



Environmental, Social, and Governance Disclosure and Cost of Capital: Evidence from Mandatory Non-Financial Reporting Reforms in the European Union during 2003-2013

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Abstract

This study investigates the causal effect of mandatory Environmental, Social, and Governance (ESG) disclosure on firms' cost of capital, exploiting the staggered adoption of non-financial reporting directives across European Union member states between 2003 and 2013. Using a difference-in-differences (DiD) framework on a panel of 4,872 publicly listed firms from 15 EU countries, we find that mandatory ESG disclosure reduces the implied cost of equity by an average of 28 basis points and the effective interest rate on debt by 19 basis points. The effect is more pronounced for firms with high pre-existing information asymmetry, firms in environmentally sensitive industries, and those with poor prior ESG performance. Mechanism tests suggest that improved disclosure reduces estimation risk and increases analyst coverage. Our results are robust to entropy balancing, placebo tests, and alternative cost-of-capital specifications. These findings provide critical evidence for regulators weighing the costs and benefits of mandatory non-financial reporting and contribute to the management literature on strategic disclosure and capital market outcomes.

Keywords: ESG disclosure; Mandatory reporting; Non-financial information; Information asymmetry
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1. Introduction

The past two decades have witnessed a global shift from voluntary to mandatory corporate disclosure of environmental, social, and governance (ESG) information. In 2003, the European Union began a gradual process of harmonising non-financial reporting through the Modernisation Directive (2003/51/EC), followed by the 2014 Non-Financial Reporting Directive (2014/95/EU). Yet, even before the latter's implementation, several EU member states—including France, Sweden, and Denmark—had enacted national laws requiring listed firms to disclose ESG information. This staggered regulatory landscape from 2003 to 2013 provides a unique quasi-experimental setting to answer a foundational question in management and finance: Does mandating ESG disclosure lower a firm's cost of capital?

From a theoretical standpoint, the relationship between disclosure and cost of capital is anchored in information asymmetry and risk sharing (Diamond & Verrecchia, 1991; Easley &



O'Hara, 2004). Greater disclosure reduces adverse selection, improves liquidity, and lowers investors' required rate of return. However, ESG information differs from traditional financial disclosure. It is often qualitative, forward-looking, and subject to measurement divergence. Critics argue that mandatory ESG reporting could impose compliance costs without reducing information asymmetry if investors do not value such information or if "greenwashing" confuses rather than clarifies (Christensen et al., 2017). Thus, whether mandatory ESG disclosure actually lowers the cost of capital remains an open empirical question.

Prior literature has largely focused on voluntary ESG disclosure or the effect of specific initiatives such as the Carbon Disclosure Project. Studies on mandatory regimes are rarer, with mixed results. For instance, Krueger et al. (2021) find that mandatory climate risk disclosure reduces cost of debt in developed markets, but Grewal et al. (2019) report only weak effects for broader ESG mandates. Moreover, most studies examine post-2014 reforms, leaving a gap regarding earlier, formative years of EU ESG regulation.

This paper makes three contributions. First, we provide causal evidence from a longitudinal, multi-country setting during 2003–2013—a critical period when the EU built the foundation for today's Sustainable Finance Disclosure Regulation (SFDR). Second, we separately analyze cost of equity and cost of debt, recognizing that different investor classes may react divergently to ESG information. Third, we identify channels (analyst coverage, forecast dispersion, and estimation risk) through which mandatory disclosure operates, offering direct implications for managers and policymakers.

Using a staggered DiD design with country-year and firm fixed effects, we find that mandatory ESG disclosure significantly reduces both implied cost of equity and cost of debt. The effects are economically meaningful: a reduction of 28 bps in cost of equity corresponds to an average 5.6% decline relative to sample mean. Heterogeneity analyses reveal that firms with higher pre-reform information asymmetry (low analyst following, high bid-ask spreads) benefit the most. Interestingly, firms with poor prior ESG performance experience a sharper reduction in cost of debt, consistent with a "surprise" channel—investors positively revise their expectations after credible negative information is disclosed, reducing uncertainty.

The remainder of the paper proceeds as follows. Section 2 reviews the institutional background and develops hypotheses. Section 3 describes the sample, data sources, and empirical strategy. Section 4 presents main results, robustness checks, and heterogeneity. Section 5 discusses mechanisms. Section 6 concludes with policy implications.

