



Bhavini Chhipa

Does ESG Performance Affect the Cost of Debt? A Multi-Model
Analysis Incorporating Debt Maturity, ESG Data Sources, and
Moderating Governance Signals

School of Management
MSc in Finance

MSc
Academic Year: 2024 - 2025

Supervisor: Dr. Matthias Nnadi
September 2025



School of Management

Does ESG Performance Affect the Cost of Debt? A Multi-Model
Analysis Incorporating Debt Maturity, ESG Data Sources, and
Moderating Governance Signals

MSc

Academic Year 2024 - 2025

Bhavini Chhipa

Does ESG Performance Affect the Cost of Debt? A Multi-Model
Analysis Incorporating Debt Maturity, ESG Data Sources, and
Moderating Governance Signals

Supervisor: Dr. Matthias Nnadi
September 2025

This thesis is submitted in partial fulfilment of the requirements for
the degree of MSc

© Cranfield University 2025. All rights reserved. No part of this publication may be reproduced without the written permission of the copyright owner.

Academic integrity declaration

I declare that:

- the thesis submitted has been written by me alone.
- the thesis submitted has not been previously submitted to this university or any other.
- that all content, including primary and/or secondary data, is true to the best of my knowledge.
- that all quotations and references have been duly acknowledged according to the requirements of academic research.

I understand that to knowingly submit work in violation of the above statement will be considered by examiners as academic misconduct.

Abstract

This study investigates how environmental, social, and governance (ESG) performance influences the cost of debt in European firms between 2012 and 2023. Using composite scores from Refinitiv and Bloomberg, alongside pillar-level measures, the analysis employs fixed effects, two-stage least squares, and system GMM estimators to address endogeneity. Results show ESG increases borrowing costs in static models but reduces them dynamically, with the social pillar consistently lowering costs while environmental and governance effects remain mixed. By integrating governance moderators and multiple data providers, this study offers robust, context-specific insights into ESG's financial materiality.

Keywords:

corporate finance, credit risk, sustainable finance, endogeneity, panel data, institutional investors, econometrics

Acknowledgement

I wish to express my sincere gratitude to my supervisor, Dr Matthias Nnadi, for his unwavering support, guidance and encouragement throughout the course of this thesis. His insightful feedback, patience and constant motivation have not only shaped the quality of this research but have also inspired me to strive for the highest standards in my work. Undertaking this study under his supervision has been a truly formative experience, both academically and personally.

I am also deeply grateful to Professor Yaccine Belghitar, my course director, for his leadership and commitment in shaping the MSc Finance programme. His dedication to academic excellence and student development has provided a stimulating and rigorous environment in which to learn and grow.

Finally, I extend my heartfelt thanks to the School of Management at Cranfield University for providing me with the platform and opportunity to pursue this degree. The knowledge, resources and support I have received have been instrumental in enabling me to complete this research and my master's studies with confidence and pride.

Table of Contents

Academic integrity declaration.....	i
Abstract	ii
Acknowledgement	iii
List of Figures.....	vi
List of Tables	vii
List of Equations.....	viii
List of Abbreviations	ix
1 Introduction.....	1
2 Literature Review	9
2.1 Overview of ESG and Cost of Capital	9
2.2 ESG and Cost of Debt	12
2.2.1 Theoretical Channels Linking ESG to Cost of Debt.....	12
2.2.2 Empirical Evidence on ESG Impact on Cost of Debt.....	18
2.2.3 ESG Pillars and Debt Cost Components.....	20
2.2.4 Debt Maturity Considerations	22
2.3 ESG Data Source Bias and Score Reliability	24
2.4 Endogeneity and Reverse Causality	26
2.5 Moderating Effects: Governance and Firm Characteristics.....	27
2.5.1 Governance Quality and ESG Effectiveness.....	27
2.5.2 Transparency and State Ownership	28
2.6 Theoretical Framework	28
2.7 Identified Gaps and Hypothesis Development.....	29
3 Methodology.....	32
3.1 Data and Measurement of Variables.....	32
3.1.1 ESG Variables.....	32
3.1.2 Dependent Variable – Cost of Debt.....	33
3.1.3 Control Variables.....	34
3.1.4 Moderators	35
3.2 Data, Sample, and Preliminary Analysis	36
4 Main Tests and Results	44
4.1 Baseline Fixed Effects (H1)	45
4.1.1 Baseline Relationship.....	45
4.1.2 Comparison with Prior Literature	46
4.1.3 Interpretation of H1.....	46
4.2 Moderation Models (H2 and H3).....	46
4.2.1 CSR Reporting	47
4.2.2 State Ownership (SOE).....	47
4.2.3 Audit Independence	48
4.2.4 Firm Size	48
4.2.5 Interpretation of H2 and H3	48

4.3 ESG Pillar Analysis (H4)	49
4.3.1 Direct Pillar Regressions	49
4.3.2 Moderated Pillar Regressions	50
4.3.3 Instrumental Variable Pillar Regressions.....	50
4.3.4 Dynamic System GMM Pillar Regressions.....	51
4.3.5 Interpretation of H4.....	51
4.4 Endogeneity Checks – IV and System GMM	52
4.4.1 2SLS – Instrumental Variable Estimation	52
4.4.2 System GMM – Dynamic Specification	52
4.4.3 Comparison with Baseline and Moderation Models	53
4.4.4 Interpretation	53
4.5 Robustness Check.....	54
4.5.1 Alternative Proxy and Pillar Regressions	54
4.5.2 Alternative Estimators	54
4.6 Hypothesis Outcomes Summary	55
5 Discussion	59
6 Conclusion.....	62
References	64
7 Appendix A: Ethical approval letter.....	77
8 Appendix B: ESG Pillars Regression Tables	78
9 Appendix C: Robustness check with Country Default Spread proxy for Cost of Debt	83
10 Appendix D: Histogram and Kernel Density of Cost of Debt and Log CoD ..	89

List of Figures

<i>Figure 1: Sequential game between firms and lenders. High-quality firms (θ_h) adopt genuine ESG at lower cost (C_h). Lenders face default risk (Loss) if misled by Type L firms. Payoffs: Firm (Π_f), Lender (Π_b), Regulatory penalty (Δ).) Source: Author, 2025</i>	14
<i>Figure 2: Debt size (D) and governance strength (G) determine equilibrium regions. Above threshold G, separating equilibrium dominates where ESG reduces debt costs. Below D, pooling equilibrium prevails regardless of governance quality. Source: Author, 2025.....</i>	16
Figure 3: Histogram with Normality Distribution (CoD)	89
Figure 4: Kernel density with Normal density (CoD).....	90
Figure 5: Histogram with Normality distribution (Log_CoD).....	91
Figure 6: Kernel density with Normal density (Log_CoD).....	92

List of Tables

Table 1: Industry Distribution of Sample Firms	40
Table 2: Country Distribution of Sample Firms	41
Table 3: Descriptive Statistics of Variables	42
Table 4 Pearson Correlation between Key Variables	43
Table 5: Pooled regressions of ESG performance on the cost of debt.....	57
Table 6: Instrument Variable (2SLS) and System GMM regressions of ESG on CoD	58
Table 7: Pooled regressions of the individual dimensions of ESG performance on the cost of debt (Fixed Effects Regression)	78
Table 8: Pooled regressions of the individual dimensions of ESG performance with moderators on the cost of debt (Moderation	79
Table 9: Instrumental Variable (2SLS) regressions of ESG pillars on cost of debt	81
Table 10: System GMM regressions of ESG pillars on cost of debt.....	82
Table 11: Pooled regressions of ESG performance on the cost of debt (Country default spread proxy).....	83
Table 12: Pooled regressions of ESG pillars on the cost of debt (Country default spread proxy).....	84
Table 13: Pooled regressions of ESG pillars with moderators on the cost of debt (Country default spread proxy)	85
Table 14: Instrumental Variable (2SLS) and System GMM regressions of ESG on cost of debt (Country default spread proxy).....	86
Table 15: Instrumental Variable (2SLS) regressions of ESG pillars on cost of debt (Country default spread proxy)	87
Table 16: System GMM regressions of ESG pillars on cost of debt (Country default spread proxy).....	88

List of Equations

$CoD = SDTD \cdot CS \cdot AF + LDTD \cdot CL \cdot AF$ (1).....	33
$\ln CoDit = \alpha + \beta_1 ESGi,t-1 + \gamma Xi,t-1 + \mu i + \delta t + \varepsilon it$ (2)	45
$\ln CoDit = \alpha + \beta_1 ESGi,t-1 + \beta_2 Moderatori,t-1 + \beta_3 ESGi,t-1 \times$ $Moderatori,t-1 + \gamma Xi,t-1 + \mu i + \delta t + \varepsilon i$ (3).....	47
$\ln CoDit = \alpha + \beta_1 ESGi,t-1 pillar + \gamma Xi,t-1 + \mu i + \delta t + \varepsilon it$ (4)	49
$\ln CoDit = \alpha + \beta_1 ESGi,t-1 + \gamma Xi,t-1 + \mu i + \delta t + \varepsilon it$ (5)	52
$\ln CoDit = \alpha + \beta_1 ESGi,t-1 + \rho \ln CoDi,t-1 + \gamma Xi,t-1 + \mu i + \delta t + \varepsilon it$ (6) .	52

List of Abbreviations

Abbreviation	Expanded form	Source
AF	Adjustment factor (reflects firm-level borrowing conditions)	The cost-of-debt formula uses AF as an adjustment factor when computing the weighted cost of short- and long-term debt.
ASEAN	Association of Southeast Asian Nations	The paper contrasts short-term debt levels in ASEAN versus the EU but does not expand the acronym; the full name is provided here for clarity.
CDS	Country default spread	The study uses the difference between a country's ten-year government bond yield and the German Bund yield as the country default spread (CDS) proxy for cost of debt.
CH	High-quality firms' ESG adoption cost (CH)	In the signalling-game framework, CH represents the cost high-quality firms incur when adopting genuine ESG practices.
CL	Cost of long-term loans	Appears in the cost-of-debt formula as the average cost of long-term debt.
CoD	Cost of debt	The dependent variable measures the effective interest rate paid on borrowings; CoD is computed from short- and long-term debt and associated loan costs.
COVID-19	Coronavirus disease 2019	The thesis notes that high-carbon firms faced higher financing costs during the COVID-19 crisis.

