



Scripta Economica: Journal of Economics, Management, and Accounting

Vol 2 No 2 November 2026, Hal 01-24
ISSN: 3110-0848 (Print) ISSN: 3109-970X (Electronic)
Open Access: <https://scriptaintelektual.com/scripta-economica>

Corporate Greenwashing: The Discrepancy Between ESG Narratives, Environmental Performance, and Debt Costs of Indonesian Issuers

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Article Info :

Received:

14-09-2026

Revised:

28-09-2025

Accepted:

14-10-2026

Abstract

This study investigates corporate greenwashing as a disclosure–performance gap between environmental narratives and externally observable environmental outcomes among environmentally sensitive non-financial firms listed on the Indonesia Stock Exchange during 2019–2024. The research integrates corporate textual analysis, PROPER-based environmental performance assessment, sustainability assurance, audit quality, and debt-financing considerations within a longitudinal framework. Environmental narratives are evaluated through disclosure intensity, positive tone, aspirational language, quantitative specificity, vagueness, readability, and target completeness, while environmental performance is benchmarked primarily using PROPER ratings. The results show that PROPER-rated entities increased from 2,012 to 4,290 during the observation period, whereas the proportion rated Blue or better declined from 84.84% to 69.02%. The combined Red and Black share increased from 15.16% to 30.98%, while the weighted environmental-performance score decreased from 2.960 to 2.779. These findings demonstrate substantial divergence between the expansion of environmental monitoring and substantive environmental performance. The study contributes by developing a Greenwashing GAP Index that distinguishes extensive environmental communication supported by strong performance from disproportionately favorable narratives and provides a framework for examining their implications for subsequent corporate borrowing costs.

Keywords: Cost of debt, ESG disclosure, Greenwashing, PROPER, Sustainability assurance.



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INTRODUCTION

Environmental, social, and governance (ESG) considerations have become increasingly embedded in corporate reporting, investment assessment, and credit-risk evaluation. Firms are consequently under growing pressure to demonstrate environmental responsibility through sustainability reports, annual reports, climate commitments, and other forms of non-financial disclosure. Nevertheless, the expansion of ESG communication has not necessarily produced a corresponding improvement in the reliability or comparability of information available to market participants. Substantial divergence among ESG ratings demonstrates that apparently similar sustainability attributes may be interpreted differently across measurement systems, creating uncertainty regarding the extent to which disclosed ESG credentials reflect underlying corporate performance (Berg et al., 2022; Christensen et al., 2022). This development has shifted the research agenda from asking whether firms disclose sustainability information toward examining whether the substance of such disclosure is commensurate with observable environmental outcomes.

This distinction is particularly consequential in the context of corporate greenwashing. Contemporary research increasingly conceptualizes greenwashing not simply as the presence of misleading environmental statements, but as a systematic discrepancy between the environmental image projected through corporate communication and the environmental performance observable through operational or external indicators. Empirical evidence indicates that firms may selectively emphasize favorable climate information, employ aspirational language, or foreground environmental

commitments while providing comparatively limited information on measurable achievements or unfavorable outcomes (Bingler et al., 2022, 2024; Mateo-Márquez et al., 2022). Related studies show that sustainability reporting can become strategically decoupled from substantive corporate behavior, thereby allowing disclosure to function as a reputational instrument rather than a transparent representation of performance (Liu et al., 2024; Xu et al., 2023). Accordingly, the analytical problem is no longer merely the quantity of environmental disclosure, but the degree of correspondence between corporate narratives and verifiable environmental performance.

The growing importance of this distinction is reinforced by recent evidence linking greenwashing to carbon emissions, corporate value, reputational exposure, and broader ESG credibility. Treepongkaruna et al. (2024), for example, demonstrate the relevance of examining greenwashing alongside carbon emissions and ESG characteristics, while Zhou et al. (2024) show that environmental disclosure greenwashing can alter the economic valuation of environmental information. The literature also increasingly recognizes the conceptual transition from narrowly defined environmental greenwashing toward broader forms of ESG-washing in which symbolic sustainability narratives may coexist with weaker substantive outcomes (Todaro & Torelli, 2024). Systematic and bibliometric assessments similarly indicate that greenwashing has become a rapidly expanding research domain at the intersection of sustainability reporting, corporate governance, accountability, and capital-market consequences (Sundarasan et al., 2024; Zioło et al., 2024). Yet the empirical measurement of greenwashing remains challenging because corporate communication and environmental performance are often observed through different information systems.

This challenge is particularly pronounced in emerging markets, where sustainability disclosure quality, enforcement capacity, information intermediaries, and environmental performance monitoring may differ substantially from those in developed economies. Existing evidence indicates that environmental and ESG performance may have financing implications in emerging-market settings, including through firms' access to debt and their financing costs (Temiz, 2022; Uyar et al., 2024). At the same time, disclosure itself may generate economic consequences independent of actual environmental performance, creating a potential distinction between the financial value of substantive sustainability and the financial value of sustainability narratives. Studies of pollution-intensive firms further indicate that environmental and social policies can affect creditors' assessment of financing risk (Li et al., 2022). These findings raise a critical question: when corporate environmental narratives exceed the level justified by observable environmental performance, do creditors reward the sustainability image or penalize the credibility gap?

The cost of debt provides a particularly relevant setting in which to examine this question. Creditors are exposed to downside risk and therefore have strong incentives to evaluate information that may affect cash-flow stability, regulatory exposure, litigation risk, reputation, and long-term operating viability. A growing body of evidence documents significant associations between ESG performance and debt financing costs, although the direction and magnitude of such relationships vary across institutional settings, ESG dimensions, and measurement approaches (Apergis et al., 2022; Gigante & Manglaviti, 2022). Similar findings have been reported for Indian firms, Asia-Pacific corporations, and bond markets, suggesting that creditors increasingly incorporate environmental or ESG information into pricing decisions (Al Rabab'a et al., 2023; Arora & Sharma, 2022; Lian et al., 2023). Corporate climate actions may likewise be reflected in debt pricing, indicating that environmental performance can have economically meaningful consequences beyond equity-market valuation (Ali et al., 2023).

More recent research has extended this debate from general ESG performance toward disclosure quality, ESG disadvantages, rating divergence, and organizational characteristics that influence the credibility of sustainability information. Alves and Meneses (2024) document the importance of ESG scores for debt costs while emphasizing the relevance of leverage, agency considerations, and financial-system characteristics. Mathath et al. (2024) and You et al. (2025) further demonstrate that ESG disclosure and disclosure quality can affect the cost of debt, whereas Zhang et al. (2024) show that ESG competitive disadvantages can translate into financing consequences. Rating disagreement itself may also matter because inconsistent sustainability assessments increase information uncertainty for creditors (Zhang et al., 2025). Collectively, these studies establish the relevance of ESG information to debt pricing but leave unresolved whether

creditors respond to environmental communication itself or to the consistency between communication and underlying environmental performance.

Indonesia offers a particularly suitable institutional setting for addressing this unresolved issue. The country combines rapidly developing sustainability-reporting practices with substantial exposure to environmentally intensive industries, including energy, basic materials, industrial production, transportation, plantations, and resource-based activities. Recent evidence suggests that mandatory sustainability reporting has affected the quality of environmental disclosure in Indonesia, although regulatory reporting requirements alone do not eliminate concerns regarding substantive credibility (Sri Wahyuningrum et al., 2025). Indonesian evidence also indicates that corporate social responsibility disclosure can influence the cost of debt and that ownership characteristics may condition this relationship (Sari et al., 2024). At the regional level, ESG scores have been shown to affect debt costs across ASEAN economies, providing further evidence that creditors operating in Southeast Asian capital markets are increasingly attentive to ESG-related information (Ariefianto et al., 2025).

A distinctive feature of the Indonesian setting is the availability of the Corporate Performance Rating Program in Environmental Management (PROPER), which provides an external assessment of environmental performance. Unlike disclosure indices constructed exclusively from corporate reports, PROPER can serve as an independent benchmark against which environmental narratives are evaluated. This makes it possible to distinguish companies that communicate extensively because they actually perform well from those whose environmental narratives appear disproportionately favorable relative to observable environmental outcomes. Such a design addresses an important limitation of conventional disclosure research in which extensive environmental reporting is frequently treated as evidence of stronger sustainability performance. It also enables a more defensible operationalization of a *potential greenwashing signal* without presuming intentional deception or legally actionable misconduct.

The Indonesian context is also relevant because corporate sustainability strategies may interact with broader organizational incentives. Nasih et al. (2024), for instance, demonstrate that sustainability reporting may coexist with corporate strategies whose substantive alignment with sustainability objectives deserves closer scrutiny. More broadly, the literature suggests that environmental disclosure, actual environmental performance, and managerial incentives should not be treated as interchangeable constructs (Zheng & Shen, 2024). Therefore, examining the difference between environmental claims and externally observable performance offers a more analytically precise approach than evaluating disclosure intensity alone. This perspective is particularly important when the economic consequence under examination is the cost of debt, because creditors are expected to price both environmental risk and information credibility.

The present study therefore investigates the relationship among corporate environmental narratives, actual environmental performance, potential greenwashing signals, and the cost of debt among environmentally sensitive non-financial firms listed on the Indonesia Stock Exchange during 2019–2024. The study constructs a textual measure of environmental narratives from Indonesian-language annual and sustainability reports and compares the resulting narrative score with external environmental performance, with PROPER serving as the primary benchmark. A *Greenwashing GAP Index* is subsequently derived from the positive residual of a model predicting the expected level of environmental narrative from actual environmental performance and relevant firm characteristics. The index does not constitute evidence that a firm has intentionally engaged in deception; rather, it identifies an unusually large *disclosure–performance gap* that is empirically consistent with a potential greenwashing signal. The study then examines whether this gap predicts the firm's cost of debt in the subsequent year.