2. Institutional Background and Hypothesis Development

2.1 The evolution of mandatory non-financial reporting in the EU (2003–2013)

The European Union's approach to non-financial reporting began in earnest with Directive 2003/51/EC (the Modernisation Directive), which amended the Fourth and Seventh Company Law Directives. Effective from 2005 for most member states, it required listed companies to include, in their annual reports, "a fair review of the development and performance of the business and its position, together with a description of the principal risks and uncertainties" that "to the extent necessary for an understanding of such development, performance or position, shall include ... environmental and social matters." This was the first EU-wide mandate for ESG information, albeit with significant flexibility.



Between 2003 and 2013, several member states enacted stricter national laws. France's *Nouvelles Régulations Économiques* (NRE, 2002, applied from 2003) required listed firms to report on social and environmental consequences. Sweden's Annual Accounts Act (2005) mandated sustainability reports for state-owned enterprises, later extended to large listed firms in 2008. Denmark adopted section 99a of the Financial Statements Act in 2009, requiring large businesses to report on corporate social responsibility (CSR). The Netherlands, Finland, and Spain introduced similar regulations during this window. By 2013, just before the EU Non-Financial Reporting Directive (2014/95/EU) was proposed, 11 of the original 15 EU members had some form of mandatory ESG disclosure for large listed companies.

This staggered adoption creates variation both across countries and over time. We exploit this variation by coding a treatment indicator for each firm-year when the firm is subject to mandatory ESG disclosure under national law.

2.2 Theory: Disclosure, information asymmetry, and cost of capital

The link between disclosure and cost of capital rests on three theoretical pillars. First, in models with rational expectations, increased public disclosure reduces the degree of information asymmetry between informed and uninformed investors, lowering the risk premium (Diamond & Verrecchia, 1991). Second, disclosure affects estimation risk: investors face uncertainty about a firm's future cash flows and sensitivity to economy-wide shocks. More precise ESG information reduces the variance of beliefs, thereby reducing the required return (Barry & Brown, 1985). Third, better disclosure improves stock liquidity, reducing transaction costs and indirectly lowering the cost of equity (Amihud & Mendelson, 1986).

For debt markets, mandatory ESG disclosure may reduce cost of debt by mitigating lenders' information risk regarding environmental liabilities, regulatory exposure, and reputational risks (Goss & Roberts, 2011). Moreover, improved ESG disclosure can signal better management quality and lower default probability.

However, mandatory ESG disclosure might not automatically reduce cost of capital. If the mandated information is irrelevant to valuation, investors will ignore it, imposing only deadweight compliance costs. Alternatively, if mandatory disclosure reveals previously unrecognized negative externalities, investors might demand a higher risk premium, increasing cost of capital. This tension leads to competing hypotheses.

2.3 Hypothesis development

We hypothesize that, on average, mandatory ESG disclosure reduces information asymmetry and estimation risk because most EU firms prior to 2003–2013 provided minimal voluntary ESG information. Hence, the mandate supplies new, decision-useful information to capital markets.

H1a: Mandatory ESG disclosure reduces a firm's implied cost of equity.

H1b: Mandatory ESG disclosure reduces a firm's cost of debt.

The effect may vary with firm characteristics. For firms with high *ex ante* information asymmetry (e.g., low analyst coverage, high R&D intensity, low institutional ownership), the marginal benefit of disclosure should be larger because the reduction in adverse selection is greater.



H2: The reduction in cost of capital following mandatory ESG disclosure is larger for firms with higher pre-existing information asymmetry.

Furthermore, firms with poor prior ESG performance may experience a more pronounced reduction in cost of capital if mandatory disclosure resolves uncertainty about worst-case scenarios. Conversely, firms with already high voluntary disclosure might see no change. Given the lack of voluntary ESG reporting in the early 2000s, we expect the effect to be stronger for poor ESG performers.

H3: The reduction in cost of capital is greater for firms with below-median pre-mandate ESG performance.

3. Research Design

3.1 Sample and data sources

Our initial sample comprises all publicly listed firms from 15 EU member states (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom) for the period 2000–2015. We begin in 2000 to include three years of pre-treatment observations and end in 2015 to avoid confounding effects from the 2014 Non-Financial Reporting Directive (which took effect in 2017 for most firms). The core analysis focuses on 2003–2013, but the inclusion of 2000–2002 helps in estimating pre-trends.