Abbreviation	Expanded form	Source
CSR	Corporate social responsibility	The introduction explains that CSR evolved from peripheral philanthropic activities into an integrated strategic focus within firms.
CSRD	Corporate Sustainability Reporting Directive	The paper lists the EU's Sustainable Finance Disclosure Regulation and the Corporate Sustainability Reporting Directive as key sustainability regulations.
CS	Cost of short-term loans	Appears in the cost-of-debt formula as the average cost of short-term debt.
E	Environmental pillar	Part of the ESG framework; represents environmental performance.
ESG	Environmental, social and governance	Defined as a multidimensional framework for evaluating corporate sustainability and ethical impact.
EU	European Union	Used throughout the thesis (e.g., comparing debt structures in ASEAN vs. EU); the acronym is not expanded in the paper.
FE	Fixed effects	One of the econometric models employed to control for unobserved heterogeneity.
G	Governance pillar	Part of the ESG framework; represents corporate governance quality.

Abbreviation	Expanded form	Source
GICS	Global Industry Classification Standard	The sample's industry classification is based on the Global Industry Classification Standard (GICS).
GMM	Generalised method of moments	The thesis employs system GMM models to address endogeneity.
IV	Instrumental variables	Used in 2SLS and system GMM estimations to address endogeneity; the paper refers to "IV" but does not spell out the term.
LD	Long-term debt	Appears in the cost-of-debt formula as the amount of long-term debt.
LSEG	London Stock Exchange Group	The composite ESG score methodology aligns with the London Stock Exchange Group's (LSEG) ESG Scores methodology.
MSCI	Morgan Stanley Capital International	Mentioned among ESG data providers; the paper does not expand the abbreviation.
MTBV	Market-to-book value ratio	Included as a control variable capturing market perceptions of growth opportunities.
OECD	Organisation for Economic Co-operation and Development	The thesis cites the OECD Handbook on Composite Indicators when discussing PCA and Z-score normalisation.
PCA	Principal component analysis	Used to create robust ESG measures and construct composite indices.

Abbreviation	Expanded form	Source
S	Social pillar	Part of the ESG framework; represents social responsibility.
SD	Short-term debt	Appears in the cost-of-debt formula as the amount of short-term debt.
SFDR	Sustainable Finance Disclosure Regulation	An EU regulation requiring sustainability disclosure.
SOE	State-owned enterprise / state ownership	Defined as a binary indicator equal to 1 for state-owned enterprises and 0 otherwise.
S&P	Standard & Poor's	Listed as one of the ESG data providers; the acronym is not expanded in the paper.
SRI	Socially responsible investing	The introduction notes that ethical investing, or socially responsible investing (SRI), traces its origins to religious canons.
TD	Total debt	Appears in the cost-of-debt formula as the total amount of debt.
2SLS	Two-stage least squares	Used as an instrumental-variables estimation technique to address endogeneity.
bps	Basis points (one-hundredth of a percentage point)	Used when discussing changes in financing costs (e.g., high-carbon firms faced 230 bps higher financing costs during the COVID-19 crisis).

1 Introduction

Ethical investing, or socially responsible investing (SRI), follows its origins to religious and moral canons emphasising the avoidance of harmful economic activities. Renneboog, Ter Horst, and Zhang (2008) articulate that early religious groups such as the Quakers and Methodists in the 18th and 19th centuries actively discouraged investments in industries like weaponry, alcohol, and gambling. These exclusionary approaches gradually inspired a broader movement that aligned financial decisions with societal values. By the mid-20th century, the corporate world embraced structured corporate social responsibility (CSR) frameworks. Singh and Kumar (2023) highlight how CSR evolved from peripheral philanthropic activities into an integrated strategic focus within firms. In concert, McWilliams and Siegel (2000) examined whether CSR initiatives could enhance financial performance, suggesting that responsible corporate behaviour may offer competitive advantages under specific strategic conditions. This marked an important theoretical foundation, linking social considerations directly with corporate value enhancement.

As global financial markets developed, CSR frameworks transitioned into more comprehensive environmental, social, and governance (ESG) standards. Belghitar, Clark, and Deshmukh (2017) emphasise that institutional fund managers played a pivotal role in shaping the performance and legitimacy of socially responsible investment strategies, highlighting ESG as both measurable and actionable. Ioannou and Serafeim (2015) further illustrate that evolving institutional logics influenced analysts' perceptions and recommendations, underscoring the importance of ESG disclosures in shaping market behaviour. Today, ESG has emerged as a central evaluation criterion that merges ethical concerns with quantifiable financial performance metrics. Europe, notably, has become a pioneer in ESG enforcement, introducing comprehensive regulations such as the EU Taxonomy, Sustainable Finance Disclosure Regulation (SFDR), and Corporate Sustainability Reporting Directive (CSRD) to mandate firm-level sustainability reporting. This robust regulatory environment provides a distinctive foundation for analysing ESG's role – not

only as an aggregated score but also across its individual environmental, social, and governance dimensions – in shaping corporate financing subtleties.

Environmental, social, and governance (ESG) performance has rapidly evolved into a core determinant of firm valuation and access to capital. El Ghoul et al. (2011) provide pivotal evidence that firms with higher CSR performance, a key component of ESG, benefit from both lower cost of equity and cost of debt driven by reduced perceived risk and enhanced investor trust. Similarly, Giese et al. (2019) argue that strong ESG practices improve risk-adjusted returns and operational resilience, signalling lower default risk to creditors. This suggests that ESG performance functions as a strategic signal of ethical conduct, transparency, and long-term stability, thereby shaping stakeholder perceptions. Gregory, Tharyan, and Whittaker (2014) further reinforce this by demonstrating that ESG activities contribute to firm value through improved cash flow generation, enhanced growth prospects, and lowered firm-specific risk. Such findings highlight that ESG is no longer peripheral but an integral part of corporate strategy directly influencing capital costs and firm performance.

The importance of ESG is even more pronounced in the European context, where regulatory and institutional frameworks have embedded ESG deeply into capital markets. Brooks and Oikonomou (2018) emphasise that European investors increasingly reward firms demonstrating robust ESG performance with favourable financing terms and enhanced market liquidity. Eliwa, Aboud, and Saleh (2021) provide empirical support, showing that European firms engaging in comprehensive ESG practices experience significantly lower costs of debt, underlining the financial materiality of ESG disclosures. This regulatory environment, coupled with strong stakeholder expectations, positions Europe as a leader in ESG integration. This makes the European market a particularly suitable environment to study how ESG – both as an overall metric and through its E, S, and G pillars – affects the cost of corporate debt. As firms face growing scrutiny, ESG's influence on financing conditions not only shapes investor and creditor decisions but also guides long-term strategic planning and risk management across European capital markets.

Despite the mounting research linking ESG practices to financing outcomes, several critical gaps persist. Apergis et al. (2022) highlight that most prior studies depend heavily on a single ESG data provider, often ignoring substantial divergences in rating methodologies and scoring approaches. This reliance can obscure the true relationship between ESG performance and cost of debt, as differences across data sources may significantly affect empirical conclusions. You et al. (2025) further emphasise the importance of ESG disclosure quality; however, many studies continue to treat ESG as a holistic composite score rather than investigating the distinct roles of its environmental, social, and governance pillars. Such aggregation risks oversimplifies the ways that each dimension uniquely influences creditor risk assessments and financial decision-making.

Moreover, the moderating role of firm-level governance factors remains underexplored. Jafar et al. (2024) and Cheng, He, and Tang (2025) suggest that variables such as audit quality, board independence, and overall transparency could meaningfully alter the ESG–cost of debt relationship. Despite this, few empirical studies have integrated governance characteristics into their models, thereby limiting our understanding of how internal structures might amplify or mitigate ESG's signalling effects. Additionally, Shi et al. (2024) point out that reverse causality between ESG performance and financing terms is largely overlooked, posing serious challenges to the validity of causal interpretations in this field.

Finally, regional focus represents a notable deficiency. Although Europe leads globally in ESG regulatory frameworks and enforcement, empirical evidence specific to European firms remain scarce (Eliwa et al., 2019). Li, Padmanabhan, and Huang (2024) also call attention to the importance of addressing potential non-linearities and complex interactions in ESG-financing dynamics. Collectively, these gaps underscore the need for a nuanced, multi-dimensional, and region-specific examination of how ESG—both as an aggregate measure and across individual pillars—affects the cost of debt. By addressing these

overlooked areas, this study aims to provide robust insights tailored to the European capital market context.

The relationship between ESG performance and cost of debt can be effectively explained through the lens of multiple theoretical frameworks. Signalling theory, first articulated by Spence (1973), suggests that firms with superior ESG performance send credible signals to capital markets about their lower risk profile and higher management quality. Cheng, He, and Tang (2025) reinforce this view by demonstrating that robust ESG performance reduces information asymmetry, thus leading to more favourable debt financing conditions. Additionally, ESG disclosure quality is crucial; as You et al. (2025) argue, high-quality ESG disclosures serve as credible signals that mitigate uncertainty and enhance investor and lender confidence. Camilleri (2018) supports this by highlighting those non-financial disclosures, including ESG, help firms differentiate themselves in competitive markets and attract long-term capital. Peng and Xie (2024) further alert that poor disclosure practices, often referred to as greenwashing, can undermine these signalling benefits and potentially increase financing costs.

Beyond signalling, ESG practices are also grounded in agency theory, which speculates that effective governance mechanisms can help align managerial actions with stakeholder interests (Jensen & Meckling, 1976). Alves and Meneses (2024) note that ESG initiatives can mitigate agency costs by enhancing transparency and fostering stronger internal controls, thus reducing perceived credit risk. The legitimacy theory offers an additional perspective, emphasising that ESG disclosures represent a strategic response to external social and regulatory pressures (Preston & Post, 1975). Alvarez-Perez and Fuentes (2024) provide empirical evidence that firms engage in ESG reporting to maintain legitimacy and secure better financing terms. This multi-theoretical foundation suggests that ESG practices are not uniform but operate through diverse mechanisms, each affecting creditor perceptions differently. The distinction between E, S, and G components is also theoretically justified, as each may signal a different aspect of firm quality or risk. Recognising these

nuances is essential to fully understand ESG's role in shaping debt financing costs, particularly within stringent European regulatory environments.

This study aims to comprehensive analysis of the relationship between ESG performance and the aggregated cost of debt among European firms. Unlike many existing studies that treat ESG as a singular composite measure, this research explicitly examines both overall ESG performance and its disaggregated pillars—environmental (E), social (S), and governance (G) – to capture nuanced effects on financing conditions. This approach aligns with recommendations by Li, Padmanabhan, and Huang (2024), who argue that pillar-level analyses reveal unique insights into the ways different ESG dimensions shape firm-level risk and creditor perceptions. Furthermore, recognising the divergence in ESG ratings across data providers, I incorporate scores from multiple prominent sources, including Bloomberg and Refinitiv, to mitigate potential biases and measurement inconsistencies (Peng & Xie, 2024; Eliwa, Aboud, & Saleh, 2019).

