TRANSNATIONAL ACADEMIC JOURNAL OF ECONOMICS

TACJE

Transnational Academic Journal of Economics, Year: 2025, Volume: 2, Issue: 1, Pages : 105-119 *Research Article*

DOI: 10.5281/zenodo.18485723

Publication Date: 30.01.2025

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Beyond ESG Disclosure:Measuring Real-World Outcomes and Disclosure–Outcome Misalignment

Abstract

Environmental, social, and governance (ESG) reporting has expanded rapidly across global capital markets. Despite this growth, persistent concerns remain that disclosure quality and ESG scores are imperfect proxies for real-world environmental and social outcomes. Disclosure reflects what firms say, not necessarily what they change. This study develops a transparent and replicable measurement framework that shifts ESG assessment from "ESG-as-disclosure" to "ESG-as-impact" by explicitly linking firm-level ESG disclosures to externally verifiable outcome indicators. The framework distinguishes three analytically separate layers: (i) disclosure and managerial inputs, (ii) operational outputs, and (iii) real-world outcomes. Building on theories of decoupling and greenwashing, the paper operationalizes disclosure–outcome misalignment as a measurable indicator of greenwashing risk. Using established disclosure standards and publicly available outcome datasets, the study provides a structured data architecture, validation logic, and reporting templates that enhance comparability, materiality, and auditability. The contribution is both methodological and practical: a rigorous approach for evaluating ESG performance beyond narrative reporting, without reliance on proprietary ESG ratings.

Keywords: ESG; sustainability impact; disclosure; outcome measurement; greenwashing; decoupling; performance measurement; climate metrics; social outcomes; corporate governance

How to cite: Bansal T. Beyond ESG Disclosure:Measuring Real-World Outcomes and Disclosure–Outcome Misalignment. *Transnational Academic Journal of Economics, 2*(1), 105-119.

1. Introduction

Environmental, social, and governance (ESG) considerations have moved from the margins of corporate communication to the core of reporting practice, investment analysis, and regulatory agendas. Firms now routinely publish sustainability reports, climate transition plans, human-capital disclosures, governance statements, and a growing set of quantitative indicators intended to describe non-financial risks and societal contributions. In parallel, asset managers, lenders, and regulators increasingly treat ESG information as decision-relevant, using it to evaluate downside risk, long-term resilience, cost of capital, and compliance exposure. Yet the rapid institutionalization of ESG has amplified a fundamental measurement challenge: **disclosure does not necessarily imply impact**.Two structural features explain why this gap persists. First, disclosure is primarily a communicative and organizational output. Firms can improve the *appearance* and completeness of ESG reporting relatively quickly by adopting reporting frameworks, hiring specialized consultants, standardizing templates, and expanding narrative coverage, even when operational practices change only marginally. This is not inherently deceptive. It reflects the reality that reporting systems can scale faster than physical or social systems. Second, real-world outcomes, such as absolute greenhouse gas emissions, toxic releases, occupational injuries, or community externalities, are constrained by technology, production processes, legacy assets, supply-chain structure, and the broader regulatory environment. These outcomes often evolve slowly, are affected by external shocks (e.g., energy prices, macroeconomic cycles), and may display delayed responses to policy or managerial interventions.This temporal and structural mismatch creates a risk for ESG assessment: evaluations that rely heavily on disclosure may conflate reporting sophistication with substantive performance. A firm may exhibit exemplary disclosure practices (clear targets, detailed narratives, formal governance structures) while outcomes remain weak or stagnant, particularly in heavy-emitting sectors or in contexts where monitoring is limited. Conversely, firms may achieve measurable outcome improvements but disclose less, due to conservative communication strategies, resource constraints, or limited reporting maturity. The result is a persistent concern that ESG can drift into a "symbolic compliance" equilibrium, where the reporting signal becomes more reliable than the underlying outcome it is presumed to represent.These concerns are amplified by well-documented criticisms of ESG measurement: limited verification of reported claims, inconsistent methodologies across frameworks and rating providers, low comparability across sectors, and vulnerability to greenwashing. Greenwashing, in this context, can be understood as a strategic response to reputational, market, and regulatory pressures under conditions of information asymmetry and uneven enforcement. When stakeholders reward ESG narratives but cannot reliably validate outcomes, firms have incentives to prioritize disclosure that improves perceptions, even if operational changes are partial, delayed, or narrowly scoped. Importantly, this does not imply that all ESG reporting is performative; rather, it highlights why ESG analysis requires measurement designs that explicitly test whether disclosure corresponds to externally meaningful outcomes.From a research perspective, the disclosure–impact gap is not a minor technical issue. It shapes empirical conclusions about whether ESG "works," influences which firms are classified as leaders or laggards, and affects how policy and capital allocation respond to corporate sustainability claims. If disclosure is treated as performance, studies may overestimate progress, misidentify mechanisms, and underestimate the role of regulatory monitoring and sector context. A credible ESG evaluation therefore requires measurement that distinguishes between what firms claim, what they do operationally, and what changes in the external environment.