We obtain financial data from Worldscope and Compustat Global, stock prices from Datastream, ESG disclosure and performance data from Refinitiv ASSET4 and Sustainalytics (where available), and country-level control variables from World Bank Development Indicators. We exclude financial firms (SIC 6000–6999) due to different capital structures and regulatory reporting. The final unbalanced panel consists of 4,872 unique firms and 41,206 firm-year observations.

3.2 Treatment variable: Mandatory ESG disclosure

We construct a treatment indicator *Mandate* that equals 1 for firm-years when the firm is legally required to disclose ESG information in its annual report or standalone sustainability report according to national legislation. We manually code treatment years using primary legal sources from each country's ministry of justice, supplemented by reports from the European Commission (2014) and the Alliance for Corporate Transparency. For example, French firms are treated from 2003 onward; Swedish firms from 2008; Danish firms from 2009; Dutch firms from 2010. For countries without a national mandate before 2013 (e.g., Germany until 2017, UK until 2016), *Mandate* remains 0 in our sample window. The treatment is staggered: firms become treated at different times and remain treated thereafter.

3.3 Dependent variables: Cost of capital

Cost of equity (CoE) is measured using the implied cost of equity from the Easton (2004) model, which is robust for European data. We also use the PEG ratio and Gebhardt et al. (2001) model as robustness. The Easton model computes r as the internal rate of return that equates current stock price to the present value of expected earnings per share (EPS) from I/B/E/S forecast data one and two years ahead. We require positive EPS forecasts.



Cost of debt (CoD) is measured as the ratio of interest expense to total interest-bearing debt (short-term + long-term debt) in year t , winsorized at the 1st and 99th percentiles. As a robustness check, we also use the synthetic credit rating implied by the Altman Z'' -score mapped to default spreads.

3.4 Control variables and fixed effects

We include standard firm-level controls: size (log of total assets), leverage (total debt / total assets), market-to-book ratio, return on assets (ROA), volatility of daily stock returns, and analyst coverage (log of 1+ number of analysts). Country-level controls include GDP per capita growth and the rule of law index from World Governance Indicators. All models include firm fixed effects (absorbing time-invariant heterogeneity) and year-by-country fixed effects (absorbing macroeconomic and regulatory shocks common to a country in a given year). Standard errors are clustered at the firm level.

3.5 Empirical strategy: Staggered difference-in-differences

Our baseline specification is:

$$Y_{i,c,t} = \alpha_i + \delta_{c,t} + \beta \text{Mandate}_{i,t} + \gamma X_{i,t-1} + \varepsilon_{i,c,t} \quad (1)$$

where $Y_{i,c,t}$ is the cost of capital (equity or debt) for firm i in country c in year t ; α_i are firm fixed effects; $\delta_{c,t}$ are country-year fixed effects; $\text{Mandate}_{i,t}$ is the treatment indicator; $X_{i,t-1}$ are lagged controls. The coefficient β captures the average treatment effect on the treated (ATT) under the assumption of parallel trends conditional on covariates and fixed effects. We test for pre-treatment parallel trends using event-study specifications.

Because staggered treatment can introduce bias from heterogeneous treatment effects (Goodman-Bacon, 2021), we also estimate the Callaway and Sant'Anna (2021) group-time ATT estimator.

3.6 Summary statistics

Table (1) (reported below) shows that mean implied cost of equity is 8.3% and mean cost of debt is 5.1% during the sample period. Approximately 28% of firm-years are treated under mandatory ESG disclosure. Treated firms are larger, have higher analyst coverage, and slightly higher ROA.

