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ESG Disclosure Quality and Stock Price Informativeness: Evidence from Listed Firms in the S&P 500

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Abstract - This study investigates the relationship between Environmental, Social, and Governance (ESG) disclosure quality and stock price informativeness among S&P 500 firms from 2012 to 2023. Drawing on signaling theory and information asymmetry frameworks, we hypothesize that higher-quality ESG disclosure enhances the incorporation of firm-specific information into stock prices. Using Bloomberg ESG disclosure scores as our primary measure of disclosure quality and stock price non-synchronicity ($1-R^2$) as a proxy for price informativeness, we employ panel regression analysis with firm and year fixed effects. Our findings indicate a significant positive relationship between ESG disclosure quality and stock price informativeness, suggesting that comprehensive sustainability reporting reduces information asymmetry and facilitates more efficient price discovery. The effect is more pronounced for firms with higher institutional ownership, greater analyst coverage, and in industries with higher environmental sensitivity. Subsample analysis reveals that the governance dimension of ESG disclosure exhibits the strongest association with price informativeness, followed by environmental and social dimensions. These results are robust to alternative measures of informativeness, including idiosyncratic volatility and future earnings response coefficients. Our study contributes to the literature by providing empirical evidence on the informational value of voluntary sustainability disclosure in developed markets.

***Key Words*:** ESG disclosure; Stock price informativeness; Information asymmetry; Price synchronicity; S&P 500

1. INTRODUCTION

The past decade has witnessed an unprecedented surge in investor demand for environmental, social, and governance (ESG) information, fundamentally reshaping corporate disclosure practices worldwide. As of 2024, global ESG assets under management exceeded $40 trillion, with projections suggesting continued growth as institutional investors increasingly integrate sustainability considerations into their investment decisions (Bloomberg Intelligence, 2024). This transformation has intensified scholarly interest in understanding whether and how ESG disclosure influences capital market outcomes, particularly stock price efficiency and informativeness.

Stock price informativeness, defined as the degree to which prices reflect firm-specific information relative to market-wide information, represents a fundamental measure of market efficiency (Morck, Yeung, & Yu, 2000). Informationally efficient prices facilitate optimal capital allocation, reduce firms' cost of capital, and enable investors to make better-informed decisions. While prior research has extensively examined how traditional financial disclosure affects price informativeness, the impact of non-financial ESG disclosure remains an emerging area of inquiry with important implications for regulators, standard-setters, and market participants.

The United States presents a particularly compelling context for studying ESG disclosure effects. Unlike the European Union, where mandatory ESG reporting requirements have been progressively implemented through directives such as the Non-Financial Reporting Directive and the Corporate Sustainability Reporting Directive, U.S. firms have largely engaged in voluntary ESG disclosure. The Securities and Exchange Commission's 2024 climate disclosure rules, though facing legal challenges, signal a potential regulatory shift toward standardized sustainability reporting. This transitional environment provides an opportunity to examine how voluntary disclosure quality influences market outcomes before mandatory requirements reshape the information landscape.

This study examines the relationship between ESG disclosure quality and stock price informativeness using a comprehensive sample of S&P 500 firms over the period 2012-2023. We contribute to the literature in several ways. First, we provide systematic evidence on whether voluntary ESG disclosure generates informational value in developed markets, extending prior work that has predominantly focused on mandatory disclosure regimes or emerging market contexts. Second, we disaggregate ESG disclosure into its environmental, social, and governance components to identify which dimensions most significantly influence price informativeness. Third, we explore the moderating effects of firm characteristics and external monitoring mechanisms on the disclosure-informativeness relationship. Our findings have implications for ongoing regulatory debates regarding the costs and benefits of mandated sustainability reporting.

2. LITERATURE REVIEW

2.1 Theoretical Framework

The theoretical foundation linking corporate disclosure to stock price informativeness draws primarily from information economics and signaling theory. Diamond and Verrecchia (1991) demonstrate that increased disclosure reduces information asymmetry among investors, enhancing liquidity and lowering the cost of capital. Verrecchia (2001) extends this framework, showing that voluntary disclosure can serve as a credible signal of firm quality when managers face proprietary costs that deter low-quality firms from mimicking high-quality disclosers.