This research makes several contributions. First, it moves beyond conventional ESG disclosure indices by explicitly separating environmental communication from environmental performance. Second, it develops a textual measurement framework for Indonesian corporate reports that incorporates environmental disclosure intensity, positive tone, aspirational language, quantitative specificity, vagueness, readability, and the completeness of environmental targets. Third, it integrates corporate textual analysis with an external environmental-performance benchmark rather than relying exclusively on self-reported sustainability information. Fourth, it connects the disclosure–performance gap to a real financing consequence the subsequent cost of debt thereby extending the economic-

consequences literature on ESG reporting. Finally, the study evaluates whether external sustainability assurance and audit quality mitigate the financing implications of potential greenwashing, contributing to the growing literature on assurance as a credibility-enhancing governance mechanism (Darsono et al., 2025; Hazaea et al., 2022).

RESEARCH METHOD

Research Design, Population, and Sample

This study employs a quantitative longitudinal research design that integrates corporate textual analysis, external environmental-performance assessment, and panel-data econometrics. The unit of analysis is the firm-year observation. The study focuses on non-financial companies listed on the Indonesia Stock Exchange (IDX) operating in industries with relatively substantial environmental exposure. The observation period for environmental disclosure and environmental performance covers 2019–2024, while financial information is extended to 2025 where necessary to calculate the subsequent-year cost of debt. This temporal structure enables environmental narratives and environmental performance observed in year t to be linked to financing consequences in year $t+1$.

The sampling frame prioritizes firms operating in energy, basic materials, industrials, transportation, plantations, and other resource-intensive industries. Financial institutions are excluded because their liability structures, interest expenses, regulatory capital requirements, and funding mechanisms differ materially from those of non-financial corporations. An observation is included when the corresponding annual report, audited financial statements, environmental narrative, and environmental-performance information can be reliably identified. Sustainability reports are additionally incorporated whenever companies issue them separately from annual reports. The study targets approximately 50–100 listed companies and at least 250 firm-year observations, although an unbalanced panel is permitted to avoid unnecessary loss of otherwise usable firm-year data.

The empirical dataset combines four principal information sources. First, annual reports and sustainability reports provide the textual information used to construct corporate environmental narrative indicators. Second, audited financial statements provide interest expenses, interest-bearing liabilities, and firm-level financial controls. Third, official PROPER data provide an externally generated assessment of environmental performance. Fourth, corporate reports and assurance statements are examined to identify external sustainability assurance and financial audit characteristics.

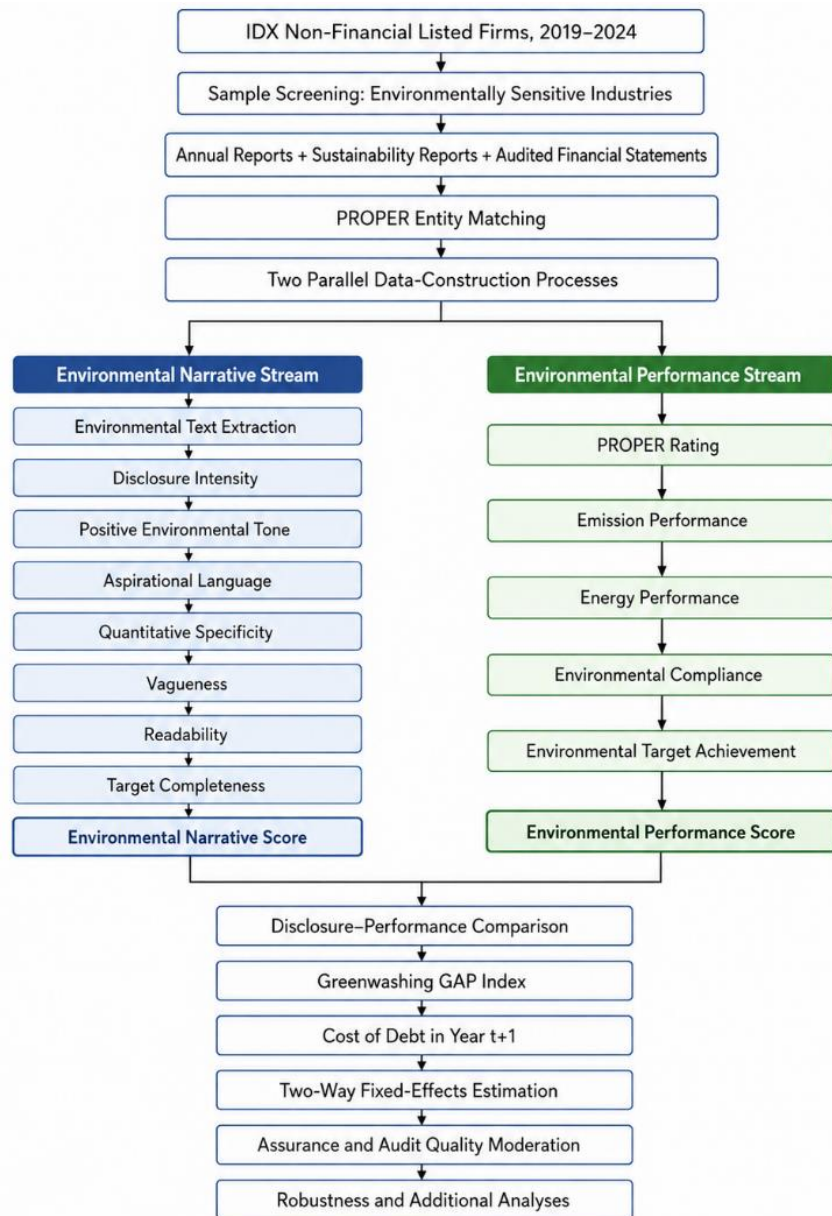


Figure 1. Research Design and Analytical Flow

Corporate–PROPER Entity Matching

A critical stage of the empirical procedure is the reconciliation of IDX-listed issuers with entities assessed under the Indonesian Corporate Performance Rating Program in Environmental Management, commonly referred to as PROPER. PROPER participants do not necessarily correspond directly to the listed parent company. Environmental assessments may instead relate to subsidiaries, production facilities, mining sites, plantations, factories, power plants, or other operating units. Consequently, two entities are not treated as equivalent merely because their corporate names are lexically similar.

A structured entity-resolution protocol is therefore applied. For every potential match, the database records the listed issuer name, ticker code, subsidiary or operating-unit name, ownership relationship, operational location, PROPER participant name, PROPER rating, and documentary evidence supporting the match. Corporate annual reports, subsidiary ownership disclosures, facility descriptions, and official PROPER documentation are cross-checked before an environmental rating is attributed to the publicly listed company.

Where a listed company controls multiple PROPER-rated facilities during the same year, the principal environmental-performance measure is based on the average score across all verified

facilities. This procedure reduces the possibility of selecting only the most favorable environmental rating. Alternative specifications using the minimum facility score, maximum facility score, and categorical PROPER measures are subsequently employed as robustness tests.

Environmental Narrative Extraction and Textual Analysis

Environmental narratives are extracted from corporate annual and sustainability reports through a predefined environmental taxonomy. Relevant passages include discussions of greenhouse-gas emissions, energy consumption and efficiency, waste management, water use, biodiversity, environmental compliance, environmental penalties, resource efficiency, environmental investment, climate commitments, net-zero objectives, emission-reduction targets, and reported achievement of environmental goals.

Text preprocessing preserves sentence structure, numbers, measurement units, percentages, dates, baseline years, target years, and negation because these linguistic components are necessary for distinguishing measurable environmental information from generalized promotional statements. Repeated headers, tables of contents, mechanically duplicated passages, irrelevant legal disclaimers, and other non-substantive textual elements are removed before analysis.

Rather than measuring sustainability reporting solely through disclosure volume, this study constructs a multidimensional environmental narrative measure. This approach is consistent with recent evidence showing that extensive environmental communication may coexist with selective disclosure, aspirational language, or limited correspondence with actual environmental outcomes (Bingler et al., 2022, 2024).

Table 1. Environmental Textual Features and Measurement

Textual Dimension	Code	Operational Measurement
Environmental Disclosure Intensity	EDI	Number of environmentally relevant sentences divided by total substantive sentences
Positive Environmental Tone	PET	Proportion of environmental sentences containing positive achievement-, improvement-, efficiency-, or commitment-oriented language
Aspirational Language	ASP	Proportion of forward-looking environmental claims referring to commitments, ambitions, plans, or future targets without contemporaneous evidence of achievement
Quantitative Specificity	QS	Proportion of environmental sentences containing numerical values, percentages, measurement units, baseline years, target dates, or measurable outcomes
Vagueness	VAG	Proportion of generalized environmental statements without measurable indicators, baselines, deadlines, or verifiable outcomes
Readability	READ	Sentence-level linguistic complexity based primarily on sentence length and related structural characteristics
Target Completeness	TC	Degree to which environmental targets contain a baseline, measurable objective, target date, and reported progress or achievement

The Environmental Narrative Score (NARR) is constructed from standardized textual indicators. Before aggregation, the indicators are directionally aligned so that the resulting score captures the intensity of favorable or promotional environmental communication relative to substantive specificity. Environmental disclosure intensity, positive environmental tone, aspirational language, and vagueness contribute positively to the promotional dimension, whereas quantitative specificity and target completeness are directionally adjusted when constructing the discrepancy-oriented narrative score.

Principal component analysis is employed as the primary data-driven aggregation procedure when the empirical factor structure is adequate. An equal-weight standardized composite index is also

calculated as an alternative specification to ensure that the principal results are not mechanically determined by a particular weighting method.

Manual Validation of Textual Classification

The automated textual-classification procedure is validated using approximately 10–15% of the analyzed corporate documents. The validation sample is selected to represent different sectors, observation years, disclosure intensities, report formats, and reporting practices.

Two independent coders manually classify environmental sentences using an identical coding protocol. The coding guidelines distinguish environmental content, positive tone, aspirational claims, measurable environmental information, vague statements, and complete environmental targets. Initial coding is conducted independently before disagreements are discussed.

