

FINANCIAL PERFORMANCE AND SUSTAINABILITY TRANSPARENCY: LOGISTIC AND BAYESIAN ANALYSIS OF ESG REPORTING

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Abstract: Amid tightening regulatory frameworks, exemplified by the EU Corporate Sustainability Reporting Directive (CSRD), understanding the determinants of Environmental, Social, and Governance (ESG) disclosure has become a critical concern for both scholars and practitioners. This paper explores the interplay between ESG reporting practices and financial performance in a sample of 300 Italian-owned firms operating in Romania over the period 2012–2022. A novel dataset was developed by integrating information from the Bureau van Dijk Orbis database with publicly available corporate reports, providing an original empirical basis for this study. Financial performance was distilled using Principal Component Analysis (PCA), while ESG disclosure was specified as a binary dependent variable. The analysis employed logistic and probit regression models, supplemented with Bayesian estimation techniques to ensure robustness.

Results reveal a U-shaped relationship between firm performance and the likelihood of ESG reporting: both underperforming and highly profitable companies are more inclined to disclose sustainability information, either as a legitimacy mechanism or as a reputational signaling strategy. Additionally, group-level ESG commitments, firm size, and sectoral risk exposure emerges as significant predictors of disclosure behavior. This research contributes to the literature by offering rare insights into an understudied Eastern European context, with implications for multinational corporate governance and sustainability policy design. Future investigations should extend this framework to dynamic modeling and incorporate qualitative evidence to better understand the motivations behind ESG transparency.

Keywords: ESG reporting, financial performance, logistic regression, PCA.

JEL Classification: M14, G30, Q56, C38

1. Introduction

Sustainability transparency has evolved from a voluntary disclosure practice into a strategic and regulatory requirement. With the implementation of the CSRD, European companies must provide extensive ESG-related information, reshaping corporate governance standards. Despite this progress, the drivers behind ESG disclosure decisions remain debated, particularly for subsidiaries of multinational firms operating in emerging economies.

Most empirical studies examine listed corporations in Western Europe or the United States, overlooking the disclosure behavior of firms in Eastern European economies, where institutional frameworks are weaker and reporting enforcement remains inconsistent. Understanding these dynamics is essential for designing effective sustainability policies in the European Union.

This paper focuses on Italian-owned firms operating in Romania, an emerging EU economy characterized by strong foreign investment flows and progressive convergence with EU corporate governance standards. Using a sample of 300 companies over 2012–2022, this study examines how financial performance, firm size, group-level ESG practices, and sectoral factors affect the probability of ESG disclosure.

To address this research question, a multi-method econometric framework was applied, combining logistic regression, probit analysis, and Bayesian inference. Financial performance was

condensed through PCA into a synthetic index capturing firm-level profitability and stability. The results reveal a U-shaped relationship between financial performance and ESG reporting, suggesting that both struggling and high-performing firms have incentives to disclose sustainability information.

2. Literature Review and Theoretical Framing

2.1. Conceptual foundations of ESG disclosure

Corporate sustainability reporting has evolved from a voluntary public relations exercise into an essential component of strategic and financial management. According to the Triple Bottom Line framework (Elkington, 1997), firms are increasingly evaluated not only on financial outcomes but also on their social and environmental performance. ESG disclosure represents the formal communication of these dimensions through sustainability or integrated reports, websites, or non-financial statements.

The EU Non-Financial Reporting Directive (NFRD) and its successor, the CSRD, have institutionalized ESG reporting requirements across Europe. However, beyond regulatory compliance, firms differ widely in their motivation and capacity to disclose ESG information. Understanding these differences requires theoretical grounding.

2.2. Theoretical perspectives

This study is anchored in three complementary theoretical frameworks:

Legitimacy Theory (Suchman, 1995):

Firms disclose ESG information to align themselves with societal norms and expectations, especially when their performance is poor or contested. Disclosure functions as a legitimacy-restoring mechanism, aimed at mitigating reputational risk and social pressure.

Institutional Theory (DiMaggio & Powell, 1983):

Organizational behavior is shaped by coercive, mimetic, and normative pressures. Firms belonging to international corporate groups, or operating under EU-linked regulation, may imitate or conform to ESG practices already institutionalized at the group level. This theory is particularly relevant for multinational subsidiaries embedded in hybrid institutional environments like Romania.

Resource-Based and Signaling Theories (Barney, 1991; Spence, 1973)

From a strategic management perspective, ESG capabilities and transparency are valuable, rare, and inimitable resources that enhance reputation and investor trust. Well-performing firms may voluntarily disclose ESG information as a signal of quality and competitive advantage.