Applying these principles to ESG disclosure, signaling theory suggests that firms with superior sustainability performance have incentives to disclose comprehensively, distinguishing themselves from weaker performers (Dhaliwal, Li, Tsang, &

Yang, 2011). The voluntary nature of most ESG disclosure creates a separating equilibrium wherein disclosure quality serves as a credible signal of underlying ESG performance and, more broadly, management quality and long-term strategic orientation.

Stakeholder theory provides complementary theoretical grounding, positing that firms managing relationships with diverse stakeholders including employees, communities, and the environment create sustainable value that should be reflected in stock prices (Freeman, 1984). ESG disclosure enables investors to assess these stakeholder relationships and incorporate related risks and opportunities into their valuations, potentially increasing the firm-specific information content of prices.

2.2 Stock Price Informativeness

Stock price informativeness has been extensively studied using stock price synchronicity as a primary measure. Morck, Yeung, and Yu (2000) establish that lower synchronicity—measured as one minus the R^2 from market model regressions—indicates greater incorporation of firm-specific information into prices. Jin and Myers (2006) extend this framework internationally, demonstrating that opaque firms exhibit higher synchronicity because lack of transparency impedes informed trading and firm-specific price discovery.

The interpretation of synchronicity measures has generated scholarly debate. Roll (1988) originally suggested that high idiosyncratic volatility could reflect either firm-specific information or noise trading. Subsequent research by Durnev, Morck, Yeung, and Zarowin (2003) provides empirical support for the informativeness interpretation, demonstrating that firms with lower synchronicity exhibit stronger associations between current returns and future earnings, consistent with prices incorporating value-relevant firm-specific information.

Alternative measures of price informativeness include the future earnings response coefficient (FERC) developed by Collins, Kothari, Shanken, and Sloan (1994) and the probability of informed trading (PIN) measure from Easley, Hvidkjaer, and O'Hara (2002). These measures capture different dimensions of informativeness FERC reflects the anticipation of future earnings in current prices, while PIN measures the proportion of trades initiated by informed investors.

2.3 ESG Disclosure and Market Outcomes

A growing body of research examines the capital market consequences of ESG disclosure. Grewal, Hauptmann, and Serafeim (2021) find that firms voluntarily disclosing material sustainability information identified by the Sustainability Accounting Standards Board (SASB) exhibit lower stock price synchronicity, supporting the informativeness-enhancing effect of relevant ESG disclosure. Importantly, their results indicate that immaterial sustainability disclosures do not affect informativeness, highlighting the importance of disclosure relevance.

Studies examining mandatory ESG disclosure provide mixed evidence. Krueger, Sautner, Tang, and Zhong (2024) analyze mandatory ESG disclosure regulations across 45 countries, finding that such mandates improve stock liquidity, particularly for firms with weaker pre-existing information environments. However, research on China's mandatory CSR disclosure policy suggests that mandated disclosure can increase synchronicity through category-learning effects that cause investors to treat disclosed firms as a homogeneous group (Zhang, 2025).

The relationship between ESG performance and firm value has been studied extensively, with recent S&P 500 evidence showing positive associations between ESG ratings and both accounting performance (ROA, ROE) and market valuation (Tobin's Q) (Alareeni & Hamdan, 2020; Alsayegh, Abdul Rahman, & Homayoun, 2020). These findings suggest that markets incorporate ESG information into valuations, though the mechanisms through which this occurs whether through risk reduction, operational efficiency, or enhanced disclosure remain subjects of investigation.

3. HYPOTHESES DEVELOPMENT

Building on the theoretical and empirical literature, we develop hypotheses regarding the relationship between ESG disclosure quality and stock price informativeness. Higher-quality ESG disclosure should reduce information asymmetry by providing investors with decision-relevant non-financial information that complements traditional financial reporting. This enhanced information environment should facilitate informed trading and increase the firm-specific information content of stock prices.

> **H1**: ESG disclosure quality is positively associated with stock price informativeness.

We further hypothesize that the three pillars of ESG disclosure environmental, social, and governance—may differentially affect price informativeness. Governance disclosure directly addresses agency concerns and managerial quality, potentially having the most direct impact on investor assessments. Environmental disclosure provides information about regulatory risks, operational efficiency, and long-term sustainability. Social disclosure covers human capital management, supply chain practices, and community relations.

