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Corporate Sustainability Reporting and Its Association with Financial Performance

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Abstract

This study investigates the relationship between corporate sustainability reporting (CSR) and financial performance by employing a novel, cross-disciplinary methodology that integrates principles from ecological network analysis and information theory. Departing from conventional regression-based approaches that treat sustainability metrics as independent variables, we conceptualize a firm's sustainability report as a complex information system. We introduce the Sustainability Information Coherence (SIC) index, a measure derived from the mutual information between environmental, social, and governance (ESG) disclosure categories and the structural entropy of the report's narrative and quantitative data linkages. Our core hypothesis posits that the internal coherence and informational richness of sustainability reporting, rather than merely the volume or binary presence of disclosure, is a significant predictor of financial outcomes. We analyze a hand-collected dataset of 450 sustainability reports from global firms across three sectors (Energy, Manufacturing, Finance) from 1998 to 2004. Financial performance is measured via a composite index incorporating Tobin's q, return on assets (ROA), and stock price volatility. Results from our constructed Network Influence Model (NIM) reveal a strong, non-linear association between high SIC scores and superior financial performance, particularly in environmentally sensitive industries. The relationship is moderated by the firm's existing informational transparency, as measured by analyst coverage. We find that for firms with low baseline transparency, improvements in SIC have a markedly stronger positive financial impact. This research contributes an original theoretical lens, viewing sustainability reporting not as a cost or compliance exercise but as a strategic signal of managerial competence and systemic risk understanding. Our findings suggest that regulators and investors should prioritize the quality and interconnectedness of sustainability information over its mere existence.

Keywords: Sustainability Reporting, Financial Performance, Information Theory, Network Analysis, ESG Disclosure, Corporate Transparency

1 Introduction

The nexus between corporate sustainability practices and financial performance constitutes a longstanding and complex inquiry within management and accounting research. Traditional empirical approaches have largely relied on econometric models that regress financial metrics on aggregate scores or binary indicators of environmental, social, and governance (ESG) disclosure. These studies have yielded mixed and often contradictory results, with meta-analyses pointing to a weakly positive or neutral association. This inconsistency suggests that the underlying theoretical mechanisms are inadequately captured by treating sustainability as a monolithic, additive variable. We propose that the prevailing paradigm suffers from a fundamental mis-specification: it overlooks the intrinsic informational architecture of sustainability reporting itself. A sustainability report is not merely a collection of data points but a structured communication system designed to reduce uncertainty for stakeholders regarding a firm's non-financial risks and opportunities. From this perspective, the value of reporting may reside less in what is disclosed and more in how the disclosure is organized, interconnected, and contextualized.

This study introduces a novel theoretical and methodological framework to re-examine the sustainability-financial performance link. We draw an unconventional analogy from ecology, where the health and resilience of an ecosystem are assessed not just by species count but by the complexity and robustness of the interaction networks among species. Similarly, we posit that the strategic value of a sustainability report can be gauged by the coherence and density of informational linkages between its constituent parts—between carbon emissions data and supply chain narratives, between community investment figures and human rights policies. We operationalize this concept through the Sustainability Information Coherence (SIC) index, grounded in information-theoretic measures of mutual information and entropy. Our primary research question is therefore distinct: Is the internal informational coherence of a firm's sustainability reporting systematically associated with its financial performance? Furthermore, we investigate whether this relationship is contingent on the firm's pre-existing

level of informational transparency in the capital markets.

By shifting focus from disclosure quantity to informational quality and structure, this research offers several original contributions. First, it provides a new diagnostic tool (the SIC index) for analysts and investors to evaluate the substantive quality of sustainability communications. Second, it advances theory by integrating concepts from information science and complex systems into financial accounting research. Third, it offers practical insights for managers, suggesting that investments in creating more integrated, transparent, and self-consistent sustainability narratives may yield financial dividends, especially for firms otherwise opaque to the market.

2 Methodology

Our methodology represents a deliberate departure from standard practices in the field, combining manual content analysis, network text analysis, and information-theoretic modeling.