Inter-coder agreement is subsequently evaluated using an appropriate reliability statistic. The automated classification is further assessed using precision, recall, and F1-score.

Precision is calculated as:

$$\text{Precision} = \text{True Positive} / (\text{True Positive} + \text{False Positive})$$

Recall is calculated as:

$$\text{Recall} = \text{True Positive} / (\text{True Positive} + \text{False Negative})$$

F1-score is calculated as:

$$F1 = 2 \times [(\text{Precision} \times \text{Recall}) / (\text{Precision} + \text{Recall})]$$

The environmental dictionary, phrase classification rules, coding protocol, and validation results are documented to support replicability. Importantly, the subsequent cost of debt is not used during dictionary construction or textual-classification development, thereby reducing the risk that the textual measure is mechanically optimized toward the expected financial outcome.

Environmental Performance Measurement

The principal measure of environmental performance is constructed from official PROPER ratings. The ordinal categories are transformed into numerical values as follows:

Black = 1

Red = 2

Blue = 3

Green = 4

Gold = 5

Accordingly, higher scores indicate stronger externally assessed environmental performance.

Where consistently available, the PROPER measure is supplemented with additional environmental indicators, including greenhouse-gas emission intensity, changes in energy consumption or energy intensity, environmental penalties or compliance incidents, and achievement of measurable environmental targets.

An expanded Environmental Performance Score (ENVPERF) can therefore incorporate:

$$\text{ENVPERF} = f(\text{PROPER}, \text{Emissions}, \text{Energy Performance}, \text{Environmental Compliance}, \text{Target Achievement})$$

The expanded index is treated as a supplementary specification rather than a substitute for the principal PROPER measure because several additional environmental indicators remain dependent on voluntary corporate disclosure.

Missing information is not automatically coded as zero. The database explicitly distinguishes between a genuine numerical value of zero, confirmation that no environmental incident occurred, and information that was unavailable or not disclosed. This distinction prevents companies with limited disclosure from being incorrectly classified as having superior environmental performance.

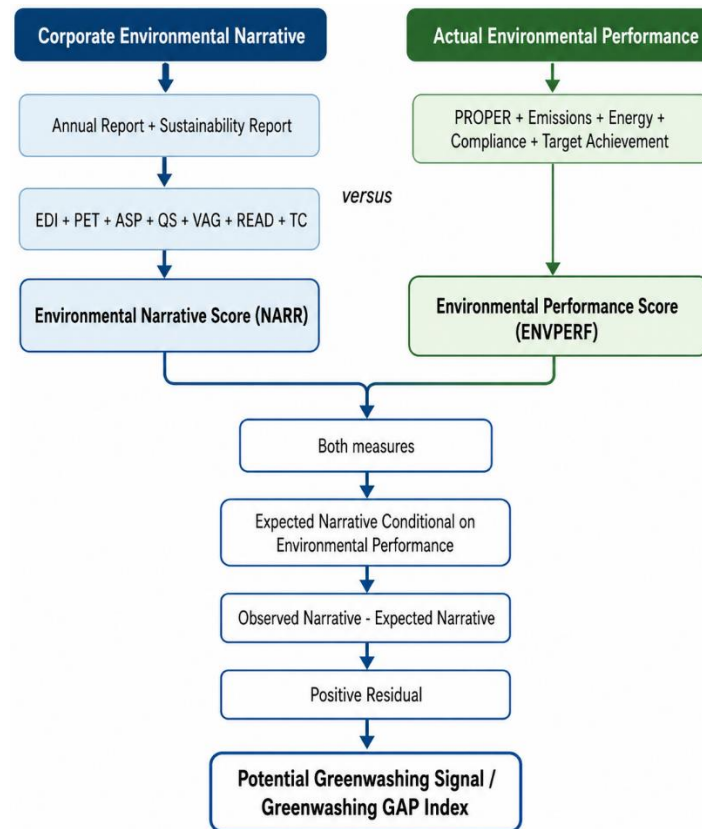


Figure 2. Construction of the Disclosure-Performance Gap

Construction of the Greenwashing GAP Index

The principal explanatory variable captures the discrepancy between a company's environmental narrative and the environmental performance that would reasonably be expected to support that narrative. Greenwashing is therefore not inferred merely from a high level of disclosure.

The expected environmental narrative is estimated using the following model:

$$NARR_{i,t} = \alpha + \beta_1 ENVPERF_{i,t} + \beta_2 SIZE_{i,t} + \text{Industry FE} + \text{Year FE} + \varepsilon_{i,t}$$

where:

$NARR_{i,t}$ = Environmental Narrative Score of firm i in year t ;

$ENVPERF_{i,t}$ = environmental-performance measure;

$SIZE_{i,t}$ = firm size;

Industry FE = industry fixed effects;

Year FE = year fixed effects; and

$\varepsilon_{i,t}$ = unexplained component of the environmental narrative.

The residual captures the component of the environmental narrative that cannot be explained by observable environmental performance, company size, industry characteristics, and common annual reporting conditions.

The principal Greenwashing GAP Index is constructed as:

$$GWGAP_{i,t} = \max(0, \hat{\varepsilon}_{i,t})$$

A larger positive residual therefore indicates that the observed environmental narrative is substantially stronger than would be predicted by the company's externally observable environmental performance.

The measure is interpreted exclusively as a potential greenwashing signal or disclosure-performance gap. It does not establish deliberate deception, fraudulent reporting, or legal wrongdoing by any individual company.

As an alternative measure, the study employs the standardized difference between the narrative and environmental-performance scores:

$$ZGAP_{i,t} = Z(NARR_{i,t}) - Z(ENVPERF_{i,t})$$

The residual-based measure constitutes the principal specification, while ZGAP is used to assess the robustness of the results to alternative greenwashing measurement.

Cost of Debt and Moderating Variables

The principal dependent variable is the subsequent cost of interest-bearing debt. Cost of debt is measured using interest expense relative to average interest-bearing liabilities:

$$COD_{i,t+1} = \text{Interest Expense}_{i,t+1} / [(\text{Interest-Bearing Debt}_{i,t} + \text{Interest-Bearing Debt}_{i,t+1}) / 2]$$

where $COD_{i,t+1}$ represents the cost of debt of firm i in the subsequent financial year.

Interest-bearing debt comprises short-term and long-term financial obligations that explicitly generate interest expenses. Trade payables and other non-interest-bearing operating liabilities are excluded whenever they can be separately identified. Firm-years without a meaningful interest-bearing debt denominator are excluded rather than mechanically assigned a zero cost of debt.

The one-year-ahead specification is preferred because it provides a stronger temporal ordering between the disclosure–performance gap and subsequent financing conditions. Existing evidence indicates that environmental performance, carbon performance, ESG scores, and disclosure quality may influence debt pricing (Al Rabab’a et al., 2023; Apergis et al., 2022; Ariefianto et al., 2025; You et al., 2025).

External Sustainability Assurance (ASSURE) is measured as a binary variable equal to 1 when environmental or sustainability information is subject to identifiable independent external assurance and 0 otherwise. External verification is expected to function as a credibility mechanism by reducing uncertainty surrounding sustainability information (Darsono et al., 2025; Hazaea et al., 2022).

Audit Quality (AUDITQ) is primarily measured using an indicator equal to 1 when the company's financial statements are audited by a Big Four affiliated audit firm and 0 otherwise. Sustainability assurance and financial audit quality are maintained as distinct variables because they represent different monitoring mechanisms.

Control Variables

The models incorporate several firm characteristics that may independently affect corporate borrowing costs. Firm Size (SIZE) is measured using the natural logarithm of total assets. Leverage (LEV) is measured as interest-bearing debt relative to total assets. Profitability (ROA) is calculated as net income divided by average total assets. Liquidity (LIQ) is represented by the current ratio.

Tangibility (TANG) represents tangible fixed assets relative to total assets. Sales Growth (GROWTH) is measured as the annual percentage change in sales. Firm Age (AGE) is represented by the natural logarithm of firm age. Institutional Ownership (INST) represents institutional shareholding relative to total outstanding shares. Earnings Volatility (EVOL) captures variation in accounting earnings over a predetermined historical window.

Table 2. Definition and Measurement of Research Variables

Variable	Symbol	Measurement
Subsequent Cost of Debt	COD(t+1)	Interest expense in t+1 divided by average interest-bearing debt
Greenwashing Index	GAP GWGAP	Positive residual from the environmental-narrative prediction model
Alternative Greenwashing Gap	ZGAP	Standardized narrative score minus standardized environmental-performance score
Environmental Narrative	NARR	Composite score generated from environmental textual

Variable	Symbol	Measurement
Score		indicators
Environmental Performance	ENVPERF	PROPER-based environmental-performance score; expanded measure used as robustness
Sustainability Assurance	ASSURE	1 = externally assured sustainability report; 0 = otherwise
Audit Quality	AUDITQ	1 = Big Four affiliated auditor; 0 = otherwise
Firm Size	SIZE	Natural logarithm of total assets
Leverage	LEV	Interest-bearing debt / total assets
Profitability	ROA	Net income / average total assets
Liquidity	LIQ	Current assets / current liabilities
Tangibility	TANG	Tangible fixed assets / total assets
Sales Growth	GROWTH	Annual percentage change in sales
Firm Age	AGE	Natural logarithm of company age
Institutional Ownership	INST	Institutional shareholding / outstanding shares
Earnings Volatility	EVOL	Rolling variability of accounting earnings

Continuous financial variables are winsorized at the 1st and 99th percentiles where appropriate to limit the influence of extreme accounting observations.

Empirical Model

The relationship between the potential greenwashing signal and the subsequent cost of debt is estimated using a two-way fixed-effects panel model.

