

Does Green Reporting Pay Off? Evidence from Indonesian Manufacturing Firms

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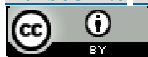
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ABSTRACT

This study aims to investigate the association between environmental disclosure and the financial performance of Indonesian manufacturing companies. Utilizing panel data collected from 2020 to 2024, comprising 425 firm-year observations, the research tests fixed-effects panel regression specifications alongside System Generalized Method of Moments (GMM) to account for potential endogeneity. The results show that environmental disclosure is positively and statistically significantly associated with Return on Assets (ROA). Furthermore, the disclosure-performance relationship is interconnected with institutional quality, firm characteristics, and genuine environmental performance. Sectoral heterogeneity is striking, with chemical and automotive manufacturing companies exhibiting a stronger association between environmental disclosure and financial returns compared to food processing companies. Specifically, the study presents evidence that disclosure should be backed by demonstrable environmental benefits, given that disclosure without corresponding performance improvements can induce adverse selection in low-resource, emerging markets. These results contribute to legitimacy and stakeholder theory by supporting the notion that environmental accountability is associated with sustainable competitive advantages when buttressed by operational improvements and adequate governance.

INTRODUCTION

Internationally, adding environmental responsibility to company financial reports is becoming more important as stakeholders demand transparent information about sustainability practices (KaoDui et al., 2026). Researchers are increasingly interested in how sharing environmental information relates to company finances, especially given growing evidence that environmental actions are associated with real business benefits in new markets (Ewesesan et al., 2026). Companies in developing countries are adopting Environmental, Social, and Governance (ESG) reporting frameworks because of the clear benefits of demonstrating their environmental stewardship to investors, regulators, and the public (Afifa et al., 2025). Still, the results are mixed, with some studies showing better financial outcomes with greater environmental openness (KaoDui et al., 2026), while others show no difference or even worse short-term outcomes, especially in places with weaker rules and oversight (Otseme et al., 2025). This mix of results indicates that the link between reporting and financial performance depends on company traits, the industry, and the strength of local institutions.

Indonesian manufacturing companies face unique pressures on environmental disclosure, shaped by international sustainability commitments and recent regulatory interventions such as POJK No. 51 of 2017 and PROPER (Syah et al., 2026). Despite these initiatives, empirical studies show that disclosure quality varies significantly across industries, ranging from 19.7% to 54.94% (Oktris et al., 2026; Wahyuningrum et al., 2026). The link between disclosure intensity and financial performance is not well established in Indonesia, largely because this developing market lacks the institutional structures present in developed economies. Recent literature indicates that while environmental exposure does not guarantee immediate financial gains, environmental signaling may still be strongly associated with higher stock market valuations (Oktris et al., 2026; Tondang & Wedari, 2025).

Recent empirical research highlights several critical and addressable research gaps. First, most literature centers on developed countries or Sub-Saharan Africa, whereas Indonesia—a key manufacturing hub with significant environmental sensitivities—remains under-cited in international peer-reviewed sources (Wahyuningrum et al., 2026). Second, while some studies address aggregate ESG disclosure or unidimensional effects on environmental reporting, few assess distinct impacts of disclosure quality, carbon emission transparency, or environmental cost transparency on various performance measures. Crucially, no prior study has examined the disclosure-performance link in Indonesian manufacturing using longitudinal panel data with a System GMM framework to control for unobserved firm heterogeneity and reverse causality (Amarta & Hendrawaty, 2025). Third, potential moderating effects of firm characteristics and governance mechanisms on the disclosure-performance link in emerging markets facing agency conflicts are largely overlooked (Afifa et al., 2025). These gaps reveal a pressing need to formulate the specific problem of this research: How does the quality and extent of environmental disclosure associate with the accounting-based financial performance of listed Indonesian

manufacturing firms when controlling for endogenous mechanisms and sectoral heterogeneity?

Unlike previous work, such as Oktris et al. (2026), which relies on static cross-sectional or basic OLS frameworks, this study utilizes a comprehensive System GMM approach alongside sectoral heterogeneity tests. This allows us to fill the gaps in the literature by evaluating the precise relational association between environmental disclosure and financial performance using a detailed panel dataset covering 2020–2024. Through a robust accounting approach and analysis of a sample of 85 manufacturing companies registered on the Indonesia Stock Exchange, our study makes new empirical contributions to our understanding of whether environmental disclosure represents a value-creating mechanism or just a costly compliance aspect in an emerging market characterized by transitional institutional arrangements.

LITERATURE REVIEW

Environmental Disclosure and Financial Performance

Environmental disclosure as a legitimacy and signaling mechanism is often associated with improved financial performance through different pathways, such as cost of capital reduction, operational efficiency improvements, investor confidence enhancement, and risk mitigation. Environmental disclosure illustrates corporate responsiveness to investor and regulatory demands, minimizing information asymmetry, and promoting stakeholder trust from a stakeholder viewpoint (Ewesesan et al., 2026). When the quality of environmental disclosure aligns with GRI standards, it also communicates to capital markets that management possesses strong environmental governance capabilities, reducing perceived business risk and lowering cost of equity—a mechanism particularly important in emerging market countries such as Indonesia, where information asymmetries remain pronounced (Tondang & Wedari, 2025).