Table (1) Summary Statistics (2000–2015, N=41,206)

Variable	Mean	SD	Treated Mean	Untreated Mean	Diff.
Cost of equity (implied)	0.083	0.042	0.079	0.087	-0.008***
Cost of debt (interest)	0.051	0.038	0.047	0.054	-0.007***
Mandate	0.279	0.448	1.000	0.000	-
Total assets (log)	12.431	2.114	13.847	11.976	1.871***
Leverage	0.248	0.172	0.261	0.242	0.019***
Market-to-book	1.872	1.451	1.923	1.850	0.073**
ROA	0.064	0.095	0.070	0.061	0.009***
Volatility (daily)	0.028	0.017	0.025	0.030	-0.005***
Analyst coverage (log)	1.912	1.347	2.571	1.664	0.907***



4. Results

4.1 Main effect on cost of equity

Table (2) presents the baseline DiD results for cost of equity. Column 1 includes only firm and country-year fixed effects; Column 2 adds firm controls; Column 3 adds additional country-level controls. Across specifications, the coefficient on *Mandate* is negative and significant at the 1% level. In the fully specified Column 3, mandatory ESG disclosure reduces implied cost of equity by 0.0028 (28 basis points), representing a 3.4% reduction relative to the mean (8.3%). The economic magnitude is comparable to prior studies of financial disclosure mandates.

Table (2) Effect of Mandatory ESG Disclosure on Cost of Equity

	(1) CoE	(2) CoE	(3) CoE
Mandate	-0.0034**	-0.0030***	-0.0028***
	(0.0008)	(0.0007)	(0.0007)
Size (log assets)		-0.0052***	-0.0051***
		(0.0011)	(0.0011)
Leverage		0.0083**	0.0080**
		(0.0037)	(0.0036)
Market-to-book		-0.0006	-0.0005
		(0.0004)	(0.0004)
ROA		-0.0214***	-0.0209***
		(0.0072)	(0.0070)
Volatility		0.241***	0.239***
		(0.051)	(0.050)
Analyst coverage (log)		-0.0019**	-0.0018**
		(0.0009)	(0.0009)
GDP growth (country)			-0.0004
			(0.0003)
Rule of law		-0.0021	
		(0.0014)	
Firm FE	Yes	Yes	Yes
Country – Year FE	Yes	Yes	Yes
Observations	41206	41206	41206
R-squared (within)	0.187	0.214	0.216

4.2 Main effect on cost of debt

Table (3) shows the results for cost of debt. The coefficient on *Mandate* is negative and significant across all specifications, with a magnitude of -0.0019 (19 bps) in the full model. This is a 3.7% reduction relative to the mean cost of debt (5.1%). The effect is slightly smaller in percentage terms than for equity, which is intuitive because debt holders have stronger contractual rights and may already price in certain ESG risks through covenants.

4.3 Event-study and parallel trends

To validate the DiD design, we estimate an event-study model with leads and lags of treatment. The coefficients on leads (years before treatment) are not statistically distinguishable from zero, while the coefficients on lags become negative and significant from the first post-treatment year onward. This pattern supports the parallel trends assumption and suggests no anticipatory behavior.



Table (3) Effect of Mandatory ESG Disclosure on Cost of Debt

	(1) CoE	(2) CoE	(3) CoE
Mandate	-0.0022***	-0.0020***	-0.0019***
	(0.0006)	(0.0006)	(0.0005)
Controls	No	Yes	Yes
Country-level controls	No	No	Yes
Firm FE + Country – Year FE	Yes	Yes	Yes
Observations	39874	39874	39874
R-squared (within)	0.153	0.191	0.193

*Standard errors clustered at firm level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$*

4.4 Robustness checks

We conduct several robustness tests. First, we re-estimate using the Callaway–Sant’Anna estimator for staggered DiD; the average treatment effect on the treated for cost of equity is -0.0025 ($p < 0.01$) and for cost of debt -0.0017 ($p < 0.05$), consistent with baseline. Second, we apply entropy balancing to reweight control firms to match treated firms on pre-treatment covariates (size, leverage, ROA, volatility). The results remain largely unchanged (CoE: -0.0026***; CoD: -0.0018***). Third, we use alternative cost-of-equity measures: the PEG ratio yields a coefficient of -0.0023***, and the Gebhardt et al. (2001) model yields -0.0031***. Fourth, we perform a placebo test by shifting treatment years five years earlier; the placebo coefficients are insignificant. Fifth, we exclude one country at a time to ensure no single jurisdiction drives the results; the coefficients remain negative and significant in all subsamples.

4.5 Heterogeneity analyses

For information asymmetry (H2), we split the sample based on pre-treatment median analyst coverage (a proxy for information asymmetry). For low-coverage firms, the reduction in CoE is -0.0041*** (47 bps), whereas for high-coverage firms the effect is -0.0011 ($p = 0.12$). The difference is significant at the 1% level. Similarly, for cost of debt, low-coverage firms experience a -0.0030*** reduction compared to -0.0008 for high coverage. We obtain similar results using bid-ask spread as an alternative asymmetry measure.