The baseline model is specified as:

$$COD_{i,t+1} = \alpha + \beta_1 GWGAP_{i,t} + \sum \gamma_k CONTROL_{k,i,t} + \mu_i + \delta_t + \varepsilon_{i,t}$$

where:

- $COD_{i,t+1}$ = subsequent cost of debt;
- $GWGAP_{i,t}$ = Greenwashing GAP Index;
- $CONTROL_{k,i,t}$ = vector of firm-level control variables;
- μ_i = firm fixed effects;
- δ_t = year fixed effects; and
- $\varepsilon_{i,t}$ = regression disturbance term.

Standard errors are clustered at the firm level to account for serial correlation within individual companies.

The sign of β_1 is interpreted according to the competing mechanisms established in the Introduction. A significantly negative coefficient is consistent with a narrative discount, indicating that disproportionately favorable environmental communication is associated with lower subsequent borrowing costs. A significantly positive coefficient is consistent with a credibility penalty, indicating that creditors demand a higher financing premium when environmental narratives substantially exceed observable environmental performance.

The moderating role of external sustainability assurance is estimated as:

$$COD_{i,t+1} = \alpha + \beta_1 GWGAP_{i,t} + \beta_2 ASSURE_{i,t} + \beta_3 (GWGAP_{i,t} \times ASSURE_{i,t}) + \sum \gamma_k CONTROL_{k,i,t} + \mu_i + \delta_t + \varepsilon_{i,t}$$

The moderating role of audit quality is estimated as:

$$COD_{i,t+1} = \alpha + \beta_1 GWGAP_{i,t} + \beta_2 AUDITQ_{i,t} + \beta_3 (GWGAP_{i,t} \times AUDITQ_{i,t}) + \sum \gamma_k CONTROL_{k,i,t} + \mu_i + \delta_t + \varepsilon_{i,t}$$

The interaction coefficients indicate whether stronger external monitoring modifies the financing consequences of a disclosure–performance gap.

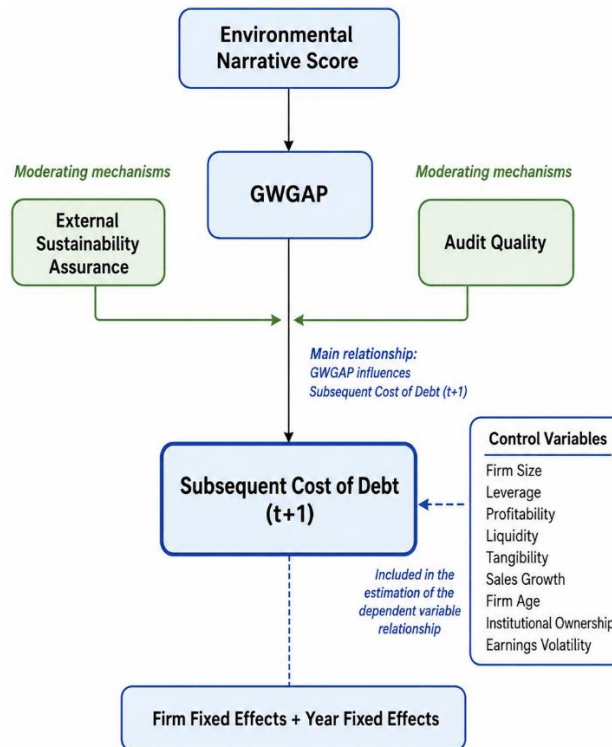


Figure 3. Empirical Model of the Disclosure–Performance Gap and Cost of Debt

Robustness and Additional Analyses

Several robustness procedures are implemented to evaluate whether the principal findings depend on specific measurement or estimation choices. First, alternative numerical mappings and aggregation procedures are applied to PROPER ratings. The analysis is repeated using average, minimum, and maximum facility-level ratings where issuers are associated with multiple verified facilities.

Second, the potential greenwashing variable is reconstructed using several alternative approaches, including the raw residual, positive residual, standardized narrative–performance difference, and expanded environmental–performance measures. This procedure evaluates whether the empirical findings are dependent on a single operationalization of the disclosure–performance gap.

Third, both contemporaneous and subsequent-year cost-of-debt models are estimated. The t+1 specification remains the principal model because it provides clearer temporal ordering, while the contemporaneous specification is treated as a sensitivity analysis.

Fourth, industry-year fixed effects are incorporated to account for industry-specific shocks, regulatory developments, and reporting trends. Fifth, the models are re-estimated after excluding firms without standalone sustainability reports to determine whether differences in report format materially affect textual measurement.

Sixth, entropy balancing or propensity-score weighting is applied as an additional procedure to improve observable covariate comparability between firm-years characterized by relatively high and low disclosure–performance gaps. These procedures complement rather than replace the fixed-effects model.

Seventh, nonlinear specifications are estimated to examine whether financing consequences emerge primarily at extreme levels of the disclosure–performance gap. Eighth, the analysis is repeated using only strictly environmental narratives and excluding broader social and governance terminology.

Finally, a placebo analysis applies a comparable textual approach to social-disclosure sections that do not have a direct conceptual relationship with PROPER. If the main environmental disclosure–performance gap exhibits substantially stronger financing consequences than the placebo measure,

this provides additional evidence that the principal findings are not simply capturing a general tendency toward expansive corporate communication.

All stages of document retrieval, corporate–PROPER matching, environmental text extraction, dictionary construction, manual coding, variable construction, and statistical estimation are documented in a reproducible research protocol. The Indonesian environmental dictionary, coding guide, entity-matching file, variable-construction rules, and analytical scripts are maintained as supplementary research materials.

RESULTS AND DISCUSSION

Environmental Performance Profile During the 2019–2024 Observation Window

The environmental-performance environment surrounding Indonesian listed firms changed materially over the observation period. Official PROPER data show that the number of entities receiving one of the five environmental-performance ratings increased from 2,012 in the 2018–2019 assessment cycle to 4,290 in 2023–2024. Across the six assessment cycles corresponding to the study period, the five published rating categories generated 17,495 rated entity-period observations. This expansion is important for the present study because it substantially increases the availability of externally assessed environmental information that can potentially be reconciled with listed issuers, subsidiaries, and operating facilities. The expansion of PROPER therefore strengthens the empirical feasibility of using external environmental performance rather than relying exclusively on self-reported sustainability information.

Table 3. Distribution of PROPER Environmental Ratings, 2019–2024

PROPER Period	Black	Red	Blue	Green	Gold	Rated Entities	Blue-or-Better (%)	Green/Gold (%)	Weighted ENVPERF
2018–2019	2	303	1,507	174	26	2,012	84.84	9.94	2.960
2019–2020	2	233	1,629	125	32	2,021	88.37	7.77	2.976
2020–2021	0	645	1,670	186	47	2,548	74.69	9.14	2.857
2021–2022	2	887	2,031	170	51	3,141	71.70	7.04	2.803
2022–2023	0	1,077	2,131	196	79	3,483	69.08	7.90	2.792
2023–2024	16	1,313	2,649	227	85	4,290	69.02	7.27	2.779

Note: Weighted ENVPERF is calculated using the scoring structure specified in the research method: Black = 1, Red = 2, Blue = 3, Green = 4, and Gold = 5. The denominator includes only entities assigned one of the five published PROPER ratings. Entities subject to enforcement, suspension, non-operation, or other unranked classifications are excluded from the weighted-score calculation. For 2022–2023, the official summary does not report a separate Black category; the published five-category calculation therefore assigns zero observations to Black.

The numerical distribution reveals an important distinction between growth in the absolute number of environmentally superior firms and deterioration in the relative environmental-performance distribution. The number of Gold-rated entities increased from 26 in 2018–2019 to 85 in 2023–2024, an increase of 226.92%. Green-rated entities similarly increased from 174 to 227. However, the combined proportion of Green and Gold entities declined from 9.94% to 7.27% because the overall PROPER population expanded considerably faster. Thus, the increasing absolute number of high-performing firms should not be interpreted as evidence that the environmental-performance distribution improved proportionately.

A more pronounced pattern appears at the lower end of the rating distribution. Red and Black ratings accounted for 15.16% of rated entities in 2018–2019 but 30.98% in 2023–2024, representing an increase of 15.82 percentage points. At the same time, the proportion of entities rated Blue or better declined from 84.84% to 69.02%. The weighted environmental-performance score constructed according to the study's five-point ENVPERF scale consequently declined from 2.960 to 2.779, equivalent to a reduction of approximately 6.11%. These results indicate that expansion in

environmental monitoring was accompanied by greater dispersion toward weaker externally assessed performance rather than a uniform shift toward superior performance.

The decline should nevertheless be interpreted carefully. The number of rated entities more than doubled, rising by 113.22% between the first and last observation cycles. The official 2022–2023 PROPER report itself notes that the inclusion of firms participating in PROPER for the first time contributed to the recorded level of non-compliance. Consequently, part of the aggregate decline may represent broader regulatory coverage and the entry of previously unassessed firms rather than a pure deterioration in the environmental performance of incumbent firms. This feature reinforces the methodological importance of firm fixed effects in the subsequent issuer-level analysis because cross-sectional changes in the monitored population should not be conflated with within-firm environmental deterioration.

Trend Diagnostics of the External Environmental Benchmark

To assess whether the observed changes represent systematic movement rather than isolated annual fluctuations, a descriptive linear trend was estimated across the six PROPER periods. These trend regressions are not substitutes for the principal firm-level two-way fixed-effects model; rather, they provide a numerical diagnostic of the external environmental-performance environment within which corporate narratives were produced.

Table 4. Descriptive Trend Diagnostics for PROPER, 2019–2024

Indicator	Trend Coefficient per Period	R ²	p-Value	Direction
Number of rated entities	+467.686	0.954	0.0008	Increasing
Blue-or-better share	−3.999 percentage points	0.805	0.0153	Decreasing
Red/Black share	+3.999 percentage points	0.805	0.0153	Increasing
Green/Gold share	−0.430 percentage points	0.507	0.1126	No statistically reliable trend
Weighted ENVPERF	−0.0432	0.861	0.0076	Decreasing

The strongest trend concerns the scale of environmental monitoring. The number of rated entities increased by approximately 467.7 entities per assessment cycle, with an R² of 0.954 and a p-value below 0.001. The environmental-performance distribution moved in the opposite direction. The Blue-or-better share decreased by approximately 4.00 percentage points per cycle ($p = 0.015$), while the combined Red/Black share increased at the same rate. The weighted ENVPERF score declined by approximately 0.043 points per cycle, and the trend was statistically distinguishable from zero at conventional levels ($p = 0.0076$).

