfolios attract premium valuations, particularly in sectors where environmental performance affects brand reputation and market access. Besides, green innovation may also signal managerial quality and strategic foresight to investors. Ye et al. (2023) found that companies with higher rates of green patent filings experience better stock performance, suggesting that investors view environmental innovation as a proxy for management competence and adaptability.

Green innovation's value effect appears to operate mainly as a direct signal rather than through environmental performance as a transmission channel: the indirect path through environmental performance is not statistically significant, so investors do not appear to be pricing the PROPER-rating improvements that green innovation generates. This suggests investors reward green innovation primarily as evidence of firm capability in itself, rather than waiting for that capability to first show up in a regulatory performance rating. Oriska & Kusumawardani (2024) found that the financial benefits of sustainability initiatives are most pronounced when accompanied by verifiable environmental achievements.

Eco-Efficiency and Market Recognition

The relationship between eco-efficiency and firm outcomes presents an interesting pattern. While eco-efficiency strongly enhances environmental performance, it fails to influence firm value, and environmental performance directly does not mediate this relationship. The theoretical consistency of the positive effect on environmental performance is evident. Eco-efficiency initiatives embed environmental considerations into core operational processes, leading to reduced waste, lower emissions, and more sustainable resource use. Under Signaling Theory, ISO 14001 certification functions as a compliance-based signal that communicates adherence to environmental management standards, consistent with the observed improvements in environmental performance metrics (Clarkson et al., 2008). Yuliandhari et al. (2023) documented that eco-efficient firms achieve superior environmental performance metrics, particularly in waste reduction and energy consumption.

However, the absence of a direct effect on firm value suggests that Indonesian investors do not recognize or reward eco-efficiency to the same extent as they value green innovation. Eco-efficiency improvements often yield primarily internal operational benefits, such as cost savings, process improvements, and waste reduction, that may not be highly visible to external stakeholders. Unlike green innovation, which often involves new products or technologies that garner public attention, eco-efficiency improvements occur in production processes and supply chain management. Even substantial efficiency gains may go unnoticed by investors who lack detailed operational information. Besides that, the financial benefits of eco-efficiency may accrue gradually over extended periods. Passeti & Tenucci (2016) noted that eco-efficiency investments require time to generate measurable cost savings and operational improvements that influence financial metrics. The three-year window in this study may be insufficient to capture the full value-creating potential of eco-efficiency initiatives. Another plausible explanation is that cultural and institutional factors may influence how different sustainability practices are perceived in emerging markets. Rahelliamelinda & Handoko (2024) found that Indonesian investors tend to prioritize visible, innovation-oriented sustainability initiatives over operational efficiency measures, possibly because innovation signals market leadership and growth potential. In contrast, efficiency improvements are viewed as routine operational enhancements. This may reflect the early stage of ESG integration in Indonesian capital markets, where investors focus on more salient sustainability signals.

The lack of mediation by environmental performance further suggests that even when eco-efficiency generates genuine environmental improvements, these improvements do not translate into market value in

the Indonesian context. This contrasts with green innovation, where environmental performance serves as a critical pathway to firm value. The divergence implies that investors differentiate between environmental improvements arising from innovation and those stemming from operational efficiency.

Environmental Performance as a Contingent Value Driver

The finding that environmental performance does not significantly enhance firm value, either directly or as a mediator of any of the three sustainability practices, challenges the assumption that improved environmental outcomes automatically translate into financial rewards. In this sample, higher PROPER ratings are numerically associated with somewhat lower Tobin's Q, consistent with the negative direct environmental performance to firm value coefficient. This suggests that environmental performance is, at most, a weak and statistically inconclusive signal in the Indonesian market, rather than either a value driver or a confirmed liability signal.