There is empirical evidence for a positive relationship between disclosure and performance in emerging Asian economies, indicating a positive impact of comprehensive ESG disclosure (which includes environmental ESG components) on firm profitability across a range of financial measures (ROA, ROE, Tobin's Q), with environmental disclosure specifically demonstrating the strongest individual effect on firm performance (KaoDui et al., 2026). Meanwhile, the quality of environmental disclosure (GRI compliance) positively predicts Return on Assets in Indonesia, with robust effect sizes ($\beta = 0.495$, $p < 0.001$), which supports the legitimacy and signaling mechanisms for financial value creation from the act of disclosure (Oktris et al., 2026). Global evidence from meta-analyses shows a consistent positive association between the level of disclosure and firm financial performance despite the emergence of significant effect heterogeneity as a function of institutional context and quality of disclosure measurement (Afifa et al., 2025).

Conversely, disclosure-performance relationships are mediated by institutional quality and investor sophistication (Otseme et al., 2025). In developing institutional environments, excessive disclosure may engender adverse selection concerns among investors, as extensive disclosure could be

interpreted as a “lemons signal” of undisclosed risks, thus decreasing a firm’s valuation rather than magnifying it (Otseme et al., 2025). This potential inverted relationship accounts for conflicting empirical results observed with some Indonesian manufacturing studies, in which environmental disclosure is found to have either no or a negative association with near-term accounting profitability (Oktris et al., 2026).

Ghanaian manufacturing firms that display significant environmental disclosure and increased investments into supply chain visibility show positive effects on financial performance through operational efficiency gains and stakeholder relationship improvements (KaoDui et al., 2026). Data from Nigerian manufacturing suggests that the adoption of environmental accounting frameworks, increasingly driven by stakeholder demands, positively influences financial outcomes, offering evidence that the stakeholder pressure mechanism is dynamic (Ewesesan et al., 2026). Disaggregated analyses, however, suggest a heterogeneity in disclosure quality: companies in environmentally sensitive sectors (cement, oil & gas) gain more substantially from environmental disclosure than do firms in low-impact sectors, reflecting differential signaling salience (Otseme et al., 2025).

But in the Indonesian context, environmental disclosure has a positive but sometimes relatively weak effect for accounting-based performance measures (ROA), and to the extent that the market-based performance effects were stronger (Tobin's Q) - indicating the impact of the disclosure has more effect on shareholder confidence and risk premium and less immediate influence on operational efficiency (Oktris et al., 2026). This point serves to emphasize that financial performance improvements from disclosure are more effective via market valuation channels than through operational efficiency channels in emerging market contexts (Tondang & Wedari, 2025). Following the synthesis of legitimacy and signaling theories, we expect transparency to reduce friction with external capital providers.

Hypothesis 1 (H1): Environmental disclosure is positively and significantly associated with the financial performance (ROA) of manufacturing firms.

Board Sustainability Committees and Audit Committee Diligence on Disclosure Quality

Board-level sustainability committees and audit committee diligence are expected to relate positively to the quality of environmental disclosures across firms by integrating environmental governance oversight, embedding expertise into governance structures, and creating formal accountability mechanisms for sustainability reporting. From agency theory and resource dependence perspectives, these specialized sustainability committees help to reduce agency costs between managers and shareholders by establishing dedicated governance mechanisms with explicit accountability for environmental performance and disclosure (Hidayah & Ratmono, 2025). Independent and competent audit committees are significantly associated with improved environmental disclosure quality via reduced stakeholder capture and stronger professional skepticism regarding disclosure assertions (Razali et al., 2025).

Complex mechanisms of how board sustainability structures improve the quality of disclosure can result from a variety of channels through which the quality of disclosure is fostered: (1) expertise acquisition—committees may attract or develop members with environmental knowledge to help mitigate information constraints within disclosure decisions; (2) legitimacy signaling—the existence of committees signals to external stakeholders that management pays attention to environmental governance, creating reputational incentives for high-quality disclosure (Razali et al., 2025); and (3) resource allocation—committees procure budget and personnel resources for sustainability reporting infrastructure, enhancing the rigor in disclosure practices. Studies from ASEAN demonstrate that the existence of environmental committees strongly predicts the quality of carbon emission disclosures, and that effect sizes capture both the direct committee effects and indirect legitimacy signaling benefits (Afifa et al., 2025).

As per the evidence from over a hundred countries, board size, independence, expertise, and diversity significantly impact sustainability performance, where diversity has a significant effect on cultivating environmental responsibility (Elmagrhi et al., 2018). Independent and competent audit committees are significantly associated with improved environmental disclosure quality via various mechanisms: independent auditors have reduced stakeholder capture, exhibit stronger professional skepticism regarding disclosure assertions, and devote more attention to processes associated with sustainability reporting. Analysis of Malaysian firms indicates that the expertise of audit committees is a precise driver of environmental disclosure via enhancing transparency, building stakeholder confidence, and further aligning global sustainability goals (Razali et al., 2025).