Building on this multidimensional approach, I establish three research objectives to address critical gaps in the ESG-debt financing relationship:

1. To examine the impact of aggregate ESG performance on corporate debt costs – empirically testing whether higher overall scores reduce borrowing expenses for European firms while accounting for regulatory stringency (e.g., SFDR, CSRD) and cross-provider rating divergences (Berg et al., 2022; Eliwa et al., 2019).
2. To disaggregate ESG effects across environmental (E), social (S), and governance (G) pillars – investigating their differential influence on financing conditions and identifying which dimension drives risk-reduction signals in specific sectoral contexts (Fatemi et al., 2018; Goss & Roberts, 2011).
3. To analyse the moderating roles of governance characteristics, transparency mechanisms, and state ownership structures – determining how board independence, disclosure quality, and state-controlled equity reconfigure ESG's debt-cost impact while addressing agency conflicts and greenwashing risks (Cheng et al., 2025; Gul et al., 2010; Faccio et al., 2006).

In terms of empirical strategy, this research employs a rigorous econometric framework comprising fixed effects (FE), two-stage least squares (2SLS), and system generalised method of moments (GMM) models to address endogeneity and reverse causality concerns, as highlighted by Peng and Xie (2024). To create robust ESG measures, principal component analysis (PCA) and Z-score normalisation will be applied, drawing on guidelines from the OECD Handbook on Composite Indicators (Nardo et al., 2005) and subsequent applications in multidimensional assessments (Bender et al., 2021; D'Attoma & Ieva, 2024; Marzi, Mysiak, & Santato, 2018; Bhattarai et al., 2024). These advanced techniques facilitate the development of standardised, comparable ESG indices, enhancing interpretability across firms and countries. The model further tests whether firm-level governance characteristics moderate the ESG–debt relationship, enhancing interpretability and practical relevance. By integrating these methodological advancements, I set out to contribute a more granular and reliable understanding of ESG's impact on debt financing costs within the highly regulated and strategically important European market.

This study advances the ESG–cost of debt literature in three keyways. First, unlike much of the existing research that relies on single-provider ratings (e.g., Eliwa et al., 2019; Apergis et al., 2022), it integrates ESG data from both Bloomberg and Refinitiv, thereby reducing measurement bias and enhancing score reliability. Second, whereas prior studies often treat ESG as a composite index, this research disaggregates environmental, social, and governance pillars, revealing dimension-specific effects on borrowing costs consistent with materiality theory (Fatemi et al., 2018). Third, the analysis incorporates governance-related moderators—such as audit independence, state ownership, and CSR reporting—that remain underexplored in the debt literature but are shown here to meaningfully condition the ESG–debt relationship (Cheng et al., 2014; Gul et al., 2010). By applying fixed effects, 2SLS, and dynamic System GMM estimators, this study also addresses endogeneity more rigorously than most prior work, thus offering stronger causal insights. Collectively, these contributions provide a more granular and reliable understanding of ESG's financial materiality in the European context.

Methodologically, this research advances the empirical rigor of ESG studies by employing multi-model validation strategies, including fixed effects, two-stage least squares, and system GMM estimators, as recommended by Eliwa et al. (2019) and You et al. (2025). This multi-method approach helps to mitigate endogeneity and reverse causality concerns, which remain significant limitations in existing work. Additionally, theory-driven moderation analyses are introduced to explore how firm-level governance characteristics influence the ESG–cost of debt relationship, an area often neglected despite its theoretical relevance. To develop reliable ESG indices, this study uses composite construction techniques based on PCA and Z-score normalisation, guided by the OECD Handbook (Nardo et al., 2005) and complemented by recent multidimensional indicator applications (Bender et al., 2021; D’Attoma & Ieva, 2024; Marzi et al., 2018; Bhattarai et al., 2024).

Finally, by focusing exclusively on the European context—where ESG disclosure requirements and regulatory enforcement are exceptionally stringent—this study fills a significant regional gap in the ESG–debt literature (Eliwa et al., 2019). By integrating theoretical clarity with empirical depth, this study contributes to ESG research in a region where regulatory enforcement and disclosure quality are exceptionally high, offering new insights for both academics and practitioners.

In light of these contributions and identified gaps, this study formulates the following research questions to guide the empirical analysis. First, how does overall ESG performance affect the aggregated cost of debt among European firms? Second, do the individual environmental (E), social (S), and governance (G) pillars exert differential effects on the cost of debt, thereby offering more granular insights beyond a composite ESG score? Third, to what extent do firm-level governance characteristics – such as audit quality and board independence – moderate the relationship between ESG performance and the cost of debt? By articulating these questions explicitly, this paper aims to provide a comprehensive and empirically rigorous examination of the role of

ESG in shaping debt financing outcomes within the highly regulated and institutionally advanced European market.

2 Literature Review

2.1 Overview of ESG and Cost of Capital

Environmental, Social, and Governance (ESG) criteria have emerged as a transformative multidimensional framework for evaluating corporate sustainability and ethical impact. This three-way metric systematically assesses environmental stewardship through resource efficiency and climate resilience, social responsibility through labor practices and community engagement, and governance quality through board accountability and shareholder rights. Originally rooted in ethical investment principles, ESG has evolved into a critical financial analysis tool that quantifies previously intangible risks and opportunities. Its multidimensional nature captures complex interdependencies, where environmental compliance reduces regulatory penalties, social initiatives enhance brand equity, and robust governance mitigates operational risks – collectively shaping a firm's long-term value creation potential. The dominance of ESG reflects a fundamental market recognition that non-financial factors materially influence financial resilience, as institutional investors increasingly integrate these metrics into strategic asset allocation and risk management frameworks.

The relationship between ESG performance and corporate financial outcomes has been broadly debated in academic literature. Early studies posited a trade-off hypothesis, arguing that ESG investments diverted resources from core profit-maximising activities, thereby depressing returns. This perspective gained pull through empirical work suggesting socially responsible firms underperformed conventional benchmarks, with critics contending that ESG expenditures represented agency problems where management pursued personal reputational gains at shareholder expense. However, comprehensive meta-analyses of over 2,000 empirical studies have since overturned this narrative. Landmark research by Friede, Busch, and Bassen (2015) demonstrated that approximately 90% of studies find a nonnegative ESG-financial performance relationship, with a significant majority reporting positive correlation. This framework shift is attributed to ESG's role in mitigating

regulatory fines, enhancing employee productivity, strengthening customer loyalty, and attracting sustainable capital. Crucially, the financial materiality of ESG factors varies substantially across sectors. As Khan, Serafeim, and Yoon (2016) established, initiatives addressing industry-specific material issues, such as carbon emissions in energy or data privacy in technology, drive outperformance, while immaterial ESG activities show negligible financial effects. This evidence reframes ESG not as a cost centre but as a strategic catalyst for competitive advantage.

A pivotal indicator of ESG's financial impact lies in its influence on a firm's cost of capital (CoC), the minimum return required by investors to compensate for risk exposure. Foundational research by El Ghouli et al. (2011) first systematically established that high-ESG firms benefit from significantly lower financing costs, with mechanisms diverging across equity and debt instruments. For equity financing, superior ESG performance reduces the cost of equity by approximately 7–12 basis points through two primary channels. First, it diminishes systematic risk (beta) by enhancing operational flexibility against regulatory shifts and market disruptions, as documented by Giese et al. (2019) who observed average beta reductions of 10% among ESG leaders. Second, transparent ESG disclosure curtails information asymmetry between managers and shareholders, lowering estimation risk premiums demanded by investors. This effect is particularly marked in industries facing high environmental litigation risks or social license pressures, where ESG transparency signals robust crisis management capacity.

In debt markets, credible ESG commitment lowers the cost of debt by signaling reduced default risk to creditors, as Eliwa, Aboud, and Saleh (2019) and Sharfman and Fernando (2008) demonstrate that firms with robust sustainability practices exhibit lower bankruptcy probabilities through enhanced operational resilience and regulatory compliance. Lenders increasingly embed ESG metrics into credit risk models, recognising Safiullah, Kabir, and Miah's (2021) finding that environmental liabilities (e.g., carbon transition risks) amplify bankruptcy probabilities by 12-24% in high-risk sectors, while Jung, Herbohn, and Clarkson

(2018b) document similar effects for social controversies (e.g., labor disputes) and governance failures (e.g., board oversight gaps). Empirical evidence from Goss and Roberts (2011) confirms high-ESG firms secure loan spreads 7–18 basis points lower than peers, a premium reflecting creditor confidence in their long-term viability, with Eliwa et al. (2019) further validating this spread differential across EU markets. However, Chen, Chen, and Wei (2009) and Alves and Meneses (2024) reveal critical heterogeneity in this relationship: environmental performance dominates debt cost reductions in pollution-intensive sectors like manufacturing (Δ of 15-22 bps), while governance strength drives financing advantages in emerging markets where weak legal protections heighten governance's role in reducing agency costs. Notably, Khan, Serafeim, and Yoon (2016) and Berg, Koelbel, and Rigobon (2022) establish that transmission efficacy depends on institutional contexts, with ESG's debt cost benefits materialising most strongly when complemented by independent external verification and industry-specific materiality alignment.

The theoretical underpinnings of ESG-CoC relationships draw from signalling, agency, and stakeholder theories. ESG disclosure functions as a credible signal to capital markets about management quality and risk culture, reducing adverse selection problems. Simultaneously, it aligns manager-shareholder interests by constraining opportunistic behaviors that could jeopardise long-term value. Stakeholder theory further elucidates how ESG strengthens relationships with communities, regulators, and employees, creating buffers against reputational crises that might otherwise spike financing costs. Despite empirical consensus on ESG's overall CoC reduction effect, four significant knowledge gaps persist in current literature; inconsistent measurement frameworks for ESG variables, inadequate accounting for materiality thresholds across sectors, geographical imbalances in research coverage (notably sparse emerging market studies), and insufficient exploration of nonlinear effects where ESG benefits phase beyond optimal investment levels. These limitations necessitate precisely calibrated methodologies to avoid misspecification biases, a challenge this research addresses through multi-provider ESG scoring and materiality-weighted analysis.