1.1 Research gap

The empirical ESG literature frequently follows one of two measurement strategies, each with important limitations. The first relies on proprietary ESG ratings. These ratings are widely used in research and practice, but they often lack transparency regarding data sources, weighting schemes, and score construction, and they may exhibit low agreement across providers for the same firm. This raises concerns about construct validity and replicability, especially when ratings are treated as objective benchmarks.The second strategy constructs disclosure-based indices from reports, coding the presence of policies, targets, governance structures, and reporting completeness. While this approach improves transparency and can be designed to be replicable, it still risks treating disclosure as the outcome of interest. In doing so, it may implicitly equate the quality of reporting with real-world improvements, even though disclosure can be decoupled from operational performance and external outcomes. Both approaches can therefore overstate the substantive meaning of ESG engagement by collapsing distinct layers (claims, outputs, outcomes) into a single proxy.What is missing is a measurement approach that (i) separates disclosure from impact, (ii) preserves replicability, and (iii) minimizes dependence on proprietary scoring systems by grounding impact assessment in outcomes that can be externally verified.

1.2 Objective and contribution

This study addresses these limitations by developing and operationalizing a replicable **"ESG-to-Impact"** framework designed to evaluate ESG performance beyond disclosure. The framework:

- **Separates disclosure, operational outputs, and real-world outcomes**, treating ESG not as a single score but as a layered measurement architecture.
- **Anchors impact measurement in externally verifiable data**, prioritizing outcomes that can be validated through public monitoring, regulatory datasets, or independent sources where available.
- **Operationalizes greenwashing as disclosure–outcome misalignment**, enabling systematic identification of cases where high disclosure is paired with weak outcomes.
- **Enhances transparency and reproducibility**, through explicit coding rubrics, data-linkage logic, and reporting templates that reduce reliance on proprietary ESG ratings.

The contribution is methodological, by offering an auditable measurement architecture that connects corporate reporting to externally meaningful outcomes, and conceptual, by reframing ESG performance as a testable relationship between claims, operational signals, and real-world effects. In practical terms, the framework supports researchers and decision-makers in distinguishing "ESG as communication" from "ESG as measurable impact," while retaining the transparency required for robust empirical work.

2. Theoretical Background and Literature Review

2.1 ESG disclosure and its limits

The rapid expansion of ESG disclosure frameworks has significantly improved the structure, scope, and comparability of non-financial corporate reporting. Standards such as the Task Force on Climate-related Financial Disclosures (TCFD), the Global Reporting Initiative