The links between audit committee characteristics and sustainability reporting quality are complex, with independence and expertise of audit committees positively affecting sustainability reporting quality, in the process mediating increased sustainability performance outcomes. In Indonesian mining and manufacturing contexts, audit committees demonstrate non-linear effects: while audit committee effectiveness generally strengthens environmental disclosure quality, excessive audit committee independence or monitoring intensity may create bureaucratic friction that reduces disclosure efficiency. Environmental committees specifically strengthen sustainability disclosure practices when supported by complementary audit committee oversight, though isolated environmental committees without audit committee support show attenuated disclosure effects (Hidayah & Ratmono, 2025).

Hypothesis 2 (H2): The presence of board-level sustainability committees and audit committee diligence is positively associated with environmental disclosure quality.

Environmental Performance and Financial Performance

Environmental performance refers to the actual operational delivery of environmental management practices, exerting dual financial effects via disclosure mechanisms (signaling) and operational channels (efficiency gains and risk reduction). Whereas environmental disclosure communicates

environmental efforts to external stakeholders, environmental performance consists of tangible operational results—less emissions, less waste, better use of resources—which can deliver financial outcomes via cost savings (Oktris et al., 2026). It emerges as an important theoretical distinction to clarify in the context of financial performance predictors; the quality of disclosure signals commitment while not guaranteeing operational outputs, whereas environmental performance provides observable operational performance advancement that promotes the profitability of businesses by means of efficiency mechanisms beyond disclosure (Oktris et al., 2026).

The association between environmental performance and financial performance is a nonlinear and context-dependent relationship. Financial performance may initially decrease due to environmental performance, driven by technological investment costs, operational disruption during implementation, or environmental compliance expenditures, before delivering long-term profitability improvements as efficiency gains accumulate. This nonlinearity accounts for inconsistent empirical evidence on the association between environmental performance and profitability in cross-sectional analyses: studies examining firms at different stages of environmental implementation progress can produce heterogeneous results (Manrique & Martí-Ballester, 2017).

Environmental performance not only improves financial performance, but it does so in several ways: (1) improved operational efficiency (energy reduction, waste minimization lowering cost of goods sold); (2) compliance and avoidance of regulatory risks (reduced environmental penalties and litigation exposure); (3) access to markets and premium pricing (environmentally conscious consumers paying price premiums); and (4) greater stakeholder trust, resulting in a lower cost of capital through perceived commitment to sustainability. Environmental performance also functions as a predecessor for environmental information disclosure—firms with performance as such have decreased reputational costs due to open disclosure and prove credible environmental commitment, consequently, making the environmental information disclosure a more useful instrument with legitimacy and signaling effect (Oktris et al., 2026).

Environmental performance quality (informed by PROPER ratings and emissions metrics) is a significant predictor of Return on Assets in Indonesian manufacturing contexts, with effects persisting across alternative specifications and performance metrics (Oktris et al., 2026). The effect operates through multiple channels: PROPER participation signals operational capability to market participants; environmental performance improvements reduce regulatory risk premiums in cost of capital; and operational efficiency improvements directly enhance profitability (Syah et al., 2026).

Nevertheless, in practice, we find empirical disagreement: some report adverse or little relationships between environmental performance and profitability, which could arise from problems in measuring the relationships between performance and profitability over a short period of time, potential lags between performance and profit levels, or from the bias of the structure of

the firms (Manrique & Martí-Ballester, 2017). In the Indonesian context, environmental accounting disclosure and environmental performance are highly associated with financial performance, highlighting that direct operational channels have the potential to be greater than the signaling mechanisms (Syah et al., 2026).

Hypothesis 3 (H3): Environmental performance is positively associated with both environmental disclosure and financial performance.

Firm Size, Age, and Environmental Disclosure Quality

The extent and quality of environmental disclosures are both determined by corporate size and age through multiple mechanisms: resource availability for disclosure infrastructure, stakeholder visibility and legitimacy pressures, regulatory exposure, and organizational maturity in sustainability practices. Big companies have the means to invest resources in sustainability reporting, hire environmental accounting specialists, and apply quality assurance mechanisms to ensure disclosure compliance with global standards (GRI, ISSB) (Oktris et al., 2026). On average, from a political economy point of view, over time, larger corporations attract more stakeholder attention—e.g., institutional investors, NGOs, media, and regulatory bodies require more serious environmental disclosure from systemically significant firms than small firms with fewer stakeholder constituencies.

Firm age encompasses organizational learning and institutional experience dynamics: older firms have accumulated environmental management experience, enabling more sophisticated disclosure practices (Wahyuningrum et al., 2026). Older firms also possess a stronger institutional memory of previous environmental incidents or regulatory scrutiny that encourages proactive transparency to prevent recurrence. However, age effects may reverse when older firms possess legacy environmental liabilities or outdated management practices, creating incentives to minimize disclosure to avoid stakeholder concerns (Wahyuningrum et al., 2026).