The non-significant mediation pattern across all three pathways is nonetheless theoretically informative. Green innovation generates measurable environmental improvements, and the point estimate of its indirect effect on firm value is negative, but the bootstrap confidence interval is too wide to distinguish this from zero, so it would be premature to conclude that environmental performance offsets green innovation's direct positive effect on firm value. One plausible interpretation, consistent with Signaling Theory, is that investors in Indonesia lack a clear basis for valuing improvements in PROPER ratings. This pattern generally aligns with the findings of Liu et al. (2023), who found that environmental disclosures do not automatically signal responsibility to investors without accompanying substantive, verifiable performance gains. This remains a plausible theoretical proposition rather than a confirmed mechanism; direct investor-perception data, and a larger sample capable of detecting smaller mediation effects with adequate power, would be needed to test it further.

The negative association between environmental performance and firm value may also reflect limitations in the measurement of environmental performance. The PROPER rating system assigns ordinal scores (0-5) that capture regulatory compliance rather than investor-relevant sustainability outcomes. Indonesia's PROPER rating system, while comprehensive, may not capture all dimensions of environmental performance that matter to investors. Additionally, Alexander (2024) noted that many Indonesian investors remain focused primarily on traditional financial metrics, with environmental considerations playing a secondary role in valuation decisions.

CONCLUSION

This study examines how carbon emission disclosure, green innovation, and eco-efficiency affect environmental performance and firm value, and whether environmental performance mediates these relationships, among Indonesian firms listed on the ESG Sector Leaders IDX KEHATI. The findings yield three substantive conclusions. First, all three sustainability practices significantly enhance environmental performance, with eco-efficiency showing the strongest effect. This confirms the importance of resource efficiency and systematic environmental management for operational sustainability outcomes. Second, sustainability practices differ markedly in their market implications. Green innovation has a significant positive direct effect on firm value, reflecting investor recognition of innovation capability as a strategic asset. Carbon emission disclosure has a significant negative direct effect, consistent with the dual-signal interpretation that disclosure in a developing ESG market can be perceived as signaling compliance costs rather than responsibility. Eco-efficiency has no significant direct effect on firm value. Third, environmental performance does not significantly mediate any of the three relationships tested. Although the point estimate for the green innovation pathway is negative, consistent with the negative (non-significant) direct effect of environmental performance on firm value, the bootstrap confidence interval is too wide to conclude that environmental performance transmits, suppresses, or otherwise channels any of the three practices' effects on firm value in this sample.

This study has several limitations. The focus on firms listed in the ESG Sector Leaders IDX KEHATI may limit the generalizability of the findings to other emerging markets or non-listed companies. The PLS-SEM specification does not include year fixed effects or industry sector controls. Tobin's Q is sensitive to macroeconomic conditions and structurally differs across sectors; cross-sector variation in Tobin's Q is statistically significant in this sample. Future research should incorporate temporal and sectoral controls, either through panel regression or by stratifying the PLS-SEM analysis by industry group. Finally, Indonesia's unique regulatory environment and stakeholder dynamics may limit the applicability of these findings to firms in other regions.

Despite its limitations, this study also makes several contributions. This study demonstrates that the symbolic-substantive distinction in environmental practice, developed in environmental accounting literature, has rarely been applied to value research in emerging markets. By treating legitimacy theory and RBV logic as sub-mechanisms within a single Signaling Theory framework rather than as separate, overlapping theories, this study shows that environmental performance is not a positive transmission

mechanism in this market context. Based on the results, this study offers practical and policy implications. The negative market response to carbon disclosure underlines the need for firms to accompany disclosures with credible, quantifiable emissions reductions rather than disclosing in isolation. Regarding policy implications, regulators should strengthen the credibility and comparability of sustainability reporting frameworks.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Rintan Nuzul Ainy: Conceptualization, Methodology, Project administration, Writing – original draft. **Navaya Helena:** Data curation, Formal analysis, Investigation, Writing – review & editing. **Lu'lu' Nafiati:** Writing – review & editing, Validation, Supervision.

DECLARATION OF COMPETING INTERESTS

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.

DATA AVAILABILITY

Data will be made available on request.