(GRI), and the sustainability standards issued by the International Sustainability Standards Board (ISSB/IFRS) provide firms with detailed guidance on how to report governance arrangements, strategic orientation, risk management processes, and quantitative sustainability metrics. These frameworks have contributed to a convergence in reporting practices by clarifying terminology, defining reporting categories, and encouraging consistency over time. Despite these advances, ESG disclosure frameworks are inherently procedural rather than outcome-oriented. They specify *how* firms should organize and communicate information, but they do not prescribe *what level of environmental or social performance must be achieved*. Compliance with disclosure standards therefore signals adherence to reporting discipline rather than demonstrable improvement in real-world outcomes. A firm may fully comply with TCFD, GRI, or ISSB requirements by disclosing targets, scenarios, governance structures, and methodologies, while actual emissions trajectories, safety outcomes, or social impacts remain unchanged or improve only marginally.This distinction highlights a fundamental limitation of disclosure-based ESG measurement. Disclosure is best understood as **declared evidence**—information produced by the firm about its intentions, structures, and processes. While such evidence can be informative and valuable, it is not equivalent to **verified impact**, which requires confirmation through externally observable outcomes. Disclosure quality may therefore reflect organizational capacity for reporting and communication rather than substantive environmental or social performance. As a result, ESG assessments that rely heavily on disclosure risk overstating progress and underestimating the persistence of structural and technological constraints that shape real-world outcomes.

2.2 Greenwashing and decoupling

Greenwashing is commonly defined as a divergence between communicated sustainability commitments and actual environmental or social performance. Within organizational theory, this divergence is conceptualized as **decoupling** between symbolic actions and substantive outcomes. Firms may adopt formal policies, governance structures, and reporting practices to demonstrate conformity with societal expectations while maintaining existing operational routines. Such symbolic alignment can generate legitimacy benefits even when substantive change is limited.Decoupling is not necessarily the result of deliberate deception. It may emerge from competing institutional pressures, resource constraints, or uncertainty about appropriate performance benchmarks. However, in the context of ESG, decoupling becomes particularly salient because sustainability claims are often difficult for external stakeholders to verify directly. This verification gap creates conditions under which disclosure can substitute for performance in shaping perceptions.Economic models of greenwashing further emphasize the role of enforcement and audit probability. When the likelihood of verification is low or when penalties for misrepresentation are weak, firms may rationally exaggerate sustainability achievements or selectively disclose favorable information. In such settings, disclosure becomes a strategic instrument rather than a neutral reporting mechanism. Conversely, stronger regulatory monitoring and credible enforcement increase the cost of misrepresentation and reduce the scope for greenwashing.These theoretical insights converge on a key implication for ESG measurement: **disclosure must be evaluated against independently verifiable outcomes**. Without such validation, ESG assessments risk capturing symbolic compliance rather than substantive impact. A rigorous measurement approach must therefore be capable of identifying when disclosure and outcomes diverge, and of explaining how institutional context, sector characteristics, and enforcement intensity influence this divergence.

3. The ESG-to-Impact Measurement Framework

3.1 Conceptual structure

To address the limitations of disclosure-centric ESG assessment, this study proposes a measurement framework that explicitly distinguishes between three analytically separate but causally related layers. The framework treats ESG not as a single score, but as a sequence of inputs, processes, and effects that can be empirically examined.

Disclosure and managerial inputs (D).

The first layer captures what firms *claim and commit to*. It includes corporate sustainability policies, environmental and social targets, governance arrangements, reporting scope, methodological transparency, and the presence of third-party assurance. These elements reflect managerial intent, organizational attention, and reporting capacity. Importantly, they are largely under managerial control and can be adjusted relatively quickly in response to external expectations.

Operational outputs (O).

The second layer captures what firms *do operationally*. It consists of internal performance indicators that reflect production processes and organizational routines, such as emissions intensity, energy consumption per unit of output, waste intensity, and workplace incident rates. These metrics are closer to day-to-day operations and may serve as mechanisms through which managerial commitments are translated into action. However, they remain intermediate indicators and do not, by themselves, establish broader societal impact.

Outcomes or impacts (I).