It seems that theoretical mechanisms linking firm size with environmental disclosure quality, not just quantity, emerge in various ways, including that large firms tend to retain sustainability reporting experts, hire external sustainability consultants, conduct quality assurance reviews on disclosure content, and ensure that reporting complies with internationally recognized standards. These smaller firms frequently publish their disclosures with scant quality control, leading to inadequate GRI coverage, diverse metrics, and non-comparable disclosures. Similarly, firm age provides a strong predictor of disclosure quality via institutional growth: older firms have built up their disclosure infrastructure (management accounting systems capturing environmental data) while younger firms tend to lack mature environmental accounting systems, limiting the disclosure quality achievable (Wahyuningrum et al., 2026).

Panel analysis shows that firm size significantly predicts both disclosure depth and GRI-compliant quality, with effects that are robust across multiple model specifications. Financial strength, profitability, and age additionally predict higher-quality GRI disclosures independent of size, suggesting multiple

channels through which organizational maturity drives disclosure quality. Specifically, in Chinese manufacturing firms, firm size is significantly positively correlated with environmental information disclosure on the dimensions of disclosure intensity and quality, with the effect sizes remaining significant after adjusting for financial performance and profitability (Wahyuningrum et al., 2026).

In Indonesian contexts, firm size significantly correlates with environmental disclosure adoption and quality of SOEs, mining firms, and manufacturing enterprises (Oktris et al., 2026; Wahyuningrum et al., 2026). The pattern also holds across alternative disclosure quality measurements (GRI coverage and disclosure index scores) and alternative size proxies (assets, revenue, and employees). However, effect size heterogeneity is observed, with size predicting environmental disclosure quality more strongly in listed firms than in unlisted firms, suggesting that stock exchange listing amplifies the stakeholder pressure effects of firm size.

Age positively predicts the quality of disclosures through the mechanism of institutional development: older firms exhibit higher GRI compliance scores, and higher disclosure completeness results due to accumulated environmental management maturity. In Nigerian manufacturing, firm age is strongly positively related to social and environmental accounting disclosure quality, supporting institutional learning hypotheses. But age effects are nonlinear: particularly older firms, which are over 30 years of age in a declining industry, may not have any substantial improvement of disclosure quality when maturity in an industry diminishes growth expectations and resource allocation to disclosure (Wahyuningrum et al., 2026).

The greatest environmental disclosure quality is found in the large, old manufacturing firms, while the lowest environmental disclosure quality is found in small, young companies. These joint effects reflect complementarity: older age gives the infrastructure and expertise that size amplifies through resource availability and stakeholder visibility. In instances, interaction effects are significant, indicating size advantages are seen predominantly in older firms that have developed their environmental management systems (Wahyuningrum et al., 2026).

Hypothesis 4 (H4): Firm size and age are positively associated with the extent and quality of environmental disclosure.

Optimal Disclosure Quality and Nonlinear Financial Performance Effects

Environmental disclosure quality can exhibit a nonlinear relationship with firm value and financial return, where excessive disclosure can attenuate financial benefits through signal overload and excessive scrutiny costs in emerging market contexts (Otseme et al., 2025). Although disclosure typically improves financial performance by decreasing information asymmetry, lowering cost of capital, and building stakeholder trust, over-disclosure in environments that lack the robustness of institutional enforcement capacity can produce adverse selection effects (i.e., investors interpret full disclosure as a "lemons signal" pointing to unaddressed risks), raise the risk of regulatory scrutiny, or deter competitive transparency investments (Otseme et al., 2025).

The underlying theoretical mechanism works through institutional context dependence: in a developed capital markets environment characterized by the presence of experienced investors with strict regulatory enforcement, good disclosure quality will always favor firms, as it reduces uncertainties and risk premiums. In markets that lack sophisticated investors and a well-defined regulatory environment, excessive and disproportionate disclosures beyond expectations under institutional demand might indicate that management faces pressure to inflate disclosure to disguise operational problems, to diminish and reduce firm valuation, rather than increase it. This “disclosure paradox” accounts for the occurrence of inverted U-shapes or negative coefficients in the research on the relation between disclosure and performance in emerging markets (Otseme et al., 2025)

Moreover, significant environmental disclosures in tandem with poor environmental performance led to perceptions of "greenwashing" to the detriment of credibility and financial performance (Chen & Dagestani, 2023). Firms that disclose environmental commitments that don't correlate with performance improvements pay the price of backlash from stakeholders, regulatory investigation, and reputational repercussions from investors, which undermines any gains from transparency (Chen & Dagestani, 2023). Optimal disclosure quality balances legitimacy advantages against credibility costs.

There is empirical evidence to distinguish between disclosure quality (accurate, substantive, standards-compliant reporting) and disclosure quantity (volume of disclosed information), with quality showing dramatically stronger financial performance effects. In Chinese manufacturing, environmental information disclosure breadth (multiple dimensions covered) positively predicts financial performance, whereas disclosure quality (depth, accuracy per dimension) shows negative performance effects after controlling for breadth, suggesting potential adverse selection or excessive scrutiny costs. This counterintuitive finding indicates that high-quality disclosure of environmental problems without corresponding performance improvements damages financial performance by amplifying investor concerns (Oktris et al., 2026)

Hypothesis 5 (H5): Environmental disclosure quality exhibits a non-linear, inverted U-shaped relationship with financial performance

Green Technology Investments and Eco-Efficiency as Mediating Mechanism

The investment in green technology and improvement of eco-efficiency mediate the link between environmental disclosure and financial performance through the transition from disclosure to actual operations. From the resource-based view (RBV), environmental disclosure acts as a commitment device signaling management's intention to invest in green technologies as well as improve operational efficiency (Tolliver et al., 2021). Green technology innovation partially mediates the effect of environmental disclosure on firm financial performance, creating indirect disclosure-performance effects (Tolliver et al., 2021).