The correlation structure produces the same descriptive pattern. The correlation between the number of rated entities and weighted ENVPERF is -0.912 ($p = 0.011$), whereas the correlation between PROPER coverage and the Blue-or-better share is -0.885 ($p = 0.019$). These associations should not be interpreted causally because they are based on only six aggregate assessment periods. They nevertheless demonstrate that the study period coincided with simultaneous expansion in regulatory observation and increased representation of weaker environmental outcomes.

Table 5. Change in Key Environmental-Performance Indicators

Indicator	2018–2019	2023–2024	Change
Rated entities	2,012	4,290	+113.22%
Gold-rated entities	26	85	+226.92%
Blue-or-better share	84.84%	69.02%	−15.82 pp
Green/Gold share	9.94%	7.27%	−2.67 pp
Red/Black share	15.16%	30.98%	+15.82 pp
Weighted ENVPERF	2.960	2.779	−0.181 (−6.11%)

The coexistence of increasing Gold counts and a declining weighted environmental score is particularly relevant to the greenwashing construct developed in this study. Aggregate sustainability progress cannot be inferred from highly visible examples of superior performance alone. A reporting environment may simultaneously produce a growing number of environmental leaders and a larger population of firms with comparatively weak environmental performance. This heterogeneity makes it methodologically inappropriate to treat extensive ESG reporting as a direct proxy for substantive environmental achievement.

Environmental Performance and the Disclosure–Performance Gap

The PROPER distribution provides a substantive basis for the study's central distinction between corporate environmental narratives and externally observable environmental performance. During the observation period, weighted environmental performance remained close to the Blue threshold but declined from 2.960 to 2.779. A mean close to three indicates that the typical externally rated entity is concentrated around regulatory compliance rather than consistently exceeding regulatory requirements. At the same time, the substantial and increasing proportion of Red and Black observations demonstrates that weak environmental outcomes remain economically relevant within the population from which environmentally sensitive listed issuers and their subsidiaries are drawn.

This empirical pattern has direct implications for the construction of NARR and GWGAP. If a firm associated with relatively weak or merely compliant PROPER outcomes produces unusually intensive positive environmental communication, the discrepancy contains different information from extensive disclosure made by a consistently Green- or Gold-rated firm. The residual-based GWGAP measure is designed precisely to preserve this distinction. High environmental communication is not mechanically treated as greenwashing; instead, the potential greenwashing signal arises when environmental narrative intensity exceeds the level that can reasonably be predicted from actual environmental performance, size, industry, and year characteristics.

This distinction is consistent with the broader greenwashing literature. Bingler et al. (2022, 2024) show that corporate climate communication can contain *cheap talk* and selective presentation even where climate-related disclosure is extensive. Mateo-Márquez et al. (2022) similarly demonstrate that voluntary carbon disclosure and greenwashing cannot be understood as interchangeable constructs, while Treepongkaruna et al. (2024) emphasize the importance of examining greenwashing jointly with actual carbon emissions and ESG performance. The Indonesian PROPER evidence strengthens this argument because it demonstrates empirically that substantial environmental-performance heterogeneity exists within the same reporting environment.

The results also clarify why conventional disclosure indices may produce misleading conclusions. A disclosure-count approach would potentially assign a high sustainability score to firms that provide extensive environmental text irrespective of whether their external environmental rating is Red, Blue, Green, or Gold. In contrast, the present design conditions the narrative on external performance. This approach is particularly appropriate given the documented divergence in ESG assessments and the broader measurement uncertainty surrounding sustainability ratings (Berg et al., 2022; Christensen et al., 2022). The Greenwashing GAP Index therefore captures relative narrative inflation rather than disclosure quantity in isolation.

The Indonesian setting provides additional justification for this strategy. Sri Wahyuningrum et al. (2025) report improvement in environmental disclosure quality following mandatory reporting requirements in Indonesia. Greater reporting quality, however, does not logically imply equivalence between disclosure and underlying performance. The PROPER results show that the environmental-performance distribution remained heterogeneous even as sustainability reporting became increasingly institutionalized. Accordingly, mandatory reporting can improve information availability while leaving unresolved the more demanding question of whether corporate environmental narratives are proportionate to actual outcomes.

Implications for Debt-Market Pricing

The environmental-performance results are economically relevant because weak environmental outcomes can influence lenders through several channels. A deterioration in external environmental performance may indicate regulatory exposure, remediation expenditure, operational disruption,

litigation risk, transition risk, or reputational vulnerability. Existing empirical evidence documents that environmental and ESG characteristics are incorporated into corporate debt pricing. Apergis et al. (2022) report a relationship between ESG scores and debt costs, while Al Rabab'a et al. (2023) demonstrate that corporate carbon performance affects the cost of debt in Asia-Pacific markets. Similar evidence for ASEAN firms is reported by Ariefianto et al. (2025), establishing the regional relevance of ESG information to creditors.

The present results add an important measurement implication to this literature. Because PROPER performance varies materially across firms and over time, a lender assessing a corporate sustainability narrative potentially has access to information against which management's environmental claims can be evaluated. The economic signal is therefore not necessarily the environmental narrative itself, but its consistency with independently observable performance. This mechanism provides the empirical foundation for the competing hypotheses developed in the Introduction: creditors may either grant a *narrative discount* when favorable ESG communication is persuasive or impose a *credibility penalty* when the communication appears excessive relative to environmental fundamentals.

The 2023–2024 distribution illustrates the information problem particularly clearly. Of 4,290 entities receiving one of the five published ratings, 1,313 were Red and 16 were Black, compared with 227 Green and 85 Gold. Thus, approximately 30.98% of rated entities occupied the two weakest categories, while only 7.27% were classified in the two above-compliance categories. In such an environment, creditors cannot reasonably infer superior environmental quality merely from the presence of positive ESG language. The underlying environmental benchmark contains substantial cross-sectional information that can potentially alter the credibility attributed to corporate disclosure.

This reasoning is consistent with evidence that the quality and credibility of ESG information matter for debt financing. You et al. (2025) associate ESG disclosure quality with the cost of debt, while Alves and Meneses (2024) demonstrate that ESG-related financing effects depend on broader agency and financial-system conditions. Zhang et al. (2025) further show that disagreement in ESG assessments can influence corporate debt costs. The disclosure–performance gap examined in the present study represents a related form of information inconsistency, but one grounded specifically in the discrepancy between managerial communication and external environmental outcomes.

Credibility Mechanisms and the Role of Assurance

The environmental-performance heterogeneity also increases the potential economic value of independent verification. Where environmental narratives are difficult to reconcile with heterogeneous operational outcomes, external sustainability assurance can provide additional information regarding reporting processes, measurement boundaries, and disclosed indicators. Hazaea et al. (2022) identify assurance as an increasingly important credibility mechanism in sustainability reporting, while Darsono et al. (2025) provide evidence that independent assurance is relevant to ESG-related financing relationships.

The role of assurance should nevertheless be distinguished from external environmental performance. Assurance verifies specified reported information or reporting processes but does not automatically transform weak environmental performance into strong performance. Consequently, a Red-rated facility accompanied by an assured sustainability report should not be interpreted as environmentally equivalent to a Green- or Gold-rated facility. In the empirical model, assurance is therefore treated as a moderator of the consequences of GWGAP rather than as a substitute for ENVPERF.

The same logic applies to audit quality. Big Four affiliation may increase the general credibility of corporate financial reporting, but financial-statement auditing does not necessarily provide assurance over all sustainability statements. The two monitoring mechanisms are therefore analytically distinct. If sustainability assurance ultimately exhibits a stronger moderating relationship with GWGAP than general audit quality, such a result would be consistent with domain-specific verification being more informative to creditors than broad auditor reputation alone.

Environmental Credibility and the Financing Channel

The preceding environmental-performance evidence has direct implications for the financing channel examined in this study. The deterioration in the weighted PROPER score from 2.960 in the

2018–2019 cycle to 2.779 in 2023–2024 indicates that environmental performance within the monitored population did not improve proportionately with the expansion of environmental reporting and regulatory coverage. At the same time, the proportion of Red and Black observations increased from 15.16% to 30.98%, while the proportion of firms rated Blue or better declined by 15.82 percentage points. These patterns suggest that creditors evaluating environmentally sensitive Indonesian firms operate in an information environment in which favorable sustainability communication cannot automatically be interpreted as evidence of superior environmental fundamentals.

This distinction is consistent with the broader ESG financing literature. Apergis et al. (2022) demonstrate that ESG scores are relevant to corporate debt costs, while Gigante and Manglaviti (2022) provide evidence that ESG characteristics can affect the cost of debt financing under a discontinuity-based identification strategy. Arora and Sharma (2022) similarly document a relationship between ESG performance and borrowing costs among Indian firms. At the regional level, Ariefianto et al. (2025) show that ESG scores influence the cost of debt across ASEAN economies. Taken together, these studies establish that sustainability information is sufficiently material to enter creditor pricing decisions.

However, the present study differs from this literature by distinguishing the environmental signal itself from the credibility of that signal. A favorable ESG score or extensive environmental disclosure may reduce information asymmetry when it reliably represents underlying environmental conditions. The relationship becomes more ambiguous when environmental communication is substantially more favorable than externally observed performance. In this setting, the financing consequence depends not merely on the amount of sustainability information disclosed, but on whether creditors regard the information as credible.