The third layer captures what *changes in the external world*. Outcomes are defined as externally meaningful and verifiable effects, such as regulated greenhouse gas emissions, pollutant releases recorded in public registries, or workplace injury outcomes documented in official monitoring systems. Unlike disclosure and operational outputs, outcomes are not solely determined by reporting practices and are subject to external verification, regulatory oversight, and broader contextual influences.By separating these layers, the framework allows disclosure to be treated as a **claim that requires validation**, rather than as a proxy for performance. It enables researchers to test whether and under what conditions managerial commitments and operational changes translate into measurable outcomes. At the same time, it provides a basis for identifying disclosure–outcome misalignment, which serves as an empirical indicator of potential greenwashing or symbolic compliance.This layered structure is central to moving ESG research beyond narrative evaluation and toward a systematic assessment of impact that is transparent, replicable, and grounded in verifiable evidence.

3.2 Importance for comparability

Firms with similar disclosure profiles may exhibit very different outcomes due to industry characteristics, regulatory regimes, or baseline performance. By explicitly modeling these layers, the framework improves cross-firm and cross-industry comparability while respecting contextual differences.

Table 1

Outcome-Oriented ESG Measurement Framework (D–O–I)

Layer	Construct (what is measured)	Core indicators (examples)	Primary data sources	Verification logic (auditability)	Measurement notes (comparability)
Disclosure (D)	Targets & commitments	Presence of targets (absolute vs intensity), time-bound targets, baseline year declared, interim milestones	Annual report; Sustainability report; TCFD/ GRI/ISSB-aligned sections	Documented evidence in reports; consistency across years; cross-check target scope vs reported boundaries	Score with a coding rubric (0–2) per item; normalize to 0–100; apply sector materiality weights in robustness
Disclosure (D)	Governance & accountability	Board oversight of ESG; dedicated committee; executive accountability; ESG-linked incentives disclosed	Corporate governance statement; proxy/ AGM materials; sustainability governance sections	Clear responsibility assignments; disclosed oversight frequency; incentive link documented	Treat governance as input, not outcome; require explicit disclosure (avoid inference)
Disclosure (D)	Assurance & methodology transparency	Third-party assurance (yes/ no; scope); disclosed methodologies (emissions factors, calculation methods); boundary definitions	Assurance statements; methodology notes; audit reports	Independent assurance provider statement; scope and level of assurance documented	Separate "assurance existence" from "assurance scope/quality" as distinct items
Outputs (O)	Environmental operational performance	Emissions intensity (Scope 1/2/3 where available), energy intensity, renewable energy share, waste intensity	Company quantitative KPI tables; climate data annexes	Internal controls + (when present) limited third-party checks; consistency with disclosed methods	Use intensity metrics for operational comparability; standardize by sector-year (z-score)
Outputs (O)	Social operational performance	Injury frequency rates (TRIR/ LTIFR where reported), turnover rate, training hours per employee, pay equity indicators (when disclosed)	HR/safety sections in reports; KPI dashboards	Internal reporting controls; consistency checks over time	Avoid mixing definitions; keep unit consistency; flag metric-definition changes

Layer	Construct (what is measured)	Core indicators (examples)	Primary data sources	Verification logic (auditability)	Measurement notes (comparability)
Outputs (O)	Governance operational signals	Board independence %, meeting attendance, compliance training coverage, internal control disclosures	Governance section; compliance reports	Documentary verification; internal audit references if disclosed	Treat "controversy" as separate external variable (not purely output)
Outcomes (I)	Verified greenhouse gas emissions	Verified emissions (absolute) where regulated or independently reported	**EU ETS** verified emissions datasets (where applicable)	Regulatory reporting + verification under ETS rules; cross-check entity/facility link	Prefer absolute outcome trajectories; normalize by firm size only for comparability checks
Outcomes (I)	Regulated pollutant releases & externalities	Facility-level toxic releases, waste management quantities, pollutant release trends	**U.S. EPA TRI** (or equivalent public pollutant registries)	Public regulatory dataset; facility reporting requirements; consistency over years	Requires facility-to-firm matching; document matching rules; sensitivity analysis for ambiguous matches
Outcomes (I)	Workplace safety outcomes (externally recorded)	Establishment-level injuries/ illness rates; severe incident patterns	**OSHA** establishment-specific injury/illness datasets (where applicable)	Public reporting system; standardized forms; external oversight	Matching establishment to parent firm required; treat missingness explicitly
Cross-layer diagnostic	**Misalignment / greenwashing risk**	**GW = z(D) − z(I)** (high = strong disclosure, weak outcomes)	Derived from D and I	Statistical diagnostic; triangulate with enforcement/regulatory intensity	Report deciles/ quintiles; test stability over time; compare across sectors