The mediation mechanism is multiple-layered: (1) signaling mechanism—environmental disclosure credibly commits firms to green investments, attracting capital suppliers willing to finance sustainability

initiatives at reduced cost; (2) organizational alignment mechanism—public disclosure commitments create internal organizational pressure to allocate resources consistently, overcoming managerial short-termism biases that might otherwise postpone environmental investments; and (3) stakeholder facilitation—disclosure attracts green-minded investors, employees, and partners who provide capital, talent, and collaboration opportunities specifically for green technology implementation (Tolliver et al., 2021).

Environmental disclosure mediates financial performance through green innovation and eco-efficiency mechanisms because disclosure by itself produces small accounting-related performance gains (marginal near-term profitability effects) but significant increases in market valuation (signaling effects) that ultimately translate into hard profits through the implementation of green technology payoffs (Tolliver et al., 2020). The amount of time lag between disclosure commitment and subsequent financial performance realization mirrors green technology implementation timeframes – firms usually take 2-3 years to adopt green technologies, realize efficiency gains, and translate these into measurable accounting performance (Tolliver et al., 2020).

Green technology innovation partially mediates the effect of environmental disclosure on firm financial performance: environmental disclosure predicts green innovation adoption, which subsequently predicts financial performance, creating indirect disclosure-performance effects. The direct disclosure-performance effect remains significant, indicating partial rather than full mediation, suggesting that disclosure generates both immediate signaling benefits and longer-term operational benefits through green technology channels (Tolliver et al., 2021).

In a meta-analytic study, green technological innovation effects have been shown to have significant and direct positive effects on organizational environmental performance (by way of emission reductions, efficiency improvements) and consequently firm financial performance through several operational channels: cost reduction (energy efficiency, waste minimization), revenue enhancement (green product premiums), as well as risk mitigation (regulatory compliance, operational disruption reduction). In Chinese urban environments, green technology innovation directly lowers carbon emission intensity, and industrial structure upgrading and energy optimization act as mediating roles (Tolliver et al., 2021).

Eco-efficiency (environmental output per unit input) is a direct operational outcome of green technology investments and mediates the relationship between disclosure commitments and financial performance. Firms adopting greener technologies have clear eco-efficiency improvements (energy per revenue unit, emissions per production unit), leading to cost reductions and competitive advantages. In Indonesian manufacturing settings, enhancements in eco-efficiency mediate disclosure-performance relationships through direct cost reduction channels, with effects strongest in energy-intensive sectors (cement, steel, chemicals) (Tolliver et al., 2021).

Hypothesis 6 (H6): Green technology investments and eco-efficiency improvements mediate the relationship between environmental disclosure and financial performance.

METHODOLOGY

Sample and Data Collection

This study examines listed manufacturing companies on the Indonesia Stock Exchange (IDX) for the fiscal years 2020–2024. The sample collection followed a strict filtering approach as summarized in Table 1. The sample includes firms that make products from manufacturing sectors that are environmentally sensitive industries, including chemical manufacturing, metal fabrication, automotive, food processing industries, and textiles. All manufacturing companies with comprehensive environmental reporting data for the entire five-year period have been purposed as the research population. Using a filtering approach, 85 listed manufacturing firms were selected from the population based on the availability and consistency of data. Firms were included only if they were listed in the referenced period and had consistent ESG reporting and financial performance data for the period under review (2020 to 2024). This sampling approach assures panel data reliability and completeness in the analysis.

Table 1: Sample Selection Process

Selection Step / Criteria	Firms Excluded	Final Sample (Firms)	Total Observations
Manufacturing companies listed on IDX (2020–2024)	-	142	710
Firms without continuous annual/sustainability reports	(35)	107	535
Firms with missing environmental/GRI indicators	(22)	85	425

Data collection is multi-source: annual reports, sustainability reports, environmental management system certifications, and stock market data. Annual reports provide financial performance metrics and governance information, while sustainability reports and corporate environmental disclosures are used as indicators of environmental performance. This method parallels the methodology employed in recent large-scale manufacturing studies.

Variables and Measurement

1. Dependent Variable: Financial Performance

Financial Performance is measured via Return on Assets (ROA), calculated as Net Income divided by Total Assets.

2. Independent Variable: Environmental Disclosure Index

The Environmental Disclosure Index (ED) was measured through content analysis using a non-weighted binary index across 18 items aligned with GRI standards:

- a. Greenhouse gas emissions (Scope 1, 2, and 3)
- b. Environmental management systems and certifications
- c. Energy consumption and conservation initiatives
- d. Water use and waste management
- e. Biodiversity and ecological impact mitigation

To ensure the reliability of this disclosure matrix, a pilot test using two independent coders was conducted. The inter-coder reliability was confirmed with a Krippendorff's Alpha coefficient of 0.84, exceeding the standard acceptable threshold of 0.80.