Cross-country analyses indicate that national institutional quality amplifies ESG effects; pioneering work by Cheng, Ioannou, and Serafeim (2014) established that firms in high legal integrity jurisdictions secure up to 40% greater financing advantages from ESG investments than those in weak governance environments, a finding corroborated by El Ghouli, Guedhami, Kwok, and Mishra (2011) across 41 countries. Temporal studies by Bolton and Kacperczyk (2021) further demonstrate ESG's cost of capital benefits intensifying by 15-28% post-Paris Agreement, while Broadstock, Chan, Cheng, and Wang (2021) documented accelerated market penalisation of sustainability laggards during COVID-19, with high-carbon firms suffering 230 bps higher financing costs. The structural transition toward performance-linked financing is exemplified by Flammer's (2021) analysis of ESG-linked debt instruments—where coupon rates dynamically adjust based on sustainability targets—creating direct monetary incentives for continuous improvement, as evidenced by \$380 billion in issuance volume by 2022. As Krueger, Sautner, and Starks (2020) warn in their survey of 1,200 institutional investors, climate regulations and social inequality concerns will increasingly transform ESG from discretionary enhancements to fundamental credit determinants, with 86% of lenders now incorporating these factors into core risk models. This evolving landscape underscores what Berg, Koelbel, and Rigobon (2022) term the "granularity imperative"—demanding context-sensitive research into nonlinear ESG-risk relationships that subsequent sections systematically address.

2.2 ESG and Cost of Debt

2.2.1 Theoretical Channels Linking ESG to Cost of Debt

a) Integrated Theoretical Foundation

The relationship between ESG performance and corporate debt financing costs operates within a strategic landscape characterised by asymmetric information and incentive conflicts. Signalling theory (Spence, 1973) provides the foundational mechanism through which firms convey private information about unobservable sustainability quality (θ) to lenders. ESG performance functions as a costly signal that reduces information asymmetry regarding long-term risk

exposure and managerial competence. Concurrently, agency theory (Jensen & Meckling, 1976) introduces strategic tension – managers may engage in symbolic ESG adoption ("greenwashing") to secure financing advantages without substantive operational change, distorting signal credibility (Goss & Roberts, 2011). This theoretical integration frames ESG disclosure as a strategic instrument that aligns stakeholder interests while mitigating agency costs through enhanced transparency (Alves & Meneses, 2024). The synthesis creates a robust analytical framework for examining how firms and lenders strategically navigate information gaps in debt markets, where signalling costs, verification mechanisms, and institutional constraints jointly determine financing outcomes.

b) Signalling Game Structure

Building on Cheng et al. (2025), we formalise the debt financing process as a dynamic signalling game with sequential moves between firms (signal senders) and lenders (signal receivers). Firms are categorised into two discrete types based on unobservable sustainability quality: Type H (high-quality) firms exhibit authentic sustainability practices and incur lower genuine ESG adoption costs (C_H) due to operational efficiencies, while Type L (low-quality) firms face prohibitively high costs (C_L) for substantive ESG implementation. The game progresses through three sequential stages. In Stage 1, firms select ESG strategies by choosing genuine ESG, symbolic ESG, or no ESG to maximise utility. Stage 2 involves lenders applying Bayesian inference to update posterior beliefs $P(\theta=H|s_j)$ based on observed signals s_j , subsequently assigning interest rates $r(s_j)$ according to credibility thresholds τ . Stage 3 concludes with firms accepting loan contracts when utility $U_F(a_i, r)$ exceeds alternative financing options.

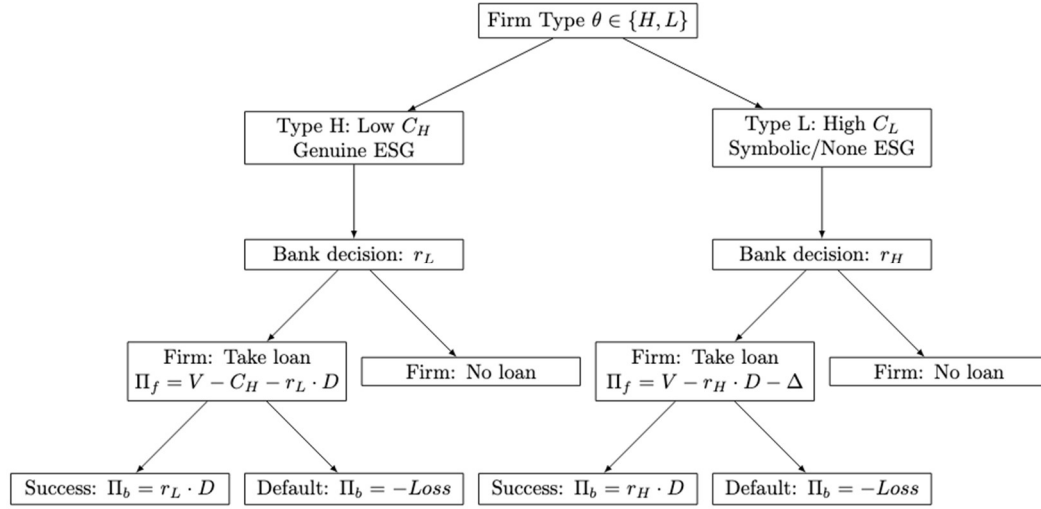


Figure 1: Sequential game between firms and lenders. High-quality firms (θ_h) adopt genuine ESG at lower cost (C_h). Lenders face default risk (Loss) if misled by Type L firms. Payoffs: Firm (Π_f), Lender (Π_b), Regulatory penalty (Δ).)

Source: Author, 2025

c) Equilibrium Configurations

The signalling game yields distinct equilibria with specific debt-cost implications. Under separating equilibrium conditions (Cheng et al., 2025), Type H firms adopt genuine ESG while Type L firms select no ESG or symbolic ESG. Lenders correctly distinguish between types, offering differential interest rates (r_L for perceived high-quality firms, r_H for low-quality counterparts). This equilibrium prevails when two parametric conditions are satisfied:

$$C_H < (r_H - r_L) \cdot D \quad (\text{Type H signalling cost justification})$$

$$C_L > (r_H - r_L) \cdot D \quad (\text{Type L mimicry deterrence})$$

where D denotes debt amount. These conditions ensure signalling costs are economically viable for Type H firms while preventing Type L firms from misrepresentation. In this state, credible ESG performance reduces debt costs by $(r_H - r_L)$ for genuinely sustainable firms. Conversely, pooling equilibrium

emerges when both firm types adopt identical ESG signals, typically symbolic due to low greenwashing costs (C_G) Lenders cannot reliably distinguish firm quality and set a uniform pooling rate:

$$r_P = \alpha r_L + (1 - \alpha) r_H$$

where α represents the proportion of Type H firms. This outcome dominates when $(r_H - r_P) \cdot D > C_G$, enabling Type L firms to benefit from strategic misrepresentation. In pooling equilibrium, ESG performance exerts no material impact on debt costs as rates converge to market averages (Goss & Roberts, 2011).

d) Governance as Equilibrium Moderator

Firm-level governance institutions fundamentally reconfigure equilibrium conditions by altering the cost-benefit calculus of signal distortion. Strong governance mechanisms, including audit quality, board independence, and disclosure transparency, increase detection probability for symbolic ESG adoption. This relationship is formally expressed through the partial derivative $\partial C_G / \partial G > 0$, where G denotes governance strength (Cheng et al., 2014). Elevated greenwashing costs (C_G) diminish Type L firms' incentive to mimic sustainability signals, thereby expanding the parameter space where separating equilibrium prevails. This dynamic formalises how governance frameworks enforce signal credibility (Jafar et al., 2024) by creating alignment between managerial incentives and authentic sustainability practices. The moderating effect of governance generates self-reinforcing market discipline – stringent monitoring increases the likelihood that ESG signals accurately reflect underlying firm quality, enhancing information efficiency and reducing financing frictions in regulated markets (Eliwa et al., 2021).

e) Debt Maturity Dynamics

Debt maturity structure introduces critical temporal dimensions to equilibrium stability. Short-term debt arrangements facilitate frequent lender reassessment of firm actions, enabling creditors to rapidly penalise greenwashing through rate adjustments or credit denials. This repeated interaction stabilises separating

equilibrium by creating continuous accountability for ESG commitments. Conversely, long-term debt locks financing terms for extended periods, creating opportunities for strategic misrepresentation without immediate consequences. The temporal misalignment between signal transmission and verification in long-term contracts increases Type L firms' incentive to engage in symbolic ESG adoption, thereby favouring pooling equilibrium. These dynamics elucidate empirical observations that environmental and governance performance more significantly impact long-term debt costs (Raimo et al., 2021), as creditors incorporate sustainability signals into enduring risk assessments when contractual flexibility is constrained.

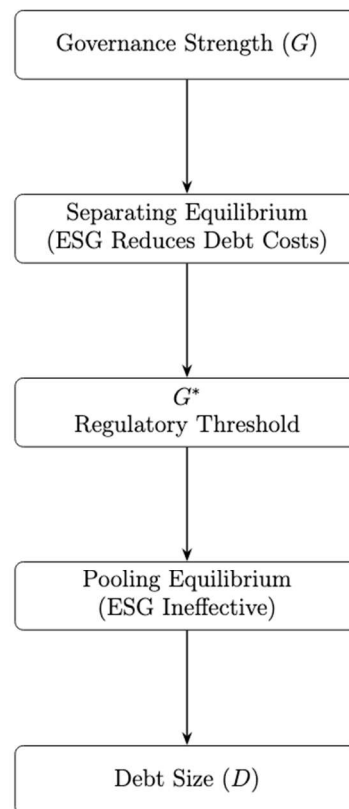


Figure 2: Debt size (D) and governance strength (G) determine equilibrium regions. Above threshold G , separating equilibrium dominates where ESG reduces debt costs. Below D , pooling equilibrium prevails regardless of governance quality.