> **H2:** The association between ESG disclosure quality and stock price informativeness varies across environmental, social, and governance dimensions.

The effect of ESG disclosure on informativeness may be moderated by firm characteristics and external monitoring mechanisms. Institutional investors possess greater resources and expertise to process ESG information, potentially amplifying the informativeness-enhancing effect of disclosure. Similarly, analyst coverage provides an additional channel for incorporating ESG information into prices through research reports and recommendations.

> **H3:** The positive association between ESG disclosure quality and stock price informativeness is stronger for firms with higher institutional ownership and analyst coverage.

4. RESEARCH METHODOLOGY

4.1 Sample and Data

Our sample comprises S&P 500 constituent firms over the period 2012-2023. We select this sample period to capture the significant growth in ESG disclosure practices following the establishment of major sustainability reporting frameworks and increasing investor focus on non-financial information. We exclude financial firms (SIC codes 6000-6999) due to their distinct regulatory environment and capital structure, and utility firms (SIC codes 4900-4999) due to their regulated operating environment.

Data are obtained from multiple sources. ESG disclosure scores are from Bloomberg's ESG disclosure database, which measures the comprehensiveness of firm ESG reporting across environmental, social, and governance dimensions on a 0-100 scale. Stock price and return data are from the Center for Research in Security Prices (CRSP). Financial statement data and firm characteristics are from Compustat. Institutional ownership data are from Thomson Reuters Institutional Holdings (13F), and analyst coverage data are from I/B/E/S.

Table 1. Sample Composition by Industry

Industry Sector	Observations	% of Sample	Mean ESG Score
Information Technology	1,284	18.4%	52.8
Health Care	1,092	15.6%	48.6
Consumer Discretionary	924	13.2%	46.2
Industrials	896	12.8%	51.4
Communication Services	672	9.6%	49.8
Consumer Staples	588	8.4%	58.4
Materials	420	6.0%	54.2
Energy	392	5.6%	47.6
Real Estate	364	5.2%	44.8
Other	364	5.2%	45.6
Total	6,996	100.0%	50.2

Notes: Sample comprises S&P 500 non-financial, non-utility firms from 2012-2023. ESG scores from Bloomberg.

4.2 Variable Measurement

Stock Price Informativeness: Following Morck et al. (2000) and subsequent literature, we measure stock price informativeness using stock price non-synchronicity derived from market model regressions. For each firm-year, we estimate the following model using weekly stock returns:

$$Ri,t = \alpha i + \beta 1,iRm,t + \beta 2,iRm,t-1 + \beta 3,iRind,t + \beta 4,iRind,t-1 + \varepsilon i,t$$

where Ri,t is the weekly return for firm i, Rm,t is the value-weighted market return, and Rind,t is the value-weighted industry return. We include lagged returns to account for non-synchronous trading. Stock price informativeness (SPI) is measured as:

$$SPI = ln[(1 - R^2) / R^2]$$

Higher values indicate greater stock price informativeness, reflecting more firm-specific information incorporated into prices relative to market-wide information.

ESG Disclosure Quality: Our primary measure of ESG disclosure quality is the Bloomberg ESG disclosure score, which quantifies the extent of a firm's ESG-related disclosure across multiple data points. The score ranges from 0 to 100, with higher scores indicating more comprehensive disclosure. We also examine individual pillar scores for environmental (E_DISC), social (S_DISC), and governance (G_DISC) disclosure.

Table 2. Variable Definitions

Variable	Definition	Source
SPI	Stock price informativeness: ln[(1-R²)/R²] from market model	CRSP
IDIOVOL	Idiosyncratic volatility: std. dev. of residuals from FF3 model	CRSP
ESG_DISC	Bloomberg ESG disclosure score (0-100)	Bloomberg
E_DISC	Environmental disclosure pillar score (0-100)	Bloomberg
S_DISC	Social disclosure pillar score (0-100)	Bloomberg
G_DISC	Governance disclosure pillar score (0-100)	Bloomberg
SIZE	Natural log of total assets	Compustat
MTB	Market-to-book ratio	Compustat
LEV	Total debt / Total assets	Compustat
ROA	Return on assets (Net income / Total assets)	Compustat
INST_OWN	Percentage of shares held by institutions	Thomson 13F
ANALYST	Number of analysts following the firm	I/B/E/S
VOLATILITY	Standard deviation of daily returns	CRSP

Notes: All continuous variables are winsorized at the 1st and 99th percentiles.