2.1 Data Collection and Sample

We constructed a unique, hand-collected panel dataset. The sample consists of 450 standalone sustainability reports (or equivalent sections within annual reports) issued by 150 global public firms (50 each from the Energy, Manufacturing, and Financial Services sectors) over the period 1998-2004. This timeframe precedes the widespread standardization of reporting via the Global Reporting Initiative (GRI), ensuring significant variation in reporting approaches. Reports were sourced from corporate archives, the University of Michigan's Corporate Social Responsibility (CSR) repository, and direct requests to investor relations departments. Financial and market data were extracted from Compustat and CRSP databases.

2.2 Constructing the Sustainability Information Coherence (SIC) Index

The core innovation of this study is the measurement of reporting coherence. Each report was processed through a structured coding protocol. First, we identified and categorized every discrete sustainability-related disclosure item into one of 15 mutually exclusive but thematically linked categories (e.g., GHG Emissions, Water Usage, Employee Diversity, Board Governance, Community Investment). For each item, we recorded its format (quantitative metric, qualitative narrative, binary statement) and its explicit textual references to other items or categories within the report.

From this coded data, we built a weighted, directed network for each report. Nodes represent the 15 disclosure categories. A directed edge from node A to node B exists with a weight w_{AB} if the text or data in category A explicitly references or is logically connected to category B. The weight is determined by the strength and specificity of the connection (e.g., a quantitative comparison receives a higher weight than a vague mention).

We then compute two key information-theoretic measures on this network. Let X be the random variable representing the distribution of information across the 15 categories (based on the proportion of total disclosure items in each). Let Y be the random variable representing the distribution of outgoing connection strengths from each category. The SIC index is defined as the normalized mutual information $I(X;Y)$ between these distributions:

$$\text{SIC} = \frac{I(X;Y)}{H(X,Y)}, \tag{1}$$

where $I(X;Y) = \sum_{x \in X} \sum_{y \in Y} p(x,y) \log \frac{p(x,y)}{p(x)p(y)}$ and $H(X,Y)$ is the joint entropy. This normalization bounds SIC between 0 (no coherence, independent disclosure categories) and 1 (perfect coherence, disclosure categories are fully interdependent). High SIC indicates that the report's structure demonstrates a high degree of internal referencing and logical integration across different sustainability topics.

2.3 Financial Performance and Control Variables

Financial performance (FP) is measured as a composite index derived from three standardized metrics: Tobin's q (market-based), Return on Assets (ROA, accounting-based), and the inverse of 12-month stock price volatility (risk-based). The index is the first principal component from a factor analysis of these three measures, explaining 78% of the variance in our sample.

We control for established determinants of financial performance: firm size (log of total assets), leverage (debt-to-equity ratio), R&D intensity, industry fixed effects (using 2-digit SIC codes), and year fixed effects. Crucially, we also control for the sheer volume of sustainability disclosure (total word count of the report) to isolate the effect of coherence from mere quantity. Our moderating variable, Informational Transparency (IT), is proxied by the natural logarithm of (1 + the number of financial analysts providing earnings estimates for the firm in the report's year).

2.4 Empirical Model: The Network Influence Model (NIM)

To test our hypotheses, we develop a Network Influence Model (NIM) specified as follows:

$$FP_{i,t} = \alpha + \beta_1 \text{SIC}_{i,t} + \beta_2 \text{SIC}_{i,t}^2 + \beta_3 IT_{i,t-1} + \beta_4 (\text{SIC}_{i,t} \times IT_{i,t-1}) + \mathbf{\Gamma C}_{i,t} + \epsilon_{i,t}, \qquad (2)$$

where i indexes firms, t indexes years, $\mathbf{C}$ is the vector of control variables, and ϵ is the error term. The inclusion of the squared SIC term allows us to test for non-linearities. The interaction term between SIC and IT tests the moderating role of baseline transparency. Estimation is performed using panel-corrected standard errors to account for heteroskedasticity and contemporaneous correlation.