Evidence from other financial settings reinforces this interpretation. Agnese and Giacomini (2023) find that ESG factors are relevant to funding costs, demonstrating that sustainability characteristics can influence the price at which financial institutions obtain external funds. Although their analysis concerns banks rather than the environmentally intensive non-financial firms examined here, the underlying mechanism is instructive: ESG information can influence financing conditions when market participants treat it as economically informative. The same mechanism may operate in the corporate debt market, but the value of the environmental signal should depend on the degree to which corporate claims are consistent with independently observable outcomes.

Carbon-related evidence provides additional support. Al Rabab'a et al. (2023) show that corporate carbon performance affects debt costs across Asia-Pacific firms, while Ali et al. (2023) demonstrate that capital markets can reward corporate climate actions through the cost-of-debt channel. These findings indicate that creditors are not restricted to conventional financial ratios when evaluating borrower risk. Environmental performance can influence expectations regarding regulatory exposure, transition costs, operating risk, and long-term cash-flow stability.

The present environmental-performance results therefore provide an important context for interpreting the eventual firm-level GWGAP coefficient. A positive association between GWGAP and COD($t+1$) would indicate that creditors impose a credibility penalty when environmental narratives exceed the level supported by external environmental performance. Conversely, a negative association would indicate that favorable environmental communication retains financing value even when the underlying environmental performance is comparatively weak. This competing-hypotheses structure is particularly appropriate because existing studies document both the economic relevance of ESG information and substantial uncertainty regarding the reliability and comparability of ESG assessments (Berg et al., 2022; Christensen et al., 2022).

The possibility of a credibility penalty is also consistent with the findings of Zhang et al. (2025), who demonstrate that ESG rating divergence can affect the cost of corporate debt. Rating disagreement is conceptually different from the disclosure–performance gap examined in this study, but both represent forms of information inconsistency. In the former, uncertainty emerges across external ESG evaluators; in the latter, inconsistency emerges between corporate environmental communication and external environmental-performance evidence. Both mechanisms can increase the information-processing burden faced by creditors.

This perspective also explains why the use of PROPER is particularly valuable in the Indonesian setting. If the analysis relied exclusively on sustainability reports, creditors and

researchers would observe only the corporate side of the environmental-information environment. PROPER provides a second information layer against which corporate communication can be assessed. The resulting narrative–performance comparison therefore captures a dimension of environmental credibility that conventional ESG disclosure scores cannot directly identify.

Disclosure Quality, Strategic Reporting, and Potential Greenwashing

The empirical PROPER distribution also provides a basis for distinguishing environmental reporting quality from environmental reporting intensity. Between the beginning and end of the observation window, the number of rated entities increased by 113.22%, yet the weighted ENVPERF score declined by approximately 6.11%. This divergence demonstrates that broader environmental monitoring and greater availability of sustainability information do not necessarily imply corresponding improvement in underlying environmental performance.

The distinction is consistent with evidence from Indonesia. Sri Wahyuningrum et al. (2025) find that mandatory reporting has improved environmental disclosure quality in Indonesia. Improved reporting quality is institutionally important because it enhances the availability and structure of environmental information. However, disclosure quality and environmental performance remain analytically distinct. A company can improve the clarity or completeness of its reporting without necessarily achieving a comparable improvement in environmental outcomes.

Amarna et al. (2024) provide further evidence that ESG disclosure has financing implications and that the credibility of corporate reporting should be considered jointly with other managerial reporting choices. Their findings concerning ESG disclosure, real earnings management, and financing costs illustrate that sustainability communication does not occur independently from broader managerial incentives. This is especially relevant to the present study because a disclosure–performance gap may reflect strategic presentation choices that extend beyond environmental reporting itself.

Similar concerns arise in the greenwashing literature. Mateo-Márquez et al. (2022) demonstrate that voluntary carbon disclosure can coexist with greenwashing behavior, while Xu et al. (2023) distinguish sustainability reporting from substantive shared-value creation. Liu et al. (2024) further show that capital-market conditions can affect ESG-reporting greenwashing. These findings collectively indicate that sustainability disclosure should not be interpreted solely as a neutral reflection of corporate environmental conditions.

The textual components developed in this study are designed to capture precisely this distinction. Positive Environmental Tone measures favorable environmental framing, Aspirational Language identifies future-oriented claims without contemporaneous evidence of realization, and Vagueness captures environmental statements without measurable baselines or outcomes. Quantitative Specificity and Target Completeness, by contrast, provide information about the degree to which environmental claims can be independently evaluated. The resulting NARR construct therefore incorporates the qualitative structure of environmental communication rather than relying only on disclosure volume.

Bingler et al. (2022) provide particularly strong support for this approach by demonstrating the presence of *cheap talk* and selective presentation in corporate climate disclosures. Their later study shows that such climate communication can be systematically related to climate initiatives, corporate emissions, and reputational risk (Bingler et al., 2024). These findings justify the inclusion of aspirational and quantitative-specificity dimensions because apparently favorable climate language may convey very different information depending on whether it is accompanied by measurable environmental results.

The same reasoning underpins the use of the residual-based GWGAP measure. A firm that reports extensively but simultaneously exhibits strong PROPER performance should not be classified in the same manner as a firm that communicates equally extensively while displaying materially weaker external environmental outcomes. The residual framework conditions expected narrative intensity on environmental performance, thereby preserving the distinction between substantive environmental signaling and potentially excessive environmental promotion.

Recent research also suggests that the concept of greenwashing has broadened beyond isolated misleading claims. Todaro and Torelli (2024) describe the transition from conventional greenwashing toward ESG-washing, in which symbolic sustainability narratives may encompass multiple aspects of

corporate responsibility. Sundarassen et al. (2024) similarly document the growing prominence of sustainability reporting and greenwashing in the international research literature, while Zioło et al. (2024) identify greenwashing as an increasingly mature but methodologically heterogeneous field of inquiry.

The Indonesian evidence contributes to this literature by providing an institutional mechanism for separating environmental narrative from environmental performance. The use of an official environmental benchmark allows potential greenwashing to be operationalized through measurable inconsistency rather than subjective textual judgment alone. This is particularly important because the study does not infer managerial intent. GWGAP identifies an observable disclosure–performance discrepancy, not proof of fraudulent or deliberately deceptive conduct.

Environmental Performance, Corporate Risk, and Cost-of-Debt Interpretation

The financial relevance of the disclosure–performance gap becomes clearer when environmental performance is considered as a component of corporate risk. The increase in the Red/Black share from 15.16% to 30.98% over the study period suggests that a substantial proportion of environmentally monitored entities remain exposed to relatively weak external performance assessments. For creditors, such performance can signal greater vulnerability to regulatory enforcement, environmental remediation costs, operational disruption, and reputational consequences.

Temiz (2022) provides evidence that environmental performance influences financing costs in emerging markets, supporting the argument that environmental outcomes can be incorporated into creditors' required returns. Li et al. (2022) similarly show that CSR and green financial guidelines affect debt financing among pollution-intensive industries. These findings are particularly relevant to the present sample because the study deliberately focuses on sectors in which environmental externalities are economically material.

Lian et al. (2023) extend this evidence to bond markets by demonstrating that corporate ESG performance affects bond credit spreads. Their findings suggest that ESG information can influence market-based assessments of credit risk even when lenders do not directly participate in corporate environmental management. The underlying mechanism is consistent with the present study: environmental and ESG information can alter perceptions of future risk and therefore affect required compensation for supplying debt capital.

Zheng and Shen (2024) further show that corporate environmental information disclosure can affect the cost of debt and that managerial ownership influences this relationship. This evidence reinforces the importance of distinguishing the content of environmental disclosure from the governance incentives under which the disclosure is produced. Environmental reporting is therefore embedded in a broader agency setting in which managers, creditors, owners, and external monitors possess different information and incentives.

Uyar et al. (2024) similarly demonstrate that CSR performance and reporting can facilitate access to debt financing in emerging markets, conditional on firm-level characteristics such as asset structure and performance. This heterogeneity is relevant to the control structure of the present models. Firm size, leverage, profitability, liquidity, tangibility, growth, age, institutional ownership, and earnings volatility are included precisely because debt pricing reflects both sustainability-related information and conventional borrower characteristics.

The cost-of-debt literature therefore provides a coherent interpretation of GWGAP. When a firm's environmental narrative is supported by strong environmental performance, environmental communication can reduce information asymmetry and operate as a credible signal. When the narrative substantially exceeds externally observable performance, the same communication can become less credible and potentially increase information risk. This asymmetry explains why the present research does not assume *ex ante* that environmental disclosure necessarily reduces financing costs.

The distinction is also compatible with the findings of Alves and Meneses (2024), who show that the relationship between ESG scores and debt costs depends on agency costs, indebtedness, and characteristics of the financial system. ESG information should therefore not be interpreted independently from the institutional and financial environment in which creditors operate. Indonesia provides a particularly useful setting because listed firms coexist with a formal governmental environmental-performance rating system.

Mathath et al. (2024) additionally demonstrate that the relationship between ESG disclosure and debt costs may differ across stages of the corporate life cycle. This finding provides a further reason for controlling firm age and related firm characteristics. Younger and older firms may differ in information availability, reputational capital, borrowing relationships, and sustainability-reporting maturity, all of which can affect the pricing implications of environmental narratives.

You et al. (2025) focus specifically on ESG disclosure quality and the cost of debt, providing recent evidence that the informational characteristics of ESG reporting matter to lenders. The present study extends this perspective by arguing that disclosure quality should also be assessed relative to substantive performance. High-quality presentation without corresponding environmental outcomes may reduce rather than strengthen informational credibility when creditors can access external performance indicators.

Zhang et al. (2024) further document that ESG competitive disadvantage affects debt financing costs. Their evidence implies that creditors evaluate corporate ESG standing relative to economically relevant benchmarks rather than in complete isolation. GWGAP follows a related comparative logic: corporate environmental narratives are evaluated relative to the environmental performance that would ordinarily justify those narratives.