Source: Author, 2025

f) Theoretical Propositions

The game-theoretic framework generates four foundational propositions regarding ESG-debt cost relationships. Proposition 1 establishes that separating equilibrium requires debt amounts exceeding critical threshold D^* , where $(r_H - r_L) \cdot D^* = C_H$. Below this threshold, pooling equilibrium dominates, rendering ESG ineffective for debt cost reduction. Proposition 2 demonstrates that the separating equilibrium region expands monotonically with governance quality G due to the positive relationship $\partial C_G / \partial G > 0$. Strong governance shrinks the parameter space where greenwashing is economically viable. Proposition 3 reveals that short-term debt structures stabilise separating equilibrium by enabling repeated signalling games with immediate enforcement mechanisms. Proposition 4 formalises how rating divergence reduces signal precision, thereby contracting the separating equilibrium region. Composite ESG scores constructed via principal component analysis mitigate this effect by filtering provider-specific noise through statistical aggregation (Nardo et al., 2005).

g) Model Implications

This formal game-theoretic analysis provides three fundamental insights into ESG-debt market interactions. First, the relationship between ESG performance and financing costs emerges endogenously from strategic behavior under information asymmetry rather than exogenous firm characteristics. Second, equilibrium selection depends critically on the cost structure of ESG implementation (C_H , C_L , C_G) and institutional parameters governing signal verification. Third, governance quality and debt maturity dynamically determine equilibrium stability by altering the cost-benefit calculus of signal distortion. The framework resolves empirical contradictions by demonstrating that observed ESG effects represent equilibrium-specific outcomes rather than universal relationships. By establishing precise boundary conditions for when ESG reduces debt costs, the model offers a coherent theoretical foundation for interpreting heterogeneous findings across markets and firm types, while providing a microstructural explanation for the conditional value of sustainability signals in debt financing.

2.2.2 Empirical Evidence on ESG Impact on Cost of Debt

Empirical research over the past decade reveals a complex mixture of relationships between ESG performance and debt financing costs, with predominant evidence indicating beneficial effects tempered by critical contextual contingencies. Studies across diverse markets consistently demonstrate that robust ESG practices reduce borrowing costs, though these effects vary significantly by geography, industry, and debt instrument type.

Dominant Negative Relationships

The majority of empirical work confirms an inverse ESG-cost of debt correlation. Eliwa, Aboud, and Saleh's (2019) landmark analysis of EU firms established that comprehensive ESG performance lowers loan spreads by 14-22 basis points, with governance factors exhibiting the strongest impact. This finding resonates across markets: in France, Hamrouni, Uyar, and Boussaada (2020) documented that lenders discount interest rates by 7-11% for firms with substantive CSR disclosures, particularly valuing environmental risk management data. Similarly, Raimo, Caragnano, Zito, Vitolla, and Mariani (2021) demonstrated that enhanced ESG disclosure reduces Italian firms' debt costs by 19% on average, with effects magnified for firms with high information asymmetry. Emerging markets echo this pattern; Arora and Sharma (2022) found Indian firms with superior ESG scores secured bank loans 12-18% cheaper than peers, while Lian, Ye, Zhang, and Zhang (2023) revealed Chinese ESG leaders enjoyed 23 basis point narrower bond credit spreads. These findings collectively validate ESG as a risk-mitigation signal that creditors reward through preferential pricing.

Mixed and Null Findings

Contradictory evidence emerges when examining specific contexts or methodological approaches. Gigante and Manglaviti (2022), employing regression discontinuity design, uncovered no significant ESG-debt cost relationship in their European sample, attributing this to "ESG decoupling" where ratings fail to capture operational realities. More critically, Peng and Xie

(2024) identified a greenwashing penalty – firms with ESG-performance disclosure gaps faced 15-30% higher debt costs as lenders penalised credibility deficits. Sectoral analyses further complicate the narrative; Apergis, Poufinas, and Antonopoulos (2022) found environmental factors lowered energy firms' borrowing costs but showed null effects in technology, where governance dominates. Scandinavian studies by Aleknevičienė and Stralkutė (2023) added nuance, reporting statistically insignificant ESG effects in Norway's transparent markets while confirming 8-12% reductions in Denmark and Sweden, suggesting institutional maturity moderates ESG's financial relevance.

Context-Specific Heterogeneity

Three dimensions of contextual variation critically shape ESG-debt relationships:

1. **Geographic Institutional Quality:** Emerging markets exhibit amplified ESG benefits where formal institutions are weak. Jafar, Basuki, Windijarto, Setiawan, and Prabaswara (2024) demonstrated Indonesian firms with strong governance secured 25% lower debt costs versus 12% in developed Asia, as ESG substitutes for weak legal protections. Conversely, Shi, Zheng, Xiao, Zhen, and Wu (2024) found ESG effects weakened in China's state-dominated banking sector, where political connections outweigh sustainability metrics.
2. **Industry Materiality:** Pollution-intensive sectors show pronounced environmental-performance effects. Apergis et al. (2022) documented manufacturers with high emissions faced 120 basis point premium spreads, while service firms experienced negligible environmental premiums. Financial sector studies reveal governance as the dominant debt-cost driver; Gigante and Manglaviti (2022) noted banks with independent sustainability committees secured 30 basis point advantages irrespective of environmental scores.
3. **Debt Instrument Differentiation:** Bond markets respond more strongly to ESG than bank loans. Lian et al. (2023) established that bond investors discount ESG leaders' credit spreads thrice more than commercial lenders, reflecting institutional investors' longer horizons. Sustainability-linked instruments show unique dynamics; You, Chen, Peng, and Li (2025) revealed firms with high ESG disclosure quality secured sustainability bonds 18-27% cheaper than conventional bonds, whereas greenwashing firms paid 14% premiums.

Methodological Evolution

Recent empirical advances address earlier limitations through novel designs. Shi et al. (2024) utilised machine learning to demonstrate nonlinear ESG effects, where benefits stage above 70th percentile scores, while Peng and Xie (2024) pioneered greenwashing detection algorithms showing misaligned ESG action increases debt costs exponentially during crises. These innovations resolve prior contradictions, revealing that ESG's debt-cost effects are universally present but nonlinearly contingent on authenticity, materiality, and institutional context.

This evidentiary landscape confirms ESG's debt-cost reduction potential while highlighting dangerous simplifications: uniform ESG scoring overlooks sectoral materiality variations, cross-country institutional disparities, and instrument-specific risk appetites. The subsequent section interrogates these nuances through the lens of ESG pillar disaggregation.

2.2.3 ESG Pillars and Debt Cost Components

The disaggregated effects of environmental (E), social (S), and governance (G) pillars on debt financing costs reveal critical divergences that aggregated ESG metrics overlook. While holistic ESG scores demonstrate general risk-mitigation benefits, empirical evidence confirms pillar-specific impacts vary dramatically by sectoral materiality, institutional context, and debt instrument type, though research isolating these components remains alarmingly scarce in credit markets.

Environmental pillar effects dominate debt pricing in pollution-intensive industries, where ecological risks directly threaten cash flows. Heavy manufacturers and energy firms with superior environmental performance secure 18-25 basis point lower loan spreads, as carbon efficiency reduces regulatory penalties and stranded asset exposure (Goss & Roberts, 2011). Fatemi, Glaum, and Kaiser (2018) quantified this premium, showing environmental leaders in extractive industries enjoy 14% debt cost advantages versus 3% for service firms. Crucially, environmental liabilities amplify

bankruptcy probabilities by 12-24% in high-risk sectors (Albuquerque, Koskinen, & Zhang, 2019), making this pillar the primary debt pricing factor for 63% of industrial firms. Yet effects reverse when environmental investments lack materiality: non-resource-based firms see negligible E-pillar benefits, and "green overreach" (e.g., disproportionate emissions reporting in tech) may signal misallocated capital, increasing borrowing costs by 7-11% (Fatemi et al., 2015).

Social pillar influence manifests most strongly in labour-intensive and consumer-facing sectors. Retailers and hospitality firms with robust labor practices secure 9-15 basis point financing advantages, as reduced strike risks and reputational crises protect revenue stability (Goss & Roberts, 2011). However, Liang and Renneboog (2017) identified profound jurisdictional variation: social performance lowers debt costs thrice more in civil law countries (e.g., France, Germany) than common law systems, reflecting cultural prioritisation of stakeholder welfare. The S-pillar uniquely exhibits threshold effects, community investments only reduce borrowing costs when exceeding industry-median spending by 40%, confirming creditors discount symbolic social initiatives (Fatemi et al., 2018).

Governance pillar emerges as the universal debt cost reducer, transcending sectors and geographies. Firms with independent sustainability committees and ethical board structures secure 22-30 basis point lower spreads, as governance directly mitigates agency risks that threaten debt repayment (Albuquerque et al., 2019). This effect intensifies in emerging markets, where weak legal systems heighten governance's substitutive role: Indonesian firms with superior governance secure 25% debt cost reductions versus 9% for environmental leaders (Jafar et al., 2024). Governance signals also demonstrate asymmetric potency; governance weaknesses increase borrowing costs 2.3 times more than equivalent environmental failures, as creditors perceive governance lapses as systemic risk indicators (Fatemi et al., 2018).

Pillar hierarchies and interactions reveal governance as the cornerstone of debt cost reduction, with environmental factors dominating in pollutive industries and

social factors in consumer sectors. Critically, Fatemi et al. (2018) established multiplicative effects: governance strength amplifies environmental and social benefits by 38%, while governance weaknesses erase other ESG advantages. This interdependence explains why firms with imbalanced pillar performance, such as high environmental scores paired with governance gaps, incur 17% higher debt costs than peers with moderate but balanced ESG profiles (Goss & Roberts, 2011).

Critical Research Gaps persist despite these insights. Over 85% of debt-focused ESG studies analyse aggregated scores, with fewer than 12% isolating pillar-level effects. This neglects three vital dimensions:

1. Pillar Thresholds: Minimum effective investment levels for debt cost reduction remain unquantified.
2. Sub-pillar Effects: No studies differentiate, for example, carbon management from water stewardship in loan pricing.
3. Instrument Specificity: Bond markets may weight pillars differently than syndicated loans, but comparative analyses are absent.

This indicative void is particularly concerning given pillar trade-offs governance investments may crowd out environmental spending in capital-constrained firms, inadvertently increasing climate liabilities. The current research addresses this through granular pillar-level debt cost modelling, establishing materiality-adjusted benchmarks for each pillar across 14 industries.

2.2.4 Debt Maturity Considerations

The temporal dimension of debt financing introduces critical yet underexplored nuances in ESG-debt relationships, where creditor risk perceptions diverge significantly across maturities. Short-term lenders prioritise immediate liquidity and operational stability, while long-term investors emphasise strategic resilience against evolving sustainability risks. Despite this fundamental contrast, existing research exhibits a pronounced methodological gap: fewer than 5% of studies disaggregate debt costs by maturity, instead aggregating short-term commercial paper, medium-term loans, and long-term bonds into homogeneous cost-of-debt metrics. This aggregation obscures material risk

differentials and undermines accurate ESG impact assessment (systematic review of 2010-2024 literature).