Notes (APA-style):

D = Disclosure (inputs/policies/commitments). O = Operational outputs (internal performance signals). I = Outcomes/Impact (externally meaningful and verifiable effects). "Verification logic" specifies how each indicator can be audited or validated (documentation, regulatory verification, independent datasets). Where outcomes are facility- or establishment-level, a documented matching protocol (facility → firm) is required to ensure reproducibility.

Table 2

Materiality-Based Weighting Template by Sector

Sector	Material environmental (E) metrics	Material social (S) metrics	Material governance (G) metrics	Primary rationale (materiality logic)	Weighting approach (example)
Manufacturing	Absolute CO_2 emissions; emissions intensity; regulated pollutants; energy intensity	Workplace injury rates; occupational illness; training coverage	Regulatory compliance; internal controls; board oversight	Direct physical externalities, regulatory monitoring, and safety-critical operations	E 50%, S 30%, G 20%
Energy & Utilities	Absolute emissions; methane leakage; air pollutants; water use	Workforce safety; contractor safety; community impact	Risk management; regulatory compliance; board risk committees	High environmental impact and strong regulatory exposure	E 60%, S 25%, G 15%
Transportation & Logistics	Fuel consumption; emissions intensity; fleet efficiency	Driver safety; accident rates; labor practices	Compliance systems; safety governance	Mobile assets and safety-intensive operations	E 45%, S 35%, G 20%
Construction & Real Estate	Energy use; embodied carbon (where available); waste	Injury frequency; site safety; subcontractor practices	Project governance; compliance	High safety risk and project-based environmental impacts	E 40%, S 40%, G 20%
Finance & Insurance	Financed emissions; portfolio carbon exposure	Financial inclusion; customer protection	Board independence; risk oversight; compliance	Indirect environmental impact mediated through capital allocation	E 35%, S 25%, G 40%
Technology & Services	Energy use (data centers); Scope 2 emissions	Human capital retention; diversity indicators	Data governance; cyber risk oversight	Lower direct emissions, higher governance and human-capital relevance	E 30%, S 35%, G 35%
Consumer Goods & Retail	Supply-chain emissions; packaging waste	Labor practices in supply chains; product safety	Supplier governance; compliance systems	Reputational risk and supply-chain externalities	E 40%, S 40%, G 20%
Healthcare & Pharmaceuticals	Energy use; waste management; regulated substances	Worker safety; patient outcomes; training	Compliance; ethics oversight	High regulatory scrutiny and social sensitivity	E 30%, S 45%, G 25%

Notes (APA-style):

Materiality weights are illustrative baseline values used for index construction and robustness checks. Sector classifications follow standard industry groupings. Environmental (E), social (S), and governance (G) weights sum to 100% within each sector. Weights are applied to the disclosure index and outcome selection to reflect sector-specific externalities and regulatory exposure.

4. Hypotheses and Testable Expectations

H1 (Decoupling):

The correlation between ESG disclosure (D) and real-world outcomes (I) is low to moderate, indicating that disclosure is not equivalent to impact.

H2 (Mediation):

Operational outputs (O) partially mediate the relationship between disclosure (D) and outcomes (I).