Sustainability Assurance, Audit Quality, and the Credibility Architecture

The potential financing consequences of GWGAP also depend on the institutional mechanisms available to validate sustainability information. External sustainability assurance is expected to reduce uncertainty concerning the reliability of environmental measurements, reporting boundaries, calculation procedures, and target achievement. Its economic relevance is therefore particularly strong when corporate environmental narratives contain information that is difficult for external users to verify independently.

Hazaea et al. (2022), in their systematic review of sustainability assurance practices, demonstrate that assurance has become an increasingly important component of sustainability-accountability systems. The function of assurance extends beyond formal report certification because independent verification can strengthen internal data processes and constrain unsupported reporting claims. In the present research design, ASSURE is therefore modeled as a moderator rather than merely as another disclosure characteristic.

Darsono et al. (2025) provide direct support for this approach by documenting the role of independent assurance in the relationship among ESG, financial performance, and the cost of debt. Their evidence is especially relevant to the Indonesian and emerging-market context because it suggests that creditors differentiate between sustainability information that is externally verified and information that remains solely under managerial control.

Assurance nevertheless cannot substitute for actual environmental performance. A sustainability report may be independently assured while the underlying operating facility continues to receive a relatively weak PROPER rating. This distinction is conceptually central to the present framework. ENVPERF captures the underlying environmental outcome, while ASSURE captures an institutional mechanism intended to improve the credibility of reported information.

Audit quality constitutes a separate but related monitoring mechanism. High-quality financial auditing may reduce general information risk and constrain opportunistic financial reporting, yet it does not necessarily verify all environmental statements contained in sustainability disclosures. Consequently, AUDITQ is analytically separated from ASSURE. The interaction models examine whether general financial-reporting credibility and specialized sustainability verification exert different moderating effects on the association between GWGAP and subsequent borrowing costs.

The distinction also connects to the evidence reported by Sari et al. (2024), who show that the relationship between CSR disclosure and the cost of debt in Indonesia is conditioned by family-business characteristics. Their findings demonstrate that governance context matters when creditors interpret sustainability disclosure. Environmental communication should therefore not be viewed as operating independently from monitoring, ownership, and organizational characteristics.

Nasih et al. (2024) further illustrate that sustainability reporting can coexist with corporate practices whose alignment with sustainability objectives is not necessarily straightforward. Their analysis of tax avoidance and sustainability reporting reinforces the broader argument that favorable sustainability communication should be evaluated in relation to substantive corporate behavior.

Although tax behavior lies outside the environmental focus of PROPER, the conceptual lesson is directly relevant: narrative alignment cannot be assumed solely from the presence of sustainability reporting.

Integration with the Greenwashing Literature

The broader greenwashing literature supports interpreting the disclosure–performance gap as a continuum rather than a binary classification. Firms may exhibit varying degrees of inconsistency between environmental communication and environmental outcomes, and those inconsistencies may arise from different reporting incentives, organizational structures, or information constraints. The use of a continuous GWGAP measure is therefore more appropriate than assigning companies mechanically to greenwashing and non-greenwashing categories.

Treepongkaruna et al. (2024) demonstrate the importance of analyzing greenwashing alongside carbon emissions and ESG characteristics. Their approach reinforces the need to connect sustainability claims with environmental outcomes. Zhou et al. (2024) additionally show that environmental disclosure greenwashing can generate both valuation premiums and subsequent devaluation effects, indicating that favorable environmental communication may initially generate benefits while simultaneously creating future credibility risks.

These findings are especially relevant to the competing hypotheses employed in the present study. The *narrative discount* hypothesis captures the possibility that favorable environmental communication reduces borrowing costs because creditors initially reward the sustainability signal. The *credibility penalty* hypothesis captures the alternative possibility that creditors identify the mismatch between narrative and performance and demand greater compensation for the resulting information and reputational risk.

The coexistence of these mechanisms explains why an unambiguously negative or positive relationship should not be imposed ex ante. Environmental communication can provide valuable information, but its value depends on credibility. Extensive disclosure by a high-performing firm may represent substantive signaling, whereas equivalent disclosure by a weak-performing firm can generate a fundamentally different interpretation.

The PROPER results reinforce this point. The observation period contains substantial variation across environmental categories, including a more than twofold expansion in monitored entities, a decline in the weighted external-performance benchmark, and considerable persistence of lower environmental ratings. Such heterogeneity creates the empirical conditions necessary for the disclosure–performance gap to contain information beyond disclosure intensity alone.

Accordingly, the primary contribution of the Greenwashing GAP Index is not to identify legal wrongdoing but to provide a reproducible empirical signal of environmental narrative inflation relative to externally observable performance. This terminology is particularly important in corporate greenwashing research because statistical inconsistency cannot establish intentional deception. The study therefore consistently uses the terms *potential greenwashing signal* and *disclosure–performance gap* when interpreting GWGAP.

Synthesis of Findings and Research Contribution

The results reported across the environmental-performance analysis establish several quantitative features of the Indonesian setting. PROPER coverage increased from 2,012 rated entities in the 2018–2019 cycle to 4,290 in 2023–2024, representing an increase of 113.22%. Over the same period, the Blue-or-better share declined from 84.84% to 69.02%, while the combined Red/Black share increased from 15.16% to 30.98%. The weighted ENVPERF benchmark correspondingly declined from 2.960 to 2.779.

The trend diagnostics reinforce this pattern. The number of rated entities increased by approximately 467.7 entities per assessment cycle, while the Blue-or-better share declined by approximately 4.00 percentage points per cycle. The weighted ENVPERF trend was -0.0432 points per assessment period, with an R^2 of 0.861 and a p-value of 0.0076. Although these aggregate trends should not be interpreted causally, they demonstrate that environmental-performance heterogeneity increased during the same period in which sustainability reporting became more institutionalized.

The substantive implication is that an increase in environmental communication cannot be treated as equivalent to an improvement in environmental performance. This finding is consistent with

research documenting ESG-rating divergence (Berg et al., 2022; Christensen et al., 2022), strategic or selective climate disclosure (Bingler et al., 2022, 2024), greenwashing in sustainability reporting (Liu et al., 2024; Mateo-Márquez et al., 2022; Xu et al., 2023), and the broader evolution toward ESG-washing (Todaro & Torelli, 2024).

The study also contributes to the debt-financing literature by integrating disclosure credibility with environmental performance. Previous research shows that ESG scores, environmental outcomes, carbon performance, disclosure quality, and sustainability characteristics can affect borrowing costs (Al Rabab'a et al., 2023; Apergis et al., 2022; Ariefianto et al., 2025; Arora & Sharma, 2022; Gigante & Manglaviti, 2022; Lian et al., 2023; Mathath et al., 2024; Temiz, 2022; You et al., 2025). The present framework advances this literature by focusing on whether creditors price the gap between what companies communicate and what external environmental evidence indicates.

A further contribution concerns information verification. Existing evidence emphasizes the role of independent assurance and other monitoring mechanisms in strengthening the credibility of sustainability information (Darsono et al., 2025; Hazaea et al., 2022). By interacting assurance and audit quality with GWGAP, the study evaluates whether verification mechanisms reduce the financing consequences associated with environmental narrative–performance inconsistency.

More broadly, the analysis integrates insights from research on sustainability reporting, ESG measurement, corporate financing, greenwashing, and environmental performance. Evidence from Agnese and Giacomini (2023), Alves and Meneses (2024), Amarna et al. (2024), Li et al. (2022), Uyar et al. (2024), Zheng and Shen (2024), and Zhang et al. (2024, 2025) collectively demonstrates that sustainability-related information is financially consequential but cannot be interpreted independently from firm characteristics, reporting incentives, external verification, and information quality.

The resulting contribution is therefore both methodological and substantive. Methodologically, the study constructs a disclosure–performance measure using Indonesian-language textual characteristics and an external environmental-performance benchmark. Substantively, it examines whether discrepancies between environmental communication and observable environmental performance are economically relevant to creditors. This approach moves beyond the conventional question of whether ESG disclosure affects financing costs and instead asks whether the credibility of ESG disclosure relative to actual environmental performance affects the subsequent cost of debt.

CONCLUSION

This study examines corporate greenwashing through the discrepancy between environmental narratives and externally observable environmental performance, rather than treating the volume of ESG disclosure as a direct representation of substantive sustainability performance. Using Indonesian non-financial listed firms operating in environmentally sensitive sectors as the empirical setting, the study integrates corporate textual analysis, PROPER-based environmental assessment, sustainability assurance, audit quality, and debt-financing considerations within a longitudinal framework covering 2019–2024. The environmental-performance evidence reveals a substantial expansion in regulatory coverage, with the number of PROPER-rated entities increasing from 2,012 to 4,290, or 113.22%, across the observation window. At the same time, the proportion of entities rated Blue or better declined from 84.84% to 69.02%, while the combined Red and Black share increased from 15.16% to 30.98%. The weighted environmental-performance score consequently declined from 2.960 to 2.779, representing a reduction of approximately 6.11%. These results indicate that the institutionalization of environmental reporting and the expansion of environmental monitoring have not been accompanied by a uniform improvement in substantive environmental performance. The divergence between increasingly visible sustainability communication and heterogeneous external environmental outcomes therefore provides a strong empirical basis for measuring potential greenwashing as a disclosure–performance gap rather than as disclosure intensity alone.

The principal contribution of the study lies in developing a more discriminating framework for evaluating the credibility of corporate environmental communication. The Greenwashing GAP Index conceptualizes potential greenwashing as the positive residual between the observed Environmental Narrative Score and the narrative level predicted by externally assessed environmental performance, firm characteristics, industry, and reporting year. This approach allows extensive environmental communication by genuinely high-performing firms to be distinguished from unusually favorable

narratives unsupported by comparable environmental outcomes, while avoiding categorical allegations of intentional deception. The framework also establishes a direct connection between sustainability credibility and corporate financing by positioning the subsequent cost of debt as the primary economic consequence and external sustainability assurance and audit quality as credibility-enhancing mechanisms. The findings imply that regulators, creditors, investors, auditors, and assurance providers should evaluate sustainability information not merely according to its volume, positivity, or formal disclosure quality, but according to its consistency with independently observable environmental outcomes. For sustainability accounting research, the study consequently shifts the analytical emphasis from “how much firms disclose” toward “whether what firms disclose is proportionate to what they actually achieve,” thereby providing a replicable foundation for future issuer-level tests of whether environmental narrative–performance discrepancies generate a narrative discount or a credibility penalty in corporate debt markets.