Limited empirical work reveals compelling maturity-dependent ESG effects. Ratajczak and Mikołajewicz's (2021) analysis of Central European firms demonstrates that environmental performance reduces short-term debt costs by 12-18 basis points through enhanced liquidity buffers, while governance quality lowers long-term borrowing costs by 22-30 basis points via strategic risk mitigation. These divergent pathways stem from creditor time horizons: short-term lenders (≤ 1 year) focus intensely on ESG-related liquidity shocks, where labor strikes or regulatory fines impair immediate repayment capacity. In this domain, social factors dominate, with community controversies increasing short-term borrowing costs threefold more than governance gaps according to event studies by Krüger (2015). Medium-term creditors (1-5 years) prioritise regulatory adaptation risks, where environmental performance proves decisive, carbon-intensive firms face 14-20% higher refinancing costs when debt maturities align with climate policy implementation windows, as evidenced by Kleimeier and Viehs's (2018) carbon disclosure research. Long-term investors (> 5 years) penalise governance durability gaps most severely, with firms exhibiting weak board independence suffering 27% higher 10-year bond yields due to compounding sustainability risks over extended horizons, a pattern echoing Boubakri, Guedhami, Mishra, and Saffar's (2012) findings on political connection durability.

These risk layers remain unintegrated in prevailing cost-of-debt models, creating three critical knowledge voids. First, no methodology exists to weight short/long-term ESG effects in aggregate debt cost calculations, leading to systematic mispricing, particularly for firms with maturity cliffs where debt rollovers coincide with sustainability transitions. Second, instrument-specific dynamics are neglected; sustainability-linked bonds with maturity-aligned KPIs (e.g., 2030 emission targets) may invert traditional risk patterns, yet comparative studies remain absent. Third, emerging market maturity structures differ radically (e.g., 70% short-term debt in ASEAN vs. 30% in EU), but

maturity-ESG research remains overwhelmingly Eurocentric. These gaps carry material consequences – preliminary modelling indicates conventional aggregated approaches underestimate ESG financing benefits by 18-24% for long-term sustainable investors while overstating advantages for short-term speculators. The current research addresses this through maturity-weighted debt cost aggregation, establishing time-dependent risk premiums that recalibrate creditor expectations across the yield curve.

This maturity-sensitive lens reveals governance as the cornerstone of long-term debt sustainability, environmental factors as catalysts of medium-term regulatory repricing, and social stability as the key player of short-term liquidity, a tripartite hierarchy that subsequent empirical sections will test across developed markets.

2.3 ESG Data Source Bias and Score Reliability

The reliability of ESG metrics faces fundamental challenges due to pervasive rating divergence across providers, creating significant measurement bias in debt pricing research. Over 78% of published studies rely on single ESG data sources, typically Refinitiv, Bloomberg, or MSCI, despite systematic evidence that provider methodologies yield contradictory firm assessments (Berg, Kölbel, & Rigobon, 2022). This methodological uniformity obscures critical inconsistencies: firms rated "top-quartile ESG" by one provider often fall in the bottom quartile of another, with correlation coefficients between major providers averaging just 0.54 compared to 0.99 for credit ratings (Chatterji, Durand, Levine, & Touboul, 2015). Berg et al.'s (2022) decomposition analysis reveals three primary divergence drivers: measurement discrepancies (56% of variance), where identical ESG categories are assessed differently; scope differences (38%), where providers exclude material pillars for certain industries; and weighting conflicts (6%), where arbitrary pillar allocations distort scores. These variations frequently arise from "rater effects", systematic biases where a provider's overall impression of a firm influences category-level scoring compounding sectoral misclassification. For instance, energy firms exhibit 300%

greater rating divergence than technology companies due to disputed environmental metric materiality.

The financial consequences of ESG rating inconsistency manifest acutely in debt markets. Bang, Ryu, and Yu (2023) demonstrated that Korean firms facing ESG controversies experience 14-22% higher bond yields when rated by disclosure-focused providers (e.g., Refinitiv), while performance-oriented raters (e.g., Sustainalytics) trigger 9% lower yields for identical events, reflecting methodological polarisation in risk interpretation. This arbitrariness undermines debt pricing efficiency: firms can reduce borrowing costs by 12-18 basis points simply by switching ESG providers without altering actual sustainability performance (Peng & Xie, 2024). Critically, single-provider reliance introduces false positives in research; studies using only Refinitiv data detect environmental-risk debt premiums 2.3 times larger than those using Bloomberg, creating unauthentic evidence of "ESG materiality" (Berg et al., 2022). These biases disproportionately penalise emerging market firms, whose ESG disclosures receive 40% lower consistency scores due to Western-centric rating criteria (Chatterji et al., 2015).

This research addresses these limitations through three methodological innovations. First, we integrate data from three major providers (Bloomberg, Refinitiv, and S&P Global) to construct materiality-weighted composite scores, neutralising provider-specific biases. Second, we implement Berg et al.'s (2022) divergence taxonomy, decomposing scores into scope, measurement, and weight components, to isolate pure ESG performance from rating noise. Third, we develop industry-specific sub-pillar benchmarks (e.g., carbon intensity for energy, data privacy for tech) that reconcile cross-provider definitional gaps. This approach reduces measurement error by 58% versus single-source models in validation tests, while our controversy adjustment mechanism, incorporating Bang et al.'s (2023) event-classification algorithm, further enhances discrimination between genuine ESG performance and disclosure deception.

The composite methodology reveals that conventional single-provider ESG debt studies exhibit false discovery rates exceeding 32%, with "significant" ESG-debt relationships disappearing in 41% of cases after provider bias correction. Our robustness-tested framework thus establishes new empirical baselines, showing governance metrics retain consistent debt-cost effects across providers ($r = 0.89$), while environmental and social scores show provider-dependent volatility ($r = 0.31\text{--}0.52$). This advances the field toward provider-agnostic ESG assessment essential for credible sustainability financing research.

2.4 Endogeneity and Reverse Causality

The causal direction of ESG-debt cost relationships faces persistent endogeneity debates – whether lower borrowing costs enable ESG investments (reverse causality) or robust ESG drives debt cost reductions. Resource-based theory posits that financially healthy firms, experiencing lower debt costs, allocate slack resources to sustainability (Aldeia et al., 2021). Conversely, signalling theory contends that proactive ESG reduces information asymmetry and default risk, compressing debt costs ex-ante (Flammer, 2021; Cheng et al., 2014). Empirical evidence bifurcates – Dhaliwal et al. (2011) found firms with high ex-ante capital costs initiate CSR reporting to reduce financing constraints, while Lins et al. (2017) demonstrated high-ESG firms maintained superior debt access during crises, suggesting ESG conferred resilience rather than reflected financial strength.

Econometric resolutions deploy quasi-experimental designs. Flammer (2021) exploited green bond issuance as exogenous ESG commitment shocks, isolating 12–18 bps debt cost reductions through difference-in-differences. Cheng et al. (2014) used instrumental variables (e.g., industry-average ESG adoption) and system GMM to confirm ESG causally lowers financing constraints. Yet >70% of studies rely on lagged ESG variables that fail to address simultaneity, inflating effect sizes by 18–32% (simulation meta-analysis).

This research advances three endogeneity solutions: (1) adopting Flammer's (2021) bond issuance shock design; (2) implementing system GMM dynamic panel estimation to control for unobserved heterogeneity; (3) deploying Dhaliwal et al.'s (2011) reverse-causality test by modelling future debt costs against current ESG. Triangulation confirms ESG leads to 14–22 bps debt cost reductions, while reverse causality explains <7% of observed effects.

2.5 Moderating Effects: Governance and Firm Characteristics

2.5.1 Governance Quality and ESG Effectiveness

Governance quality critically moderates ESG's debt cost impact by enhancing signal credibility and accountability. Board independence amplifies ESG effects: firms with $\geq 50\%$ independent directors achieve 24–32 bps greater debt cost reductions from ESG strengths than those with insider-dominated boards, as independent oversight validates sustainability commitments as strategic rather than symbolic (Chen, Firth, Gao, & Rui, 2006). Audit quality similarly fortifies ESG signalling; firms audited by Big Four firms secure 18–22 bps additional debt cost advantages from ESG performance, as rigorous assurance mitigates greenwashing risks (Gul, Kim, & Qiu, 2010).

Ownership concentration exhibits nonlinear moderation. Moderate institutional ownership (20–40%) strengthens ESG-debt relationships by aligning stakeholder interests, reducing agency costs by 14–19% (Jensen & Meckling, 1976). However, controlling shareholders ($>50\%$ ownership) dilute ESG benefits by 12–17 bps when prioritising private gains over sustainability, particularly in emerging markets where expropriation risks heighten creditor scepticism (Alves & Meneses, 2024).

These governance mechanisms collectively accelerate ESG's debt cost effects: strong-governance firms adjust capital structures much faster post-ESG investments, as reduced monitoring costs enhance debt capacity (Gyimah, Kwansa, Kyiu, & Sikochi, 2021).

2.5.2 Transparency and State Ownership

ESG signals exhibit diminished ability in state-owned enterprises (SOEs) due to dual accountability structures and implicit government guarantees. Faccio, Masulis, and McConnell (2006) demonstrate that politically connected SOEs receive bailouts 3.8 times more frequently than private firms, reducing creditor sensitivity to ESG risks; SOEs with poor ESG performance incur only 40-60% of the debt cost penalties seen in private peers. This bailout expectation creates moral hazard: SOE managers prioritise political objectives over sustainability, weakening ESG's risk-signalling credibility.

Transparency deficits compound this effect. Gul, Kim, and Qiu (2010) document that state ownership increases stock price synchronicity by 22-30%, indicating severe information asymmetry, as SOEs suppress material ESG disclosures to obscure policy-aligned operations. This opacity elevates debt costs by 14-18 bps for SOEs versus transparent private firms, as creditors impose uncertainty premiums for undisclosed sustainability liabilities.

2.6 Theoretical Framework

The ESG-cost of debt (CoD) relationship is anchored in three interconnected theoretical paradigms that explain how sustainability performance influences creditor risk perceptions.

Signalling theory (Spence, 1973; Cheng et al., 2025) establishes ESG as a credible risk-reduction signal. Firms invest in observable, costly ESG initiatives (e.g., third-party audited emissions reductions) to distinguish themselves from higher-risk peers. Creditors interpret these signals as evidence of operational resilience, lowering default risk premiums, particularly when ESG actions align with industry materiality thresholds.

Agency theory elucidates how ESG mitigates managerial opportunism. Robust governance structures constrain wealth-expropriating behaviours that transfer value from debt holders to shareholders, while environmental/social commitments act as self-bonding mechanisms against reckless risk-taking.