Table 3

Disclosure–Outcome Misalignment (Greenwashing Risk) Summary

Group (by GW rank)	Definition (classification rule)	Mean D-score (z)	Mean Outcome I (z)	GW = z(D) − z(I) (mean)	Interpretation	Suggested validation checks
Top decile GW	Firms in the highest 10% of GW in year *t*	—	—	—	High disclosure combined with weak outcomes; elevated greenwashing risk	Re-check boundary consistency; verify external outcome linkage; inspect assurance scope vs claimed coverage
Deciles 8–9	Firms in the 70th–90th percentile of GW	—	—	—	Above-average misalignment; potential symbolic emphasis	Compare to industry peers; test whether misalignment persists over ≥2 years
Middle (deciles 4–7)	Firms in the 30th–70th percentile of GW	—	—	—	Typical alignment range; mixed evidence	Examine dispersion by sector; assess sensitivity to weighting scheme
Deciles 2–3	Firms in the 10th–30th percentile of GW	—	—	—	Below-average misalignment; outcomes relatively stronger than disclosure	Check for conservative disclosure; confirm completeness of D-score coding

Group (by GW rank)	Definition (classification rule)	Mean D-score (z)	Mean Outcome I (z)	GW = z(D) − z(I) (mean)	Interpretation	Suggested validation checks
Bottom decile GW	Firms in the lowest 10% of GW in year *t*	___	___	___	Low disclosure with strong outcomes; possible under-reporting or conservative communication	Confirm outcome reliability; check for reporting lags; review whether firm reports in alternative channels

Notes (APA-style):

D-score is the standardized disclosure index (higher values indicate more comprehensive and verifiable disclosure). Outcome I is a standardized outcome metric derived from externally verifiable sources (e.g., regulated emissions, pollutant releases, publicly recorded injury/illness outcomes). GW is the disclosure–outcome misalignment metric computed as **GW = z(D) − z(I)**, where higher values indicate stronger disclosure relative to outcomes. Group definitions follow decile ranking within each year to avoid conflating misalignment with time trends. Cells marked "___" are populated with empirical estimates once the sample is assembled.

Table 4

Panel Regression Models (Dependent Variable = Outcome metric, I)

Model	Dependent variable (DV)	Key independent variables (IVs)	Controls (X)	Fixed effects (FE)	Estimation details	Interpretation focus
(1) Baseline disclosure model	$I_{i,t+1}$	$D_{i,t}$	Firm size; leverage; profitability; baseline outcome $I_{i,t}$; industry conditions	Firm FE; Year FE	Clustered SE at firm level; unbalanced panel	Tests whether disclosure predicts future outcomes after accounting for time-invariant firm factors
(2) Disclosure + outputs (mediation logic)	$I_{i,t+1}$	$D_{i,t}$, $O_{i,t}$	Same as (1) + operational baseline where relevant	Firm FE; Year FE	Clustered SE at firm level; check multi-collinearity (VIF)	Evaluates whether outputs mediate the disclosure–outcome association (attenuation of β_1)
(3) Context dependence (enforcement moderation)	$I_{i,t+1}$	$D_{i,t}$, $D_{i,t} \times Enforce_{c,t}$	Same as (1) + country/ regulatory controls (time-varying)	Firm FE; Year FE	Clustered SE at firm level; interaction marginal effects reported	Tests whether stronger monitoring reduces misalignment by strengthening the disclosure–impact link
(4) Full model (D + O + enforcement)	$I_{i,t+1}$	$D_{i,t}$, $O_{i,t}$, $D_{i,t} \times Enforce_{c,t}$	Full control set + sector-year shocks (optional)	Firm FE; Year FE	Clustered SE at firm level; robustness with alternative lags $t+2$	Joint test of mediation and moderation in a single specification
(5) Misalignment as DV (greenwashing risk)	$GW_{i,t}$	$Enforce_{c,t}$, $D_{i,t}$, sector characteristics	Firm size; baseline GW; industry competition proxies (optional)	Firm FE; Year FE	Clustered SE at firm level; distribution checks	Explains variation in misalignment (greenwashing risk) across contexts and time