2.3. Empirical evidence and research gap

Empirical studies on the relationship between financial performance and ESG disclosure have produced mixed results. Some find positive associations, suggesting that financially healthy firms have more resources to invest in sustainability and communication (e.g., Buallay, 2019). Others report negative or insignificant effects, implying that weaker firms may use ESG reporting as a compensatory mechanism (Clarkson et al., 2008). A third stream of research identifies nonlinear relationships, particularly U-shaped ones, where both underperforming and highly profitable firms engage in reporting for different reasons (Nekhili et al., 2017; Giannarakis et al., 2021).

Most of these studies, however, focus on listed corporations in Western economies. Evidence from foreign-owned subsidiaries in Eastern Europe remains scarce, despite their growing importance in EU value chains. These subsidiaries are subject to dual institutional pressures, from both the parent company's governance system and the host country's regulatory environment, making their ESG disclosure behavior a theoretically rich but underexplored phenomenon.

2.4. Research objective and hypotheses

Building on the theoretical framework and prior empirical findings, this study aims to investigate how financial performance and firm-level characteristics influence ESG disclosure decisions among Italian-owned firms in Romania.

The analysis tests the following main hypotheses:

H1: There is a U-shaped relationship between financial performance and the likelihood of ESG reporting.

H2: Firms whose parent groups publish ESG reports are more likely to disclose locally (institutional spillover effect).

H3: Larger firms are more inclined to report ESG information, due to higher visibility and stakeholder scrutiny.

H4: Firms in regulated sectors, such as finance and energy, exhibit a higher probability of ESG disclosure.

3. Data and Methodology

3.1. Data sources and sample selection

The sample consists of 300 Italian-owned firms active in Romania from 2012 to 2022, identified through the Bureau van Dijk *Orbis* database. Firms were included if Italian ownership exceeded 50%, ensuring strategic control by the parent company. The dataset includes financial variables (ROA, ROE, leverage, liquidity, EBITDA margin) and a binary variable indicating ESG disclosure.

After data cleaning, 652 firm-year observations were retained, spanning manufacturing, services, and finance sectors. ESG data were manually verified from company websites and reports.

3.2. Measurement of variables

Dependent variable:

ESG Disclosure (*rapnfloc*): A binary variable coded as 1 if the firm disclosed ESG or non-financial information at the *local subsidiary level*, either through a standalone sustainability report or integrated reporting section, and 0 otherwise. The coding follows the EU CSRD disclosure taxonomy and was validated through two independent reviews of publicly available documents.

Key explanatory variables:

Financial1: PCA-based financial performance index (explaining 65.2% of variance).

Financial12: squared term to test the U-shaped relationship.

CertESG: group-level ESG reporting dummy.

CompSize: log of total assets.

NoOfShareh: number of shareholders (ownership dispersion).

CompType: financial sector dummy (1 = financial/insurance).

Control variables:

To reduce omitted-variable bias, models include sectoral and regional dummies based on NACE Rev. 2 classification, as well as year fixed effects to account for time-related shocks such as regulatory transitions or macroeconomic events.

3.3. Principal Component Analysis (PCA)

PCA reduced collinearity among financial ratios, creating a composite measure of firm performance. The first component had an eigenvalue of 4.56, explaining 65.2% of variance, confirming one-dimensionality (KMO = 0.712).

Table 1. Financial performance PCA summary

Component	Eigenvalue	Explained Variance (%)	Cumulative (%)
1	4.56	65.2	65.2
2	0.83	12.1	77.3

Source: computation using STATA

3.4. Econometric approach

A binary logistic regression estimates the probability of ESG disclosure as a function of financial performance and firm characteristics:

$$P(\text{ESG}_i = 1) = 1 / \left[1 + e - \left((\beta^0 + \beta^1 \cdot \text{financial1}_i + \beta^2 \cdot \text{financial1}_i^2 + \beta^3 \cdot X_i) \right) \right] \quad (1)$$

where X_i represents the vector of firm-level covariates (size, sector, ownership, and group ESG commitment). The logit specification allows estimation of marginal effects on the odds of disclosure.

To test robustness, two complementary estimations were conducted: Probit model, assuming a normal cumulative distribution of the latent response function and Bayesian logistic regression, employing Markov Chain Monte Carlo (MCMC) simulation to estimate posterior distributions of coefficients and credible intervals.

Model fit was evaluated using Hosmer-Lemeshow goodness-of-fit tests, pseudo R^2 , and Receiver Operating Characteristic (ROC) curves. The consistency of estimates across logit, probit, and Bayesian specifications ensures robustness against distributional assumptions and small-sample bias.

4. Empirical Results

4.1. Descriptive statistics and preliminary insights

Before estimating the econometric models, descriptive analyses were conducted to understand the dataset. Among the 300 Italian-owned firms in Romania, 27.6% publish ESG or non-financial information locally, while 72.4% do not disclose any sustainability data.

Firms engaging in ESG disclosure generally show higher financial performance, larger size, and are more often part of corporate groups already issuing consolidated sustainability reports. Financial and energy firms record the highest disclosure rates, reflecting stronger regulatory and stakeholder pressures.