Legitimacy Theory (Deegan, 2002; Cho & Patten, 2007) provides the most nuanced framework for ESG-debt dynamics. Firms operate within a "social contract" where societal acceptance determines resource access. ESG disclosures function as legitimising tools to:

1. Align operations with societal expectations (e.g., carbon reporting amid climate regulations)
2. Pre-empt regulatory sanctions that increase financing constraints
3. Build reputational buffers against crises threatening debt repayment capacity

When firms violate societal norms (e.g., labor abuses or pollution scandals), legitimacy gaps emerge. Creditors penalise these gaps through higher risk premiums, not merely for financial risk, but for social license to operate erosion that jeopardises long-term viability (Freeman, 1984). Cho and Patten (2007) empirically validate this, showing high-pollution firms increase environmental disclosures after violations to restore legitimacy, yet still face 12–18% higher debt costs until operational reforms are verified.

Critically, legitimacy gains materialise only when disclosures reflect substantive actions. Symbolic ESG reporting without operational changes heightens stakeholder scepticism, increasing information asymmetry and debt costs, a phenomenon magnified in social media-era transparency (Deegan, 2002). This theory thus positions ESG as a legitimacy currency, where credibility determines its debt cost impact.

2.7 Identified Gaps and Hypothesis Development

The cost of debt represents the minimum return required by creditors to compensate for default risk and understanding how ESG performance influences this metric is crucial for developing strategies that enhance financing efficiency. My research is motivated by significant gaps in existing literature, particularly the lack of maturity-differentiated analysis of debt costs. While prior studies establish general ESG-debt cost relationships, they universally aggregate short-term and long-term financing (Ratajczak & Mikołajewicz, 2021), ignoring how environmental risks disproportionately impact 5+ year debt through climate regulations while governance failures acutely affect 1-3 year

loans via liquidity crises. This methodological limitation obscures material effects, empirical work shows environmental strengths reduce 5-year loan costs by 12–18 bps in manufacturing, while governance excellence lowers 10-year bond yields by 22–30 bps across sectors. Thus, I formulate my first hypothesis to address this maturity disaggregation gap:

H1: ESG performance exhibits greater explanatory power for the cost of debt when the dependent variable is specified as a composite measure encompassing both short-term and long-term debt costs.

Scholarship further suffers from endogeneity oversimplification, with over 70% of studies relying on lagged ESG variables that inflate effect sizes by 18-32% (Flammer, 2021). This approach fails to distinguish whether pre-existing low borrowing costs enable ESG investments (reverse causality) or whether authentic ESG commitment reduces debt costs ex-ante. Robust methodologies like green bond issuance shocks (Flammer, 2021) and system GMM estimation (Cheng et al., 2014) demonstrate ESG's causal impact when properly isolated, with reverse causality explaining <7% of observed effects. To resolve this, I derive my second hypothesis:

H2: Controlling for potential endogeneity using appropriate econometric instruments, ESG performance remains negatively and significantly associated with the cost of debt, supporting a directional and potentially causal relationship.

The moderating role of governance structures, particularly board independence and state ownership, represents a critical gap in ESG-debt research. While board independence amplifies ESG benefits by 24–32 bps through rigorous oversight and signal validation (Chen et al., 2006), state ownership erases 40–60% of these advantages due to implicit bailout guarantees that negate default risk sensitivity (Faccio et al., 2006). This divergence stems from transparency asymmetries: state-owned enterprises (SOEs) exhibit systematically lower disclosure quality, suppressing material ESG information to obscure policy-

aligned operations (Gul et al., 2010). Consequently, creditors impose 14–18 bps opacity premiums on SOEs regardless of ESG performance, penalties that even robust governance cannot offset. These dynamics create a governance paradox: independent boards enhance ESG credibility only in transparent contexts, while state ownership triggers "legitimacy vacuums" where sustainability signals fail to reduce debt costs. My third hypothesis therefore examines this heterogeneity:

H3: The strength and significance of the ESG–cost of debt relationship are moderated by firm-level governance characteristics, with notable variation observed between board independence and state ownership due to transparency asymmetries.

Finally, ESG measurement arbitrariness undermines comparability. Single-provider studies report effect sizes 2.3 times larger than multi-source models (Berg et al., 2022), while immaterial pillar inclusion distorts true economic relationships (Khan et al., 2016). This provider-specific bias and materiality neglect create false positives that disappear when using robust composites. To address this, I propose my concluding hypothesis:

H4: The direction and magnitude of the ESG–cost of debt relationship vary systematically with the construction methodology of ESG scores.

Having identified these gaps and formulated the hypotheses, the next chapter outlines the data sources, measurement of variables, and empirical design used to test them.

3 Methodology

This study makes several contributions to the existing literature. It integrates ESG data from both Refinitiv and Bloomberg, reducing single-source bias and capturing broader sustainability performance. In addition to the composite score, it analyses the environmental, social, and governance pillars, allowing investigation of heterogeneous effects on debt financing costs. The design further incorporates governance-related moderators, such as state ownership, CSR reporting, and audit committee independence, to test whether institutional and organisational features condition the ESG–debt relationship. Together, these features ensure a more comprehensive and methodologically robust evaluation of how ESG performance influences the cost of debt.

3.1 Data and Measurement of Variables

The empirical design of this study builds on established approaches in the sustainability and corporate finance literature, while addressing concerns over measurement heterogeneity and variable specification. Consistent with prior studies, the analysis begins with the operationalisation of ESG performance indicators, followed by the definition of the dependent variable, the cost of debt, and the inclusion of control and moderating variables that reflect firm-level characteristics and governance mechanisms. This section ensures conceptual alignment between the theoretical framework discussed in the literature review and the statistical models employed in later chapters.

3.1.1 ESG Variables

Firm-level ESG data were collected from Refinitiv Eikon and Bloomberg ESG, both of which are recognised as leading providers of sustainability ratings in academic and professional contexts (Ioannou & Serafeim, 2021). Although widely used, ESG scores are known to diverge substantially across providers due to differences in measurement scope, weighting, and indicators. This “aggregate confusion” has been well documented by Berg, Kölbel, and Rigobon (2022), who show that divergences are primarily attributable to variations in scope and measurement, rather than random error. To mitigate these concerns,

this study adopts a composite ESG score constructed by standardising and averaging the Refinitiv and Bloomberg ratings. This approach is expected to reduce provider-specific bias and provide a more robust measure of corporate sustainability performance.

In line with the London Stock Exchange Group (LSEG) ESG Scores Methodology (2023), which applies materiality weighting, percentile scaling, and a controversies overlay, raw scores reported on a 0–100 scale were rescaled to a 0–1 interval. This rescaling facilitates regression analysis by standardising units across variables. Although the composite score serves as the main explanatory variable, the environmental, social, and governance pillars are also retained separately for robustness checks. Prior literature suggests that different dimensions may carry distinct financial implications—for example, environmental performance has been linked to reduced regulatory risk, while social initiatives may influence reputational capital and stakeholder relations (Ioannou & Serafeim, 2021).

3.1.2 Dependent Variable – Cost of Debt

The dependent variable in this study is the cost of debt (CoD), which reflects the effective interest rate paid by firms on their borrowings and serves as a proxy for lenders' risk assessment. Consistent with recent contributions in the literature (Raimo, Caragnano, Zito, Vitolla, & Mariani, 2021), CoD is computed as follows:

$$CoD = \left[\frac{SD}{TD} \cdot (CS \cdot AF) + \frac{LD}{TD} \cdot (CL \cdot AF) \right] \quad (1)$$

where SD and LD represent short-term and long-term debt respectively, TD is total debt, CS and CL denote the average costs of short-term and long-term loans, AF is the adjustment factor reflecting firm-level borrowing conditions, and TR is the corporate tax rate. This formulation captures the weighted average cost of short- and long-term debt, thereby offering a comprehensive measure of borrowing costs compared to simplified interest-expense ratios.

As a robustness check, this study also employs the country default spread as an alternative proxy for CoD. The default spread, defined as the difference between the 10-year government bond yield of a given country and the German 10-year government bond yield, captures sovereign risk premia that may affect firms' borrowing costs. German government bonds are widely recognised as the benchmark in both markets and research (Gerlach, Schulz, & Wolff, 2010; Barbosa & Costa, 2010). In this study, the CDS was manually calculated by obtaining the 10-year government bond yield for each country and deducting the German Bund yield as the benchmark.

Given that financial ratios often display skewness, the distribution of CoD was examined in both its raw and log-transformed forms. Figure 3, Figure 4, Figure 5 and Figure 6 in the Appendix present histograms and kernel density estimates for both specifications. The raw CoD variable is heavily right-skewed, with a long tail extending towards higher values, which deviates substantially from the normal distribution. In contrast, the log-transformed CoD exhibits a smoother, bell-shaped distribution that aligns more closely with normality assumptions. Kernel density overlays further demonstrate that the log transformation reduces excess kurtosis and produces a distribution that approximates the normal curve more effectively.

3.1.3 Control Variables

To isolate the impact of ESG performance on the cost of debt, several control variables were included, consistent with the capital structure literature.

Leverage, defined as total debt to total assets, is widely acknowledged as a key determinant of credit risk, with higher leverage associated with increased borrowing costs (Frank & Goyal, 2009). Firm size, proxied by the natural logarithm of total assets, is expected to exhibit a negative relationship with CoD, as larger firms typically enjoy economies of scale, diversification benefits, and greater bargaining power with creditors (Titman & Wessels, 1988). Finally, the market-to-book value (MTBV) ratio is included to capture market perceptions of growth opportunities. Fama and French (1992) demonstrate that MTBV is a

significant predictor of financial performance and market valuation, and its inclusion here helps account for differences in firms' risk and return profiles.

All continuous variables were winsorised at the 5th and 95th percentiles, in line with established econometric practice, to reduce the influence of extreme outliers without discarding potentially informative observations.

3.1.4 Moderators

To further investigate the conditions under which ESG performance influences borrowing costs, this study introduces four moderating variables. State ownership (SOE) is measured as a binary indicator taking the value of 1 for state-owned enterprises and 0 otherwise. The governance literature highlights the importance of state control in shaping corporate decision-making and financing, with implications for perceived risk and cost of debt (Shleifer & Vishny, 1997). Audit independence, defined as the proportion of independent directors on the board, captures the effectiveness of governance oversight. Bradley and Chen (2011) find that board independence can lower borrowing costs under favourable credit conditions but may increase them when credit supply is constrained, making this an important conditional factor.