AI USAGE STATEMENT

During the preparation of this work, the authors used ChatGPT (OpenAI) and Grammarly to improve the language and clarity of the manuscript. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

REFERENCES

- Agustia, D., Sawarjuwono, T., & Dianawati, W. (2019). The mediating effect of environmental management accounting on green innovation: firm value relationship. *International Journal of Energy Economics and Policy*, 9(2), 299-306. <https://doi.org/10.32479/ijeeep.7438>
- Alexander, N. (2024). Environmental, social, governance (ESG) disclosure and firm value: Empirical study in Indonesia. *South East Asia Journal of Contemporary Business, Economics and Law*, 32(1), 136–141.
- Amalo, F., & Husen, G. N. (2024). The role of financial performance in mediating the relationship between green innovation and eco-efficiency on company value. *Management Studies and Entrepreneurship Journal*, 5(2), 3939–3945. <http://journal.yrpioku.com/index.php/msej>
- Aviyanti, S. C., & Isbanah, Y. (2019). Pengaruh eco-efficiency, corporate social responsibility, ownership concentration, dan cash holding terhadap nilai perusahaan sektor consumer goods di BEI periode 2011-2016. *Jurnal Ilmu Manajemen*, 7(1), 77-84.
- Bae Choi, B., Lee, D., & Psaros, J. (2013). An analysis of Australian company carbon emission disclosures. *Pacific Accounting Review*, 25(1), 58-79. <https://doi.org/10.1108/01140581311318968>
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120. <https://doi.org/10.1177/014920639101700108>
- Chairani, C., & Siregar, S. V. (2021). The effect of enterprise risk management on financial performance and firm value: The role of environmental, social and governance performance. *Meditari Accountancy Research*, 29(3), 647-670. <https://doi.org/10.1108/MEDAR-09-2019-0549>
- Choi, B., & Luo, L. (2021). Does the market value greenhouse gas emissions? Evidence from multi-country firm data. *British Accounting Review*, 53(1), 100909. <https://doi.org/10.1016/j.bar.2020.100909>
- Clarkson, P. M., Li, Y., Richardson, G. D., & Vasvari, F. P. (2008). Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis. *Accounting, Organizations and Society*, 33(4–5), 303-327. <https://doi.org/10.1016/j.aos.2007.05.003>
- Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011). Signaling theory: A review and assessment. *Journal of Management*, 37(1), 39-67. <https://doi.org/10.1177/0149206310388419>
- Deegan, C. (2002). Introduction: The legitimising effect of social and environmental disclosures—a theoretical foundation. *Accounting, Auditing & Accountability Journal*, 15(3), 282-311. <https://doi.org/10.1108/09513570210435852>
- Desai, R. (2024). Analysing the firm value effects of environmental, social and governance disclosure: Empirical study of Indian firms. *NMIMS Management Review*, 32(1), 58-67. <https://doi.org/10.1177/09711023241264679>
- Dhaliwal, D. S., Li, O. Z., Tsang, A., & Yang, Y. G. (2011). Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting. *Accounting Review*, 86(1), 59-100. <https://doi.org/10.2308/accr.00000005>
- Dihardjo, J. F., & Hersugondo, H. (2023). Exploring the impact of ESG disclosure, dividend payout ratio, and institutional ownership on firm value: A moderated analysis of firm size. *Jurnal Ekonomi Bisnis dan Kewirausahaan*, 12(2), 184-207. <https://doi.org/10.26418/jebik.v12i2.64129>
- Fanda, V., & Damayanti, S. P. F. (2024). Pengaruh pengungkapan emisi karbon, eco-efficiency, dan green innovation terhadap nilai perusahaan. *Jurnal Ilmiah Mahasiswa Akuntansi*, 13(1), 60–73. <https://doi.org/10.33508/jima.v13i1.5727>