Correlation checks confirmed no multicollinearity ($VIF < 3$), and the financial ratios used in the PCA displayed sufficient variance and normality, supporting the suitability of dimensionality reduction.

4.2. Logistic regression results

The baseline logistic regression models the probability of ESG disclosure as a function of financial performance (linear term), group ESG commitment, firm size, ownership structure, and sector.

Table 2. Determinants of ESG disclosure (logit model)

Variable		Odds Ratio	p-value	Interpretation
Group commitment (certesg)	ESG	2.01	0.019	Firms whose parent groups issue ESG reports are twice as likely to disclose locally.
Financial sector (comptype)	sector	94.9	0.004	Financial firms face stronger regulatory incentives and thus report more frequently.
Firm size (compsize)		0.136	0.023	Larger subsidiaries are less likely to report locally, possibly due to consolidated group reporting.
Ownership dispersion (noofshareh)		0.124	0.043	More dispersed ownership reduces local ESG transparency.

Source: STATA

The model fit is satisfactory (Pseudo $R^2 = 0.456$), and the Hosmer–Lemeshow test indicates a good model calibration ($\chi^2(10) = 8.81$, $p = 0.55$). The ROC curve shows an area under the curve (AUC) of 0.87, suggesting excellent discriminative power between disclosing and non-disclosing firms.

These findings support hypotheses H2 and H4, confirming that both group-level practices and sectoral regulation significantly influence local ESG reporting. However, the negative coefficient for firm size contradicts the conventional expectation of a positive relationship, suggesting that subsidiaries of large multinationals rely on consolidated group reporting rather than local disclosure.

4.3. Testing the nonlinear (U-shaped) effect

To test hypothesis H1, the extended logistic regression model includes both the linear and squared terms of the financial performance variable.

Table 3. Results of the extended logit model with a squared term (Binary Logistic Regression)

Variable		Odds Ratio	p-value	Effect
Financial (financial1)	performance	0.92	0.050	Negative slope at low performance levels
Squared (financial12)	performance	1.00	0.045	Positive curvature confirming a U-shape

Source: STATA

The results confirm a U-shaped relationship between financial performance and ESG reporting probability. Firms with low performance tend to disclose sustainability information as a legitimacy-repair mechanism, while firms with high performance disclose as a reputational signaling strategy. The middle-performing firms, by contrast, show less motivation to engage in ESG reporting.

A marginal effects analysis shows that the turning point of the curve, the minimum probability of disclosure, occurs at approximately the 40th percentile of the financial1 score, after which the likelihood of ESG reporting increases significantly with performance.

4.4. Robustness checks: probit and Bayesian estimation

The probit model yields similar coefficients and significance levels. The Bayesian logistic regression (10,000 posterior draws) produces posterior means and credible intervals consistent with frequentist results. Gelman–Rubin statistics (<1.05) confirm convergence, and posterior predictive checks validate the U-shaped relationship.

5. Discussion

The results reveal dual motivations for ESG disclosure. Underperforming firms use ESG communication to legitimize operations, consistent with Legitimacy Theory. Conversely, highly profitable firms disclose sustainability information as a reputational signal to investors, aligning with Signaling Theory.

Institutional pressures play a crucial role: subsidiaries embedded in multinational groups imitate parent-company practices, confirming the “institutional spillover effect.” The negative effect of firm size suggests that large subsidiaries rely on consolidated ESG reporting at the group level rather than producing local reports, which has implications for policymakers seeking greater transparency at subsidiary levels.

These findings suggest that sustainability regulations such as the CSRD should account for the dual motivations behind ESG reporting and provide differentiated incentives for subsidiaries versus parent companies.

6. Conclusions, contributions and limitations

This study offers new insights into ESG reporting among foreign-owned firms in Eastern Europe. The findings indicate a U-shaped relationship between financial performance and ESG disclosure, suggesting that both low- and high-performing firms are more likely to report on

sustainability. Additionally, a strong ESG commitment at the group level appears to significantly encourage local transparency, while sector-specific regulations, especially in finance and energy, remain important drivers. Firm size also plays a role, showing a substitution effect between local and consolidated reporting.

From a theoretical perspective, the study extends legitimacy and institutional frameworks to multinational subsidiaries operating in transition economies. Empirically, it provides the first systematic evidence on ESG disclosure among Italian-owned firms in Romania. Methodologically, the research demonstrates a robust approach by combining PCA, logistic and probit models, and Bayesian inference.

However, the study has some limitations. ESG reporting was coded as a binary variable, which does not capture the depth or quality of disclosure. The analysis was limited to a single country (Romania) and did not track changes over time following the adoption of the CSRD.

Future research could build on these findings by conducting multi-country comparative studies and using dynamic panel models, while also integrating qualitative assessments of disclosure content to capture richer insights.

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