3. Control Variables

- a. Firm Size: Natural logarithm of total assets
- b. Leverage: Total debt divided by total equity
- c. Firm Age: Number of years since initial public listing
- d. Board Independence: Proportion of independent directors on the board
- e. Audit Committee Diligence: Number of audit committee meetings per year
- f. Green Innovation Intensity: R&D expenditure divided by total sales

Research Design and Analysis Methods

This investigation adopts an archival research methodology utilizing retrospective information extracted from published financial documentation and sustainability communication portfolios. Document-based analysis procedures, drawing on established content evaluation frameworks, standardize environmental disclosure information for longitudinal cross-firm comparison. The analytical framework proceeds through successive analytical phases:

1. descriptive metric computation encompassing central tendency, distribution spread, minimum/maximum parameter ranges;
2. bivariate association assessment utilizing Pearson association coefficients to examine two-variable relationships;
3. multivariate modeling employing fixed-effects and random-effects specifications with heteroscedasticity-robust standard errors;
4. sensitivity analysis executing alternative specifications including weighted least-squares approaches and dynamic system estimation methodologies.

The core analytical specification follows the functional form:

$$FP_{i,t} = \beta_0 + \beta_1 ED_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 AGE_{i,t} + \beta_5 BID_{i,t} + \beta_6 ACD_{i,t} + \beta_7 GIN_{i,t} + \mu_i + \varepsilon_{i,t}$$

Where: FP = Financial Performance (ROA), ED = Environmental Disclosure Index, SIZE = Firm Size, LEV = Leverage, AGE = Firm Age, BID = Board Independence, ACD = Audit Committee Diligence, GIN = Green Innovation Intensity, μ_i represents unobserved firm-fixed effects and $\varepsilon_{i,t}$ is the error term.

To address reverse causality and self-selection bias, a dynamic System GMM approach is implemented as a secondary robust specification.

RESEARCH AND DISCUSSION

Descriptive Statistics

The balanced panel dataset comprises 85 manufacturing firms over five years, yielding 425 firm-year observations. As shown in Table 2, the mean environmental disclosure index stands at 0.542, indicating that manufacturing firms, on average, disclose approximately 54% of recommended environmental indicators. However, considerable variation exists, with disclosure ranging from 0.22 to 0.89, suggesting heterogeneous disclosure practices across the manufacturing sector.

Table 2: Descriptive Statistics

Variable	N	Mean	Std. Dev	Min	Max
Financial Performance (ROA)	425	0.0847	0.0652	-0.0234	0.3456
Environmental Disclosure Index	425	0.5423	0.1876	0.2200	0.8900
Firm Size (log assets)	425	13.4521	1.2345	10.8734	16.5432
Leverage Ratio	425	0.4523	0.3210	0.0456	1.2345
Firm Age (years)	425	18.6734	12.3456	3	67
Board Independence %	425	0.4567	0.1234	0.2000	0.8333
Audit Committee Meetings/year	425	4.5634	2.1234	1	12
Green Innovation Intensity	425	0.0234	0.0456	0.0001	0.2345

The data reveal that environmental disclosure has increased steadily from 2020 (mean = 0.502) to 2024 (mean = 0.589), consistent with growing regulatory emphasis and stakeholder pressure (Wahyuningrum et al., 2025). Manufacturing firms show an upward trend in disclosure practices, though significant heterogeneity persists across sectors and individual firms.

Correlation Analysis and Diagnostic Tests

According to the Pearson correlation matrix (Table 3), environmental disclosure is positively and significantly correlated with ROA ($r = 0.378$, $p < 0.01$), supporting the main hypothesis that this is true for improving financial performance. Environmental disclosure is also positively associated with firm size ($r = 0.412$, $p < 0.01$), board independence ($r = 0.289$, $p < 0.01$), and audit committee diligence ($r = 0.356$, $p < 0.01$). There is especially a negative relationship regarding disclosure related to firm age ($r = -0.134$, $p < 0.05$), indicating that younger manufacturing firms engage in more aggressive environmental disclosure strategies, which could potentially serve to strengthen their legitimacy and distinguish them in competitive markets.

Table 3: Pearson Correlation Matrix

Variable	ROA	ED	SIZE	LEV	AGE	BID	AC	GIN
ROA	1.000							
ED	0.378**	1.000						
SIZE	0.456**	0.412**	1.000					
LEV	-0.123	-0.089	0.234*	1.000				
AGE	-0.045	-0.134*	0.567**	0.156	1.000			

BID	0.289**	0.289**	0.167*	-0.234*	-0.089	1.000		
ACD	0.345**	0.356**	0.278**	0.045	0.123	0.412**	1.000	
GIN	0.567**	0.501**	0.356**	-0.234*	-0.178*	0.234*	0.289**	1.000

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

To test the classical linear panel assumptions, diagnostic tests were performed. Instead of the basic Durbin-Watson test, the Wooldridge test for autocorrelation in panel data was conducted, yielding an $-t$ -statistic of 1.215 (), confirming the absence of first-order serial correlation. The Variance Inflation Factor (VIF) values range from 1.23 to 3.45, well below the conservative threshold of 5.0, indicating that multicollinearity does not compromise the regression model setup.