- Fikriyah, S. H., & Wiyanti, R. (2023). The effect of environmental performance and green accounting on firm value. *EAJ (Economic and Accounting Journal)*, 6(1), 19–31. <https://doi.org/10.32493/eaj.v6i1.y2023.p19-31>
- Firdaus, Saputra, D., & Ananda, Y. A. (2024). The effect of green accounting, carbon emission, eco-efficiency, and gender diversity on firm value. *International Conference on Law and Social Science*, 1–17. <https://pps.uir.ac.id/icls2024/>
- Fransisca, S., Robiani, B., Meutia, I., & Yusnaini, Y. (2024). Development of carbon emission disclosure indicators in Indonesia and analysis of determining factors. *Qubahan Academic Journal*, 4(3), 242–262. <https://doi.org/10.48161/qaj.v4n3a617>
- Fuadah, L. L., Mukhtaruddin, M., Andriana, I., & Arisman, A. (2022). The ownership structure, and the environmental, social, and governance (ESG) disclosure, firm value and firm performance: The audit committee as moderating variable. *Economics*, 10(12), 1-16. <https://doi.org/10.3390/economics10120314>
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24. <https://doi.org/10.1108/EBR-11-2018-0203>
- Hardiyansah, M., Agustini, A. T., & Purnamawati, I. (2021). The effect of carbon emission disclosure on firm value: Environmental performance and industrial type. *Journal of Asian Finance, Economics and Business*, 8(1), 123-133. <https://doi.org/10.13106/jafeb.2021.vol8.no1.123>
- Hart, S. L., Milstein, M. B., & Caggiano, J. (2003). Creating sustainable value. *Academy of Management Executive*, 17(2), 56–69. <https://doi.org/10.5465/ame.2003.10025194>
- Hassan, N. H., Alfian, E., & Sapiei, N. S. (2021). Carbon disclosure: A systematic literature review of determinants. *International Journal of Accounting*, 6(6), 183-201.
- Helmina, M. R. A., Sutomo, I., & Respati, N. W. (2022). Empirical examination of green industry strategy through ISO-14001 on firm value: Mediating roles of profitability and leverage. *International Journal of Sustainable Development and Planning*, 17(5), 1417-1424. <https://doi.org/10.18280/ijssdp.170505>
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115-135. <https://doi.org/10.1007/s11747-014-0403-8>
- Laela, S. F., Hendrasto, N., & Surur, M. (2024). Green initiatives and firm value: The moderating effect of environmental performance. *Jurnal Dinamika Akuntansi dan Bisnis*, 11(2), 261–278. <https://doi.org/10.24815/jdab.v11i2.38257>
- Li, Z., Feng, L., Pan, Z., & Sohail, H. M. (2022). ESG performance and stock prices: Evidence from the COVID-19 outbreak in China. *Humanities and Social Sciences Communications*, 9(1), 1-10. <https://doi.org/10.1057/s41599-022-01259-5>
- Liu, Y. S., Zhou, X., Yang, J. H., Hoepner, A. G. F., & Kakabadse, N. (2023). Carbon emissions, carbon disclosure and organizational performance. *International Review of Financial Analysis*, 90, 102846. <https://doi.org/10.1016/j.irfa.2023.102846>
- Luo, L., & Tang, Q. (2014). Does voluntary carbon disclosure reflect underlying carbon performance? *Journal of Contemporary Accounting and Economics*, 10(3), 191-205. <https://doi.org/10.1016/j.jcae.2014.08.003>
- Matsumura, E. M., Prakash, R., & Vera-Muñoz, S. C. (2014). Firm-value effects of carbon emissions and carbon disclosures. *Accounting Review*, 89(2), 695-724. <https://doi.org/10.2308/accr-50629>
- Melinda, A., & Wardhani, R. (2020). The Effect of Environmental, Social, Governance, and Controversies on Firms' Value: Evidence from Asia. In W. A. Barnett & B. S. Sergi (Eds.), *Advanced Issues in the Economics of Emerging Markets* (Vol. 27, p. 0). Emerald Publishing Limited. <https://doi.org/10.1108/S1571-038620200000027011>
- Oriska, S., & Kusumawardani, N. (2024). The impact of carbon emission disclosure and green innovation on company value: Moderating role of environmental performance. *InJEBA: International Journal of Economics, Business and Accounting*, 2(3), 240–249. <https://doi.org/10.5281/zenodo.12948519>
- Passetti, E., & Tenucci, A. (2016). Eco-efficiency measurement and the influence of organisational factors: Evidence from large Italian companies. *Journal of Cleaner Production*, 122, 228-239. <https://doi.org/10.1016/j.jclepro.2016.02.035>
- Patten, D. M. (1992). Intra-industry environmental disclosures in response to the Alaskan oil spill: A note on legitimacy theory. *Accounting, Organizations and Society*, 17(5), 471-475. [https://doi.org/10.1016/0361-3682\(92\)90042-Q](https://doi.org/10.1016/0361-3682(92)90042-Q)
- Putra, F. K., & Budastra, M. A. (2024). The mediating role of financial performance in environmental, social, and governance (ESG) and firm value. *Jurnal Akuntansi Bisnis*, 17(1), 1-16. <https://doi.org/10.30813/jab.v17i1.4931>
- Putra, P. D., Zainal, A., Harahap, K., Agusti, I. S., Saputra, H., & Afrida, F. (2025). The impact of green factors and digitalization to firm value and firm performance: Evidence from micro, small and medium-sized enterprises (MSMEs) in Medan city. *Proceedings of the 6th International Conference on Innovation in Education, Science, and Culture, ICIESC 2024, 17 September 2024, Medan, Indonesia*, 1–16. <https://doi.org/10.4108/eai.17-9-2024.2352853>
- Rahelliamelinda, L., & Handoko, J. (2024). Profitabilitas sebagai moderating pengaruh kinerja ESG, green innovation, eco-efficiency terhadap nilai perusahaan. *Jurnal Informasi, Perpajakan, Akuntansi, dan Keuangan Publik*, 19(1), 145-170. <https://doi.org/10.25105/jipak.v19i1.19191>
- Rahmaniati, N. P. G., & Ekawati, E. (2024). The role of Indonesian regulators on the effectiveness of ESG implementation in improving firms' non-financial performance. *Cogent Business and Management*, 11(1), 2293302. <https://doi.org/10.1080/23311975.2023.2293302>
- Rasyad, R. K., Afgani, K. F., & Ali, Q. (2024). Effects of ESG on firm performance and firm value: A study of Indonesian and Malaysian listed companies. *Journal Integration of Management Studies*, 2(1), 1-17. <https://doi.org/10.58229/jims.v1i2.118>