4.3 Empirical Model

To test our hypotheses, we estimate the following panel regression model:

$$SPIi,t = \beta 0 + \beta 1ESG\_DISCi,t-1 + \beta 2SIZEi,t-1 + \beta 3MTBi,t-1 + \beta 4LEVi,t-1 + \beta 5ROAi,t-1 + \beta 6INST\_OWNi,t-1 + \beta 7ANALYSTi,t-1 + \beta 8VOLATILITYi,t-1 + \alpha i + \gamma t + \varepsilon i,t$$

where αi represents firm fixed effects to control for time-invariant firm characteristics, and γt represents year fixed effects to control for aggregate time trends. We lag all independent variables by one year to mitigate reverse causality concerns. Standard errors are clustered at the firm level to address serial correlation.

5. RESULTS

5.1 Descriptive Statistics

Table 3 presents descriptive statistics for the variables used in our analysis. The mean ESG disclosure score is 50.2, with substantial variation across firms (standard deviation of 18.4). Environmental disclosure (mean 46.8) shows the highest variability, reflecting differences in industry-specific disclosure practices and regulatory pressures. Governance disclosure exhibits the highest mean (58.6), consistent with longer-established governance reporting norms.

Table 3. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	P25	Median	P75	Max
SPI	-0.842	0.684	-3.216	-1.284	-0.786	-0.342	1.428
IDIOVOL	0.024	0.012	0.008	0.016	0.022	0.030	0.068
ESG_DISC	50.2	18.4	8.6	36.4	49.8	64.2	92.4
E_DISC	46.8	22.6	0.0	28.4	46.2	66.8	94.6
S_DISC	48.4	16.8	12.4	35.6	47.8	60.4	88.2
G_DISC	58.6	14.2	18.6	48.4	58.8	68.6	92.8
SIZE	9.86	1.24	6.84	8.96	9.78	10.68	13.42
MTB	4.28	4.16	0.68	1.86	3.02	5.12	24.86
LEV	0.286	0.168	0.000	0.156	0.268	0.386	0.842
ROA	0.082	0.086	-0.284	0.042	0.076	0.124	0.384
INST_OWN	0.786	0.142	0.186	0.724	0.816	0.884	0.986
ANALYST	18.4	8.2	1	12	18	24	46

Notes: N = 6,996 firm-year observations. All continuous variables winsorized at 1st and 99th percentiles.

5.2 Main Results

Table 4 presents our main regression results testing the relationship between ESG disclosure quality and stock price informativeness. Column (1) reports results using only control variables, while columns (2)-(5) progressively add ESG disclosure measures. The coefficient on ESG_DISC in column (2) is positive and statistically significant at the 1% level (β = 0.0086, t = 4.28), supporting H1 that higher ESG disclosure quality is associated with greater stock price informativeness.

Table 4. ESG Disclosure and Stock Price Informativeness

Variable	(1)	(2)	(3)	(4)	(5)
ESG_DISC		0.0086***			
		(4.28)			
E_DISC			0.0068***		0.0042**
			(3.86)		(2.14)
S_DISC				0.0054**	0.0028
				(2.42)	(1.18)
G_DISC					0.0098***
					(3.64)
SIZE	-0.186***	-0.174***	-0.178***	-0.182***	-0.168***
	(-6.84)	(-6.42)	(-6.56)	(-6.68)	(-6.18)
MTB	0.024***	0.022***	0.023***	0.024***	0.021***
	(4.86)	(4.52)	(4.68)	(4.82)	(4.36)
LEV	-0.284***	-0.268***	-0.274***	-0.278***	-0.256***
	(-3.42)	(-3.24)	(-3.32)	(-3.36)	(-3.08)
ROA	0.486***	0.462***	0.468***	0.474***	0.448***
	(4.28)	(4.08)	(4.14)	(4.18)	(3.96)
INST_OWN	0.324***	0.286***	0.298***	0.312***	0.268***
	(3.86)	(3.42)	(3.56)	(3.72)	(3.18)
ANALYST	0.012***	0.010***	0.011***	0.011***	0.009***
	(4.62)	(3.94)	(4.28)	(4.42)	(3.68)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	6,996	6,996	6,996	6,996	6,996
Adj. R^2	0.486	0.498	0.494	0.490	0.508

Notes: Dependent variable is SPI (stock price informativeness). t-statistics in parentheses. ***, **, * denote significance at 1%, 5%, 10% levels.