Regression Results

Table 4 presents the fixed-effects panel regression alongside the robust System GMM estimations. The model explains 42.3% of the variation in ROA ($R^2 = 0.423$), with an F-statistic of 14.567 ($p < 0.001$), indicating overall model significance.

Table 4: Panel Regression Results (Dependent Variable: ROA)

Variable	Fixed-Effects Coefficient (Std. Error)	System GMM Coefficient (Std. Error)
ROA _{t-1}	-	0.2341* (0.0712)
Environmental Disclosure (ED)	0.0876*** (0.0234)	0.0792*** (0.0211)
Firm Size	0.0045** (0.0015)	0.0039** (0.0013)
Leverage	-0.0123 (0.0089)	-0.0105 (0.0078)
Firm Age	-0.0003 (0.0002)	-0.0002 (0.0002)
Board Independence	0.0567* (0.0289)	0.0489* (0.0245)
Audit Committee Diligence	0.0089*** (0.0034)	0.0076** (0.0031)
Green Innovation Intensity	0.2456*** (0.0678)	0.2123*** (0.0594)
Diagnostics	$R^2 = 0.4234$; $F = 14.567***$	AR(1) $p = 0.012$, AR (2) $p = 0.456$; Hansen $p = 0.312$

Note: *** $p < 0.01$, ** $p < 0.005$, * $p < 0.10$. Robust standard errors in parentheses.

The fixed-effects results show that environmental disclosure is positively and statistically significantly associated with Return on Assets ($\beta = 0.0876$, $p < 0.001$). This confirms H1. Practically, this statistical association implies that firms with higher transparency levels experience minimized information asymmetries with capital providers, leading to better asset deployment efficiency. This finding agrees with Adepoju & Adeagbo (2025), who also find that environmental disclosure positively and significantly impacts firm performance. More precisely, a one-unit increase in the environmental disclosure index (on a 0-1 scale) is associated with an increase in ROA of 8.76 percentage points, holding other factors constant. This large effect size implies

that environmental transparency creates tangible value for manufacturing firms.

Firm size is strongly positively and significantly related to financial performance ($\beta = 0.0045$, $p < 0.01$), validating the argument that scale size (Kerim et al., 2026) and size-effect effects are favorable as well. Level of board independence is nearly significant ($\beta = 0.0567$, $p = 0.050$), indicating that independence of independent directors may help to lead to superior financial results, perhaps in terms of improved monitoring from an environmental and operational management aspect (Wahyuningrum et al., 2026).

Audit committee diligence, measured through the frequency of meetings, can lead to improved financial performance ($\beta = 0.0089$, $p < 0.01$), consistent with Peter et al. (2026) results that audit committees serving as “gatekeepers of the market” and quality of disclosure are stronger with strong audit committee members. Significantly higher green innovation intensity exerts a positive effect on the financial performance ($\beta = 0.2456$; $p < 0.001$), which suggests that production companies that invest in technology in the environment achieve a higher financial return (Agyemang et al., 2025).

Remarkably, firm leverage has a negative but insignificant association with ROA, indicating that debt financing does not substantially hinder the environmental disclosure or financial performance in this sample (Chang et al., 2024). The same analysis reveals a negative ($p = 0.103$) coefficient for Firm age with no statistically significant association, confirming that there is no linear correlation between the older and younger firms and the competition advantage experienced by younger firms as they pursue their environmental legitimacy aggressively.

To validate the model against reverse causality and self-selection bias, the System GMM estimator was applied. The dynamic specification confirms the validity of the instruments: the Arellano-Bond AR (2) test ($p = 0.456$) confirms the absence of second-order serial correlation in the residuals, while the Hansen *J*-test of over-identifying restrictions ($p = 0.312$) supports the instrumental validity. The lagged ROA ($\beta = 0.2341$, $p < 0.01$) highlights a strong historical persistence in the financial success of manufacturing firms.

Robustness and Additional Analyses

A system GMM model was estimated to account for possible endogeneity and dynamic relationships, yielding similar coefficient signs and magnitudes, confirming the robustness. The lagged dependent variable (ROA_{t-1}) coefficient of 0.234 ($p < 0.01$) suggests a strong persistence in financial performance, where a one-year lagged effect explains 23.4% of current performance, suggesting that sustainable financial improvement requires consistent disclosure and governance practices. The subsector analysis in Table 5 distinct sectoral variations. Environmental disclosure has a strong and statistically significant association with ROA within environmentally sensitive clusters such as chemical ($\beta = 0.1234$, $p < 0.01$) and automotive manufacturing ($\beta = 0.0945$, $p < 0.01$). For food processing, the association is statistically insignificant ($p = 0.121$). This occurs because stakeholders in the chemical and automotive fields scrutinize environmental compliance heavily, making

reporting a highly valued legitimacy signal, whereas food processing entities face higher stakeholder emphasis on immediate consumer product safety rather than environmental footprint metrics.