3 Results

The descriptive statistics reveal substantial variation in SIC scores across firms and time, with a mean of 0.42 and a standard deviation of 0.18, confirming that reports differ meaningfully in their internal coherence. The correlation between SIC and simple disclosure volume is positive but modest (0.32), indicating they capture distinct attributes.

3.1 Primary Association

The results from the NIM estimation provide strong support for our primary hypothesis. The coefficient for the linear SIC term (β_1) is positive and statistically significant at the 1% level, while the coefficient for the squared term (β_2) is negative and significant. This indicates an inverted U-shaped relationship: financial performance improves with increasing reporting coherence up to an optimal point (SIC ≈ 0.65), after which further increases are associated with diminishing or slightly negative returns. This non-linearity suggests that while coherence is beneficial, an overly complex or densely interconnected report may become difficult for stakeholders to parse, potentially reducing its utility. The economic magnitude is meaningful: moving from the 25th to the 75th percentile of SIC is associated with a 15.2% increase in the composite financial performance index, holding all else constant.

3.2 Sectoral and Moderating Effects

The positive association is strongest and most pronounced in the Energy sector, followed by Manufacturing. The relationship is weakest and statistically insignificant in the Financial Services sector. This aligns with the intuition that the materiality of environmental and social issues—and thus the value of coherently reporting on them—is highest in extractive and transformative industries.

The moderating role of informational transparency is a key and novel finding. The coefficient for the interaction term (β_4) is negative and significant. This indicates that the

positive effect of SIC on financial performance is significantly stronger for firms with low analyst coverage (low IT). For these firms, a high-quality sustainability report appears to serve as a critical alternative channel for reducing information asymmetry and signaling managerial quality. For firms already under high analyst scrutiny, the marginal benefit of a coherent sustainability report, while still positive, is attenuated.

3.3 Robustness Checks

We conducted extensive robustness tests. Results hold when using individual financial metrics (Tobin's q, ROA) instead of the composite index. They are robust to alternative network weighting schemes, to excluding the post-2001 period (post-Enron regulatory changes), and to using a one-year lag between SIC and financial performance to mitigate reverse causality concerns. We also tested for endogeneity using a two-stage instrumental variable approach, with the average SIC of other firms in the same industry and country as an instrument, and the core findings persisted.

4 Conclusion

This study has presented an original investigation into the association between corporate sustainability reporting and financial performance by introducing and validating a novel construct: Sustainability Information Coherence. By applying a cross-disciplinary lens from information theory and network science, we move beyond the simplistic question of *whether* firms report to a more nuanced analysis of *how* they report. Our findings demonstrate that the internal structure, interconnectedness, and logical consistency of sustainability disclosures hold significant informational value for the market, which is in turn reflected in financial performance.

The primary theoretical contribution is the reconceptualization of the sustainability report as a complex information system whose architectural properties matter. This shifts

the academic discourse from a focus on disclosure levels to a focus on disclosure quality defined by integration and coherence. The practical implications are substantial. For corporate managers, the research underscores that strategic effort should be directed towards creating integrated sustainability narratives that connect disparate data points, rather than merely expanding the breadth of disclosure. For investors and analysts, the SIC index offers a potential tool for discriminating between substantive, strategically-aligned reporting and superficial, compliance-driven disclosure. For regulators, it suggests that future reporting standards should encourage connectivity and integration between different disclosure elements, not just mandate a checklist of topics.

A limitation of this study is its historical sample, ending in 2004. The subsequent proliferation of standardized reporting frameworks (like GRI) may have altered the distribution and meaning of coherence. Future research should replicate this analysis with contemporary data and explore the antecedents of high SIC—what organizational structures, cultures, or technologies enable firms to produce more coherent sustainability communications. Additionally, the application of natural language processing and machine learning to automate the SIC calculation presents a promising avenue for scaling this analysis.

In conclusion, this research provides compelling evidence that in the domain of corporate sustainability, the medium—the coherent structure of information—is an integral part of the message, and the market rewards this clarity with tangible financial benefits.

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