- Ringle, C. M., Sarstedt, M., Mitchell, R., & Gudergan, S. P. (2020). Partial least squares structural equation modeling in HRM research. *The International Journal of Human Resource Management*, 31(12), 1617–1643. <https://doi.org/10.1080/09585192.2017.1416655>
- Ruth, M., Manurung, R., & Ulpah, M. (2023). Environmental, social, and governance (ESG) influence on company values in Indonesia. *Jurnal Scientia*, 12(1), 503-511.
- Sari, P. A., Rays, M., Purwanti, & Hidayat, I. (2024). Achievement of carbon emission disclosure as a mediator between factors increasing firm value: Eco-efficiency and green innovation. *International Journal of Energy Economics and Policy*, 14(6), 246–253. <https://doi.org/10.32479/ijeep.16949>
- Savitri, E., & Abdullah, N. H. N. (2023). The effect of eco-efficiency and good corporate governance on firm value: Profitability as a mediator. *Management and Accounting Review*, 22(1), 379-399. <https://doi.org/10.24191/mar.v22i01-15>
- Spence, M. (1973). Job market signaling. *Quarterly Journal of Economics*, 87(3), 355–374. <https://doi.org/10.2307/1882010>
- Streukens, S., & Leroi-Werelds, S. (2016). Bootstrapping and PLS-SEM: A step-by-step guide to get more out of your bootstrap results. *European Management Journal*, 34(6), 618-632. <https://doi.org/10.1016/j.emj.2016.06.003>
- Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review*, 20(3), 571-610. <https://doi.org/10.5465/amr.1995.9508080331>
- Ye, F., Ouyang, Y., & Li, Y. (2023). Digital investment and environmental performance: The mediating roles of production efficiency and green innovation. *International Journal of Production Economics*, 259, 108822. <https://doi.org/10.1016/j.ijpe.2023.108822>
- Yuliandhari, W. S., Saraswati, R. S., & Rasid Safari, Z. M. (2023). Pengaruh carbon emission disclosure, eco-efficiency dan green innovation terhadap nilai perusahaan. *Owner*, 7(2), 1526-1539. <https://doi.org/10.33395/owner.v7i2.1301>