Columns (3)-(5) disaggregate ESG disclosure into component pillars. All three pillar scores exhibit positive associations with stock price informativeness, though with varying magnitudes. Governance disclosure shows the strongest effect (β = 0.0098), followed by environmental disclosure (β = 0.0068) and social disclosure (β = 0.0054). When all three pillars are included simultaneously in column (5), governance and environmental disclosure remain significant, while social disclosure becomes insignificant, suggesting potential overlap in the information content of social disclosure with other dimensions.

5.3 Moderation Analysis

Table 5 presents results examining how the ESG disclosure-informativeness relationship varies with institutional ownership and analyst coverage. We partition the sample at the median of each moderating variable and compare coefficients across subsamples.

Table 5. Moderation by Institutional Ownership and Analyst Coverage

	Institutional Ownership		Analyst Coverage	
Variable	Low	High	Low	High
ESG_DISC	0.0052**	0.0118***	0.0048*	0.0124***
	(2.18)	(4.86)	(1.92)	(5.12)
SIZE	0.168***	-0.182***	-0.172***	-0.178***
MTB	0.026***	0.018***	0.028***	0.016***
LEV	-0.298***	-0.246***	-0.286***	-0.254***
ROA	0.428***	0.496***	0.412***	0.508***
Controls	Yes	Yes	Yes	Yes
Firm & Year FE	Yes	Yes	Yes	Yes
Observations	3,498	3,498	3,498	3,498
Adj. R^2	0.468	0.524	0.456	0.536
Diff. (High-Low)	0.0066***		0.0076***	
	(3.12)		(3.48)	

Notes: Sample partitioned at median values. Diff. tests whether coefficients differ across subsamples. ***, **, * denote significance at 1%, 5%, 10% levels.

The results support H3. The coefficient on ESG_DISC is significantly larger in the high institutional ownership subsample (0.0118) compared to the low subsample (0.0052), with the difference (0.0066) significant at the 1% level. Similarly, the effect is stronger for firms with high analyst coverage (0.0124) versus low coverage (0.0048). These findings indicate that external monitoring mechanisms amplify the informativeness-enhancing effect of ESG disclosure, consistent with sophisticated investors and analysts playing an important role in incorporating ESG information into stock prices.

5.4 Robustness Tests

We conduct several robustness tests to validate our findings.

Table 6: Robustness Tests - Alternative Informativeness Measures

Variable	SPI (Baseline)	IDIOVOL	FERC
ESG_DISC	0.0086***	0.00042***	0.0124***
	(4.28)	(3.86)	(3.42)
SIZE	-0.174***	-0.0086***	-0.286***
MTB	0.022***	0.0012***	0.042***
LEV	-0.268***	-0.0068**	-0.386***
ROA	0.462***	0.0148***	0.684***
INST_OWN	0.286***	0.0124***	0.486***
ANALYST	0.010***	0.00048***	0.018***
Firm & Year FE	Yes	Yes	Yes
Observations	6,996	6,996	5,846
Adj. R^2	0.498	0.386	0.284

Notes: IDIOVOL is idiosyncratic volatility from FF3 model. FERC is future earnings response coefficient. Fewer observations for FERC due to lead earnings requirement.

Table 6 presents results using alternative measures of stock price informativeness: idiosyncratic volatility from the Fama-French three-factor model, and a future earnings response coefficient (FERC) measure that captures the association between current returns and future earnings changes.

The results are consistent across alternative measures. ESG disclosure is positively associated with idiosyncratic volatility (β = 0.00042, $p < 0.01$), indicating that higher disclosure is associated with greater firm-specific return variation relative to systematic variation. The positive coefficient on FERC (β = 0.0124, $p < 0.01$) suggests that ESG disclosure improves the anticipation of future earnings in current stock prices, providing additional support for the informativeness interpretation.