Notes (APA-style):

$I_{i,t+1}$ denotes the externally verifiable outcome metric in the subsequent year. $D_{i,t}$ is the disclosure index (D-score). $O_{i,t}$ represents operational output metrics. c is a proxy for regulatory monitoring/ verification intensity in country c and year t (e.g., regulatory stringency, coverage of monitored facilities, or enforcement activity measures). Firm and year fixed effects control for time-invariant firm heterogeneity and common shocks. Standard errors are clustered at the firm level to account for serial correlation within firms. Models are interpreted as predictive associations unless stronger identification strategies are introduced.

H3 (Enforcement moderation):

Disclosure–outcome misalignment is lower in contexts with stronger regulatory monitoring and verification.

These hypotheses are grounded in decoupling theory and enforcement-based models of greenwashing.

5. Materials and Methods

5.1 Research design

The study employs an unbalanced firm-year panel design, enabling temporal analysis and controlling for unobserved firm-level heterogeneity using fixed effects.

5.2 Sample

- **Population:** Publicly listed firms.
- **Period:** 2015–2024.
- **Unit of analysis:** Firm-year.

Inclusion criteria: Availability of sufficient data to construct disclosure, output, and outcome measures. **Exclusion criteria:** Major restructurings or undocumented methodological changes that compromise comparability.

5.3 Data sources

Disclosure data

Disclosure measures are derived from annual and sustainability reports, structured using TCFD, GRI Universal Standards, and ISSB/IFRS S1.

Outcome data

To ensure external verification, outcome metrics are drawn from public regulatory datasets, including:

- Verified emissions under emissions trading systems.
- Facility-level pollutant release registries.
- Publicly reported workplace injury and illness records.

These sources reduce reliance on self-reported information and enhance auditability.

6. Variable Construction

6.1 Disclosure index (D-score)

The disclosure index is constructed using a transparent coding rubric covering:

- Target specificity and baselines.
- Scope and boundary clarity.
- Governance oversight and incentives.
- Methodological transparency and assurance.

Scores are normalized to facilitate comparison.

6.2 Operational outputs (O)

Operational metrics include intensity-based performance indicators standardized by industry and year.

6.3 Outcomes (I)

Outcome metrics capture real-world effects derived from external monitoring systems and are normalized for comparability.

6.4 Greenwashing risk

Greenwashing risk is operationalized as disclosure–outcome misalignment:

$$GW_{i,t} = z(D_{i,t}) - z(I_{i,t})$$

Higher values indicate strong disclosure combined with weak outcomes.

7. Empirical Strategy

The analysis combines descriptive statistics with fixed-effects panel regressions:

$$I_{i,t+1} = \beta_0 + \beta_1 D_{i,t} + \beta_2 O_{i,t} + \gamma X_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t}$$

Robustness checks include alternative horizons, weighting schemes, and subsample analyses.

8. Discussion

The findings are interpreted through the lens of decoupling and enforcement. Disclosure improves transparency but does not guarantee impact. The use of externally verifiable outcome data significantly strengthens ESG evaluation and limits greenwashing through narrative control.

9. Implications

For research

The framework enables reproducible ESG analysis without proprietary ratings and introduces a measurable construct for greenwashing risk.

For investors and regulators

High disclosure scores should not be interpreted as evidence of impact without supporting outcome data.

For managers

Effective ESG management requires aligning reporting practices with verifiable outcomes rather than focusing solely on disclosure completeness.

10. Limitations

Outcome data availability varies across jurisdictions and sectors. Facility-to-firm matching introduces measurement challenges, and causal attribution remains limited.

11. Conclusions

Credible ESG assessment requires a clear distinction between disclosure, operational outputs, and real-world outcomes. The ESG-to-Impact framework provides a transparent and auditable approach for evaluating sustainability performance beyond reporting, advancing ESG research toward measurable impact.

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