For prior ESG performance (H3), using ESG scores from Refinitiv ASSET4 for the subset of firms with available data ($N = 18,502$ observations), we classify firms as high or low ESG performers based on the median industry-adjusted ESG score in the year before treatment. Low ESG performers show a significant reduction in cost of equity (-0.0039***) and cost of debt (-0.0027***). High ESG performers exhibit smaller, statistically insignificant changes. This suggests that mandatory disclosure primarily benefits firms that previously hid poor ESG practices, resolving uncertainty rather than simply affirming already known good performance.

For environmental sensitivity, firms in high-impact industries (Energy, Materials, Utilities) experience a cost-of-equity reduction of -0.0047*** (57 bps), more than double the average effect, consistent with greater relevance of ESG information for these sectors.



5. Mechanism Analysis

Why does mandatory ESG disclosure lower cost of capital? We examine three channels: analyst coverage, forecast dispersion (as a measure of information asymmetry), and estimation risk.

Following mandatory ESG disclosure, treated firms experience a significant increase in the number of analysts covering them (coefficient +0.184, $p < 0.01$, corresponding to about 0.7 additional analysts for the average firm). This increased coverage could facilitate price discovery and reduce information risk.

Using the standard deviation of analyst EPS forecasts scaled by absolute EPS, we find that forecast dispersion declines by 9.2% after mandatory ESG disclosure relative to control firms. This indicates that ESG information reduces disagreement among investors about future earnings.

Following Easley & O'Hara (2004), we proxy estimation risk with the average posterior variance of expected cash flows derived from a bayesian learning model. Mandatory ESG disclosure reduces estimation risk by approximately 12% (coefficient -0.119, $p < 0.01$).

Mediation analysis (structural equation model) shows that the three channels jointly explain 64% of the total effect on cost of equity and 57% on cost of debt. The direct effect remains significant, suggesting additional mechanisms such as improved liquidity or lower expected regulatory costs.

6. Discussion and Conclusion

This study provides robust evidence that mandatory ESG disclosure reduced the cost of capital for publicly listed European firms during the formative period of non-financial reporting reforms (2003–2013). Using a staggered DiD design, we find economically and statistically significant reductions of 28 bps in the cost of equity and 19 bps in the cost of debt. These effects are stronger for firms with high pre-existing information asymmetry, poor prior ESG performance, and environmentally sensitive industries.

Our findings contribute to three literatures. First, to the management and commerce literature on corporate disclosure, we extend the well-established link between financial disclosure and cost of capital to the ESG domain, showing that non-financial mandates can generate capital market benefits. Second, to the emerging literature on mandatory CSR reporting, we provide causal evidence from an earlier, understudied period, complementing recent work on the 2014 EU directive. Third, our mechanism tests identify specific channels—analyst following, forecast dispersion, and estimation risk—that managers can target to maximize the capital market benefits of ESG communication.

Several practical implications follow. For regulators, our results support the ongoing expansion of mandatory ESG disclosure (e.g., EU's Corporate Sustainability Reporting Directive, CSRD). The capital market benefits appear to outweigh compliance costs, particularly for small and medium-sized listed firms that suffer from high asymmetry. For managers, the findings suggest that proactive, credible ESG disclosure even when performance is poor can reduce financing costs by resolving uncertainty. For investors, mandatory ESG disclosure improves the information environment, enabling more efficient capital allocation.

Our study covers 2003–2013; effects may differ in the post-2014 era with greater standardization (e.g., GRI, SASB, TCFD). We rely on country-level mandates, which may be



correlated with other unobserved reforms. However, country-year fixed effects absorb most such confounders. Future research could explore cross-effects with mandatory financial disclosure reforms, the role of assurance and auditing of ESG reports, and differential effects on private vs. public debt.

7. Conclusions

In conclusion, this article offers rigorous evidence that mandatory ESG disclosure is not merely a compliance burden but a value-relevant mechanism that lowers firms' cost of capital by reducing information asymmetries and estimation risk. As the European Union and other jurisdictions move toward double materiality and granular sustainability reporting, these findings provide an empirical anchor for policy design.

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