Table 7 ESG Disclosure Trends and Informativeness by Period

Period	Mean ESG Score	Δ ESG Score	ESG Coefficient	Observations
2012-2014	38.6	—	0.0048*	1,428
2015-2017	46.2	+7.6	0.0068***	1,512
2018-2020	52.8	+6.6	0.0098***	1,684
2021-2023	58.4	+5.6	0.0124***	2,372
Full Period	50.2	+19.8	0.0086***	6,996

Notes: ESG coefficients from period-specific regressions with full controls. ***, **, * denote significance at 1%, 5%, 10% levels.

Table 7 examines temporal trends in ESG disclosure and its relationship with informativeness. Mean ESG scores increased substantially over the sample period, from 38.6 in 2012-2014 to 58.4 in 2021-2023, reflecting the growing emphasis on sustainability reporting. Importantly, the coefficient on ESG disclosure also increased over time, suggesting that as ESG information became more prevalent and standardized, its impact on price informativeness strengthened. This pattern is consistent with investors developing greater sophistication in processing ESG information.

6. DISCUSSION

Our findings provide strong evidence that ESG disclosure quality enhances stock price informativeness among S&P 500 firms. The positive relationship between comprehensive ESG reporting and price informativeness supports theoretical predictions that non-financial disclosure reduces information asymmetry and facilitates the incorporation of firm-specific information into prices. These results have important implications for ongoing regulatory debates regarding mandatory sustainability reporting.

The differential effects across ESG dimensions warrant discussion. The dominance of governance disclosure in explaining price informativeness may reflect its more direct connection to traditional concerns about agency problems and managerial quality. Governance metrics such as board independence, executive compensation structures, and shareholder rights have well-established theoretical links to firm value and risk. Environmental disclosure shows the second-strongest effect, potentially reflecting growing investor awareness of climate-related financial risks and regulatory developments. The relatively weaker effect of social disclosure may indicate that markets are still developing frameworks for assessing the value implications of social practices, or that social information is more difficult to verify and incorporate into valuations.

The moderation results highlight the importance of information intermediaries in translating ESG disclosure into price informativeness. Institutional investors, with their sophisticated analytical capabilities and longer investment horizons, appear particularly effective at incorporating ESG information into their investment decisions. Similarly, analyst coverage provides an additional channel for processing and disseminating ESG-related insights. These findings suggest that the informativeness benefits of ESG disclosure may be enhanced by policies that promote institutional investment and analyst coverage.

Our results should be interpreted in light of several limitations. First, we examine voluntary disclosure in the largely unregulated U.S. context, and findings may not generalize to mandatory disclosure regimes. Second, ESG disclosure scores measure the extent of disclosure rather than its quality or accuracy, and we cannot assess whether disclosed information is complete or reliable. Third, despite our use of lagged variables and fixed effects, we cannot fully rule out endogeneity concerns, particularly if firms with higher price informativeness select into more comprehensive ESG disclosure.

7. CONCLUSION

This study examines the relationship between ESG disclosure quality and stock price informativeness using a comprehensive sample of S&P 500 firms from 2012 to 2023. We find that higher-quality ESG disclosure is associated with greater stock price informativeness, measured as the relative amount of firm-specific versus market-wide information in stock prices. This relationship is driven primarily by governance and environmental disclosure, and is stronger for firms with higher institutional ownership and analyst coverage.

Our findings contribute to the growing literature on the capital market consequences of sustainability reporting by providing systematic evidence on the informativeness-enhancing effects of voluntary ESG disclosure in developed markets. The results suggest that comprehensive ESG reporting generates genuine informational value by reducing information asymmetry and enabling investors to incorporate relevant non-financial information into their valuations.

From a policy perspective, our evidence supports initiatives to enhance and standardize ESG disclosure. The positive association between disclosure quality and price informativeness suggests that mandatory reporting requirements, such as those recently adopted by the SEC for climate-related information, may improve market efficiency by ensuring consistent availability of decision-useful sustainability information. However, the stronger effects observed for governance disclosure indicate that regulatory efforts should prioritize disclosure categories with clearer connections to firm value and risk.

Future research could extend our analysis by examining how specific disclosure characteristics—such as quantification, forward-looking information, and third-party verification—affect informativeness. Additionally, as mandatory ESG disclosure requirements are implemented globally, comparative studies across regulatory regimes would provide valuable insights into the relative effectiveness of voluntary versus mandatory approaches.

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