REFERENCES

- Agnese, P., & Giacomini, E. (2023). Bank's funding costs: Do ESG factors really matter? *Finance Research Letters*, 51, 103437. <https://doi.org/10.1016/j.frl.2022.103437>.
- Al Rabab'a, E. F., Rashid, A., & Shams, S. (2023). Corporate carbon performance and cost of debt: Evidence from Asia-Pacific countries. *International Review of Financial Analysis*, 88, 102641. <https://doi.org/10.1016/j.irfa.2023.102641>.
- Ali, K., Nadeem, M., Pandey, R., & Bhabra, G. S. (2023). Do capital markets reward corporate climate change actions? Evidence from the cost of debt. *Business Strategy and the Environment*, 32(6), 3417–3431. <https://doi.org/10.1002/bse.3308>.
- Alves, C. F., & Meneses, L. L. (2024). ESG scores and debt costs: Exploring indebtedness, agency costs, and financial system impact. *International Review of Financial Analysis*, 94, 103240. <https://doi.org/10.1016/j.irfa.2024.103240>.
- Amarna, K., Garde Sánchez, R., López-Pérez, M. V., & Marzouk, M. (2024). The effect of environmental, social, and governance disclosure and real earning management on the cost of financing. *Corporate Social Responsibility and Environmental Management*, 31(4), 3181–3193. <https://doi.org/10.1002/csr.2740>.
- Apergis, N., Poufinas, T., & Antonopoulos, A. (2022). ESG scores and cost of debt. *Energy Economics*, 112, 106186. <https://doi.org/10.1016/j.eneco.2022.106186>.
- Ariefianto, M. D., Rahmansyah, F., Wijaya, V., & Audreane, V. (2025). The role of environment social and governance (ESG) score to cost of debt: Evidence from ASEAN countries. *International Journal of Finance & Economics*, 30(3), 3031–3043. <https://doi.org/10.1002/ijfe.3056>.
- Arora, A., & Sharma, D. (2022). Do environmental, social and governance (ESG) performance scores reduce the cost of debt? Evidence from Indian firms. *Australasian Accounting, Business and Finance Journal*, 16(5), 4–18. <https://doi.org/10.14453/aabfj.v16i5.02>.
- Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. *Review of Finance*, 26(6), 1315–1344. <https://doi.org/10.1093/rof/rfac033>.
- Bingler, J. A., Kraus, M., Leippold, M., & Webersinke, N. (2022). Cheap talk and cherry-picking: What ClimateBert has to say on corporate climate risk disclosures. *Finance Research Letters*, 47, 102776. <https://doi.org/10.1016/j.frl.2022.102776>.
- Bingler, J. A., Kraus, M., Leippold, M., & Webersinke, N. (2024). How cheap talk in climate disclosures relates to climate initiatives, corporate emissions, and reputation risk. *Journal of Banking & Finance*, 164, 107191. <https://doi.org/10.1016/j.jbankfin.2024.107191>.
- Christensen, D. M., Serafeim, G., & Sikochi, A. (2022). Why is corporate virtue in the eye of the beholder? The case of ESG ratings. *The Accounting Review*, 97(1), 147–175. <https://doi.org/10.2308/TAR-2019-0506>.
- Darsono, D., Ratmono, D., Tujori, A., & Clarisa, T. Y. (2025). The relationship between ESG, financial performance, and cost of debt: The role of independent assurance. *Cogent Business & Management*, 12(1), 2437137. <https://doi.org/10.1080/23311975.2024.2437137>.
- Gigante, G., & Manglaviti, D. (2022). The ESG effect on the cost of debt financing: A sharp RD analysis. *International Review of Financial Analysis*, 84, 102382. <https://doi.org/10.1016/j.irfa.2022.102382>.

- Hazaea, S. A., Zhu, J., Khatib, S. F. A., Bazhair, A. H., & Elamer, A. A. (2022). Sustainability assurance practices: A systematic review and future research agenda. *Environmental Science and Pollution Research*, 29, 4843–4864. <https://doi.org/10.1007/s11356-021-17359-9>.
- Li, Y., Chen, R., & Xiang, E. (2022). Corporate social responsibility, green financial system guidelines, and cost of debt financing: Evidence from pollution-intensive industries in China. *Corporate Social Responsibility and Environmental Management*, 29(3), 593–608. <https://doi.org/10.1002/csr.2222>.
- Lian, Y., Ye, T., Zhang, Y., & Zhang, L. (2023). How does corporate ESG performance affect bond credit spreads: Empirical evidence from China. *International Review of Economics & Finance*, 85, 352–371. <https://doi.org/10.1016/j.iref.2023.01.024>.
- Liu, G., Qian, H., & Zhou, M. (2024). How do firms react to capital market liberalization? Evidence from ESG reporting greenwashing. *Corporate Social Responsibility and Environmental Management*, 31(5), 4329–4344. <https://doi.org/10.1002/csr.2808>.
- Mateo-Márquez, A. J., González-González, J. M., & Zamora-Ramírez, C. (2022). An international empirical study of greenwashing and voluntary carbon disclosure. *Journal of Cleaner Production*, 363, 132567. <https://doi.org/10.1016/j.jclepro.2022.132567>.
- Mathath, N., Kumar, V., & Balasubramanian, G. (2024). The effect of environmental, social, and governance disclosure on cost of debt: A life-cycle perspective. *Managerial and Decision Economics*, 45(4), 1883–1893. <https://doi.org/10.1002/mde.4105>.
- Nasih, M., Harymawan, I., Abdul Rasid, S. Z., & Putra, F. K. G. (2024). Tax avoidance and sustainability reporting: Alignment or greenwashing strategy? *Corporate Social Responsibility and Environmental Management*, 31(6), 6335–6351. <https://doi.org/10.1002/csr.2927>.
- Sari, M., Joni, J., & Ginting, E. K. S. B. (2024). How does family business affect the association between corporate social responsibility disclosure and cost of debt in Indonesia? *Business Strategy & Development*, 7(3), e395. <https://doi.org/10.1002/bsd2.395>.
- Sri Wahyuningrum, I. F., Sriningsih, Puspita, A. S., Budihardjo, M. A., Chegenizadeh, A., & Nikraz, H. (2025). Has mandatory reporting improved environmental disclosure quality in Indonesia? *World Development Perspectives*, 39, 100718. <https://doi.org/10.1016/j.wdp.2025.100718>.
- Sundarasan, S., Zyznarska-Dworczak, B., & Goel, S. (2024). Sustainability reporting and greenwashing: A bibliometrics assessment in G7 and non-G7 nations. *Cogent Business & Management*, 11(1), 2320812. <https://doi.org/10.1080/23311975.2024.2320812>.
- Temiz, H. (2022). Environmental performance and cost of finance: Evidence from emerging markets. *Sustainability Accounting, Management and Policy Journal*, 13(5), 1229–1250. <https://doi.org/10.1108/SAMPJ-12-2021-0537>.
- Todaro, D. L., & Torelli, R. (2024). From greenwashing to ESG-washing: A focus on the circular economy field. *Corporate Social Responsibility and Environmental Management*, 31(5), 4034–4046. <https://doi.org/10.1002/csr.2786>.
- Treepongkaruna, S., Au Yong, H. H., Thomsen, S., & Kyaw, K. (2024). Greenwashing, carbon emission, and ESG. *Business Strategy and the Environment*, 33(8), 8526–8539. <https://doi.org/10.1002/bse.3929>.
- Uyar, A., Gerged, A. M., Kuzey, C., & Karaman, A. S. (2024). Do CSR performance and reporting facilitate access to debt financing in emerging markets? The role of asset structure and firm performance. *Review of Accounting and Finance*, 23(2), 157–185. <https://doi.org/10.1108/RAF-01-2023-0020>.
- Xu, W., Li, M., & Xu, S. (2023). Unveiling the “veil” of information disclosure: Sustainability reporting “greenwashing” and “shared value.” *PLOS ONE*, 18(1), e0279904. <https://doi.org/10.1371/journal.pone.0279904>.
- You, X., Chen, C., Peng, K., & Li, Y. (2025). ESG disclosure quality and cost of debt. *Emerging Markets Review*, 64, 101219. <https://doi.org/10.1016/j.ememar.2024.101219>.
- Zhang, S., Xu, G., Shu, Y., & Zhu, J. (2024). Corporate ESG competitive disadvantage and cost of debt financing. *Finance Research Letters*, 69, 106102. <https://doi.org/10.1016/j.frl.2024.106102>.
- Zhang, X., Shan, Y. G., Zhang, Y., & Xing, C. (2025). Does ESG rating divergence affect the cost of corporate debt? *Accounting & Finance*, 65(3), 2244–2280. <https://doi.org/10.1111/acfi.13400>.

- Zheng, X., & Shen, J. (2024). Corporate environmental information disclosure, managerial ownership and the cost of debt. *International Review of Economics & Finance*, 93, 645–659. <https://doi.org/10.1016/j.iref.2024.03.052>.
- Zhou, Y., Chen, L., Zhang, Y., & Li, W. (2024). “Environmental disclosure greenwashing” and corporate value: The premium effect and premium devalue of environmental information. *Corporate Social Responsibility and Environmental Management*, 31(3), 2424–2438. <https://doi.org/10.1002/csr.2698>.
- Zioło, M., Bąk, I., & Spoz, A. (2024). Literature review of greenwashing research: State of the art. *Corporate Social Responsibility and Environmental Management*, 31(6), 5343–5356. <https://doi.org/10.1002/csr.2842>.