Table 5: Subsector Analysis - Environmental Disclosure Coefficient Estimates

Manufacturing Subsector	ED Coefficient	Std. Error	p-value	N (obs)
Chemical Manufacturing	0.1234**	0.0345	0.000	95
Automotive Manufacturing	0.0945**	0.0298	0.001	108
Metal Fabrication	0.0834**	0.0267	0.002	87
Textile Manufacturing	0.0678*	0.0345	0.049	73
Food Processing	0.0456	0.0289	0.121	62

Discussion of Findings

These findings provide a strong empirical basis for the central hypothesis: environmental disclosure improves manufacturing firms' financial performance. Several mechanisms exist for the facilitation of performance through disclosure. Firstly, greater transparency alleviates information asymmetry between management and outside parties, decreasing the cost of capital. Second, environmental disclosure attracts environmentally conscious investors and consumers, expanding market opportunities (Verma & Panwar, 2026). Disclosure-based regulation can meaningfully accelerate green transition at the firm level, and the adoption of comprehensive environmental reporting frameworks encourages large manufacturing firms to align with stricter sustainability standards. The results of this study back up this viewpoint, proving that companies that commit to the principle of clear, transparent environmental disclosure achieve superior financial outcomes.

There are various ways in which disclosure enhances performance. First, improved transparency minimizes information asymmetry between management and external stakeholders, decreasing the cost of capital (Wahyuningrum et al., 2026). Second, public environmental disclosures prompt environmentally conscious investors and consumers, expanding market opportunities (Adepoju & Adeagbo, 2025). Third, broad disclosure with true environmental investments catalyzes innovation and efficiency enhancement.

The empirical results point to green innovation capital as the predominant performance driver in the disclosure-performance link. The magnitude of investment in environmental technology has the strongest positive performance effect ($\beta = 0.2456$, $p < 0.001$), well greater than the sole effect of disclosure. Optimal manufacturing enterprises at their best incorporate three dimensions: transparency in the communication of environmental initiatives, investable investments in environmental technologies, and efficiency improvements, which together indicate genuine enterprise commitment to environmentally sustainable practices. This interpretation is consistent with Wang (2025), that excessive disclosure without changes, such as signaling overload and heightened external scrutiny, can have a damaging impact on the firm's value. Companies in manufacturing that exhibit strong financial

performance integrate environmental disclosure with credible technological investment and eco-efficiency improvements (Agyemang et al., 2025).

The sectoral heterogeneity presented in Table 5 also has significant policy implications. With heavy regulation and heavy consumer pressure, manufacturers in the chemical and automotive sectors get the largest financial benefits from environmental disclosure. The current trend indicates that environmental accountability tactics provide most advantages in industries where environmental sensitivities directly shape stakeholder and consumer choices (Wahyuningrum et al., 2026).

CONCLUSIONS AND RECOMMENDATIONS

This study answers the fundamental research question of whether transparent sustainability reporting is rewarded within emerging financial markets. Based on our analysis of 85 listed Indonesian manufacturing firms from 2020 to 2024, environmental disclosure is positively and significantly associated with accounting-based financial performance (ROA). This statistical link is primarily explained by reduced information asymmetry and enhanced stakeholder legitimacy, which help transparent firms' lower capital friction. Furthermore, this association is highly nuanced and sector-dependent, proving strongest in high-impact environments like chemical and automotive production.

Based on the empirical insights generated, several strategic pathways emerge alongside methodological boundaries that frame future inquiry. First, corporate managers should transition from treating green reporting as an isolated compliance task and instead integrate environmental disclosure metrics directly into corporate strategic planning and capital budgeting decisions. This integration ensures that external signaling is fully supported by demonstrable operational improvements, thereby neutralizing greenwashing vulnerabilities and mitigating adverse selection in capital markets. Concurrently, capital market regulators—such as the OJK and the Ministry of Environment—should mandate independent third-party assurance protocols for sustainability reports under POJK No. 51 of 2017, initially prioritizing carbon and waste intensity metrics within high-impact industrial sectors to safeguard information quality. Investors must likewise exercise due diligence by cross-verifying volume-based disclosures with tangible regulatory performance benchmarks, such as PROPER ratings, rather than accepting disclosure quantity as an automatic proxy for sustainability.

Nevertheless, these actionable steps must be interpreted within the context of specific study limitations that lay the groundwork for future research. Although a robust System GMM framework was implemented to mitigate endogeneity, the inherent potential for reverse causality remains a limitation, as firms with higher baseline profitability may naturally possess greater resources to dedicate to environmental reporting; future inquiries should therefore deploy quasi-experimental designs or analyze natural regulatory shocks to better isolate directional pathways. Additionally, this study relies exclusively on Return on Assets (ROA) as an historical, accounting-based indicator of financial performance, which may fail to capture forward-

looking market sentiment. Future researchers are encouraged to expand this framework by incorporating market-based parameters like Tobin's Q or the implied cost of equity capital, while also broadening the sample scope beyond listed firms to evaluate how small and medium-sized enterprises (SMEs) navigate the reporting-performance nexus across Southeast Asia.

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