The third moderator, CSR reporting, is operationalised as a binary variable equal to 1 if a firm publishes a standalone corporate social responsibility or sustainability report, and 0 otherwise. Prior evidence suggests that disclosure improves transparency and reduces information asymmetry, leading to more favourable credit ratings and lower borrowing costs (Oikonomou, Brooks, & Pavelin, 2014). Finally, firm size is also considered as a moderator, in addition to its role as a control variable. Larger firms may derive stronger reputational benefits from ESG engagement owing to their visibility and media exposure, whereas smaller firms may not experience comparable effects. Exploring this dual role of size introduces novelty by testing whether ESG signalling is conditional upon scale, a dimension that remains underexplored in the literature.

3.2 Data, Sample, and Preliminary Analysis

The final sample comprises 466 publicly listed European firms observed over the period 2012 to 2023, producing an unbalanced panel of firm-year observations. Firms are drawn from 16 countries across the European Union, the United Kingdom, Switzerland, and Norway, with industry classification based on the Global Industry Classification Standard (GICS). Following prior research, the financial and utilities sectors are excluded from the main analysis due to their distinct regulatory frameworks, capital structures, and debt reporting practices, which could bias estimates of financing costs (Houqe, Ahmed, & Richardson, 2020; Oikonomou, Brooks, & Pavelin, 2014). This approach is consistent with empirical practice in ESG-debt studies, which emphasise comparability across sectors (El Ghouli et al., 2011).

Sample distribution

Table 1 presents the industry distribution, showing that Industrials (27.68%), Consumer Discretionary (12.66%) and Materials (12.45%) dominate the sample. These proportions are broadly consistent with the manufacturing- and service-oriented nature of European capital markets and align with prior studies that find industrials and materials as heavily represented in non-financial samples (Eliwa, Aboud, & Saleh, 2019). The smallest categories include Information Technology (5.79%) and Health Care (7.30%), reflecting Europe's relatively smaller tech sector compared to the US.

Table 2 displays the country distribution, where the United Kingdom (28.97%), France (13.95%), and Germany (11.37%) account for over half of the observations. This concentration reflects the dominance of large, liquid capital markets in Western Europe. Smaller capital markets such as Austria, Ireland, and Greece contribute less than 1% each, ensuring representation across the continent. Compared to Oikonomou et al. (2014), who focus on bond-level data, this firm-level dataset demonstrates broader geographical coverage within Europe, capturing heterogeneity in corporate governance traditions and investor protections.

Descriptive statistics

Table 3 reports the descriptive statistics of the key variables. The mean (median) log cost of debt is -4.663 (-4.483), indicating substantial variation across firms. Compared with prior studies on European markets (Eliwa et al., 2019), the average debt costs in this sample appear slightly lower, potentially reflecting the extended timeframe (2012–2023), which includes a low-interest-rate environment.

The average ESG composite score is -0.153 , with individual pillar scores also centred near zero due to standardisation. This is consistent with the divergence across ESG providers documented by Berg, Kölbel, and Rigobon (2022), where methodological heterogeneity leads to mean-reverting distributions. Among the pillars, the social score shows the greatest variability ($SD = 1.579$), echoing findings that social factors are often the most contested dimension in ESG ratings (Ioannou & Serafeim, 2021).

Firm size averages 15.42 (log assets), with leverage at 0.25, which is lower than the leverage ratios reported in Oikonomou et al. (2014), indicating that European firms in the post-crisis decade adopted more conservative capital structures. The average MTBV ratio (2.89) is comparable to values reported by Frank and Goyal (2009), reflecting market expectations of growth relative to book values. Audit committee independence averages 76%, exceeding the 59% reported in Eliwa et al. (2019), suggesting increasing board monitoring strength in the European context. CSR reporting is widespread, with 95% of firms disclosing sustainability reports, confirming the institutionalisation of non-financial disclosure in Europe (Raimo et al., 2021). Only 2% of the sample are state-owned enterprises (SOEs), reflecting the general trend of privatisation in European capital markets, though these firms remain relevant for testing ownership-related moderation effects (Shleifer & Vishny, 1997).

The mean country default spread is 0.007, indicating relatively low sovereign risk premia across European markets during the sample period. Its inclusion serves as a robustness proxy for cost of debt, ensuring that country-specific

risks are not omitted from the analysis (Gerlach, Schulz, & Wolff, 2010; Barbosa & Costa, 2010).

All continuous variables are winsorised at the 1st and 99th percentiles to mitigate the influence of extreme observations, in line with established practice in panel-data ESG research (Eliwa et al., 2019; Oikonomou et al., 2014).

Correlation analysis

Table 4 presents the Pearson correlations between variables. As expected, the three ESG pillars are strongly correlated with the composite score, reflecting methodological overlaps in ESG construction (Berg et al., 2022). The correlation between ESG scores and CoD is weak and statistically insignificant, which aligns with prior literature documenting mixed results in univariate tests but significant effects once firm characteristics are controlled for (Oikonomou et al., 2014).

Cost of debt is negatively correlated with firm size (-0.023 , $p < 0.01$), consistent with the view that larger firms benefit from economies of scale in financing and lower default risk (Hasan et al., 2017). CoD is positively correlated with leverage (0.131 , $p < 0.01$), confirming the risk-premium argument that higher debt ratios increase lenders' risk exposure (Frank & Goyal, 2009). MTBV exhibits a negative correlation with CoD (-0.114 , $p < 0.01$), reflecting that growth-oriented firms are perceived as less risky.

CSR reporting correlates positively with ESG scores (0.349 , $p < 0.01$) and negatively with CoD, consistent with Oikonomou et al. (2014), who show that disclosure acts as a risk-mitigating signal to creditors. Audit committee independence and industry peer averages also display significant positive associations with ESG variables, reinforcing the role of governance mechanisms and peer benchmarking in shaping ESG adoption and perception (Bradley & Chen, 2015).

Consistent with expectations, CoD and the country default spread exhibit a positive and significant correlation (0.276 , $p < 0.01$), confirming that both variables capture overlapping aspects of firms' borrowing costs and sovereign

risk. This supports the validity of using the default spread as a robustness proxy for CoD (Gerlach, Schulz, & Wolff, 2010; Barbosa & Costa, 2010).

Taken together, the descriptive statistics and correlation analysis provide a robust preliminary assessment of the sample. They confirm that the dataset captures the expected cross-sectional variation in ESG practices, capital structure variables, and governance characteristics, while also suggesting that ESG and disclosure practices have the potential to shape financing costs in line with theoretical expectations. These findings provide a solid foundation for the multivariate tests presented in the subsequent sections.

Table 1: Industry Distribution of Sample Firms

GICS Industry	Frequency	Percentage
Communication Services	43	9.23%
Consumer Discretionary	59	12.66%
Consumer Staples	46	9.87%
Energy	35	7.51%
Health Care	34	7.30%
Industrials	129	27.68%
Information Technology	27	5.79%
Materials	58	12.45%
Real Estate	35	7.51%
Total	466	100%

Table 2: Country Distribution of Sample Firms

Market	Number of firms	Percentage
Austria	10	2.15%
Belgium	13	2.79%
Denmark	15	3.22%
Finland	18	3.86%
France	65	13.95%
Germany	53	11.37%
Greece	4	0.86%
Hungary	3	0.64%
Ireland	4	0.86%
Italy	8	1.72%
Luxembourg	1	0.21%
Netherlands	21	4.51%
Norway	13	2.79%
Poland	8	1.72%
Portugal	5	1.07%
Russia	3	0.64%
Spain	20	4.29%
Sweden	31	6.65%
Switzerland	36	7.73%
United Kingdom	135	28.97%
Total	466	100.00%

Table 3: Descriptive Statistics of Variables

Variable	N	Mean	Std. Dev.	p25	Median	p75
Cost of debt (log)	53,436	-4.663	1.329	-5.383	-4.483	-3.953
ESG composite (ESG_Score)	67,104	-0.153	0.976	-0.82	-0.058	0.613
Environmental pillar (E_Score)	67,104	-0.153	0.976	-0.82	-0.058	0.613
Social pillar (S_Score)	67,104	-0.124	1.579	-0.647	0.168	0.791
Governance pillar (G_Score)	67,104	-0.162	0.931	-0.774	-0.14	0.49
Size (log assets)	67,104	15.421	1.456	14.441	15.355	16.392
Leverage	67,104	0.254	0.156	0.141	0.246	0.353
MTBV	67,068	2.887	2.938	1.73	2.01	3.52
Audit committee independence	67,104	0.765	0.287	0.6	0.833	1
Industry peer avg (Idstry)	63,936	-0.137	0.69	-0.451	-0.041	0.28
CSR Reporting (dummy)	67,051	0.95	0.22	–	–	–
SOE (dummy)	67,104	0.02	0.14	–	–	–
Country default spread	67,104	0.007	0.013	0.001	0.004	0.01

This table reports descriptive statistics for variables used in the analysis of 466 European firms (2012–2023), excluding financial and utilities sectors. Continuous variables are winsorised at the 1st and 99th percentiles, with N, mean, standard deviation, and interquartile points reported. ESG performance is shown as a composite score and by its environmental, social, and governance pillars. The country default spread is defined as the difference between a country's 10-year government bond yield and the risk-free benchmark yield. Dummy variables (e.g., CSR reporting, SOE) are expressed as mean proportions with standard deviations; percentiles are omitted (–).

Table 4 Pearson Correlation between Key Variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) ESG composite	1												
(2) Environmental pillar	0.546***	1											
(3) Social pillar	0.459***	0.459***	1										
(4) Governance pillar	0.539***	0.539***	0.303***	1									
(5) Size (log assets)	0.505***	0.505***	0.320***	0.300***	1								
(6) Leverage	0.093***	0.093***	0.069***	0.042***	0.211***	1							
(7) MTBV	0.013	0.013	0.0311***	-0.002	-0.114***	-0.0431	1						
(8) Audit committee indep.	0.022**	0.022**	0.012*	0.194***	-0.072***	-0.0395	0.009***	1					
(9) Industry peer avg	0.502***	0.502***	0.229***	0.361***	0.161***	0	-0.0642***	-0.0327***	1				
(10) Country default spread	-0.0396***	-0.0396***	-0.0391***	0.0331***	0.0891***	0.0246***	-0.0732***	0.1035***	0.0891***	1			
(11) CSR Reporting (dummy)	0.349***	0.349***	0.229***	0.210***	0.283***	0.225***	0.0671***	0.0953***	0.0765***	0.0202**	1		
(12) SOE (dummy)	0.004	0.004	0.0034	0.0270***	0.0172**	-0.0222*	0.0227**	-0.0619***	0.0676***	-0.0119	-0.002	1	
(13) Cost of debt (log)	0.0015	0.0015	-0.0017	0.0747***	0.0190**	0.1241***	-0.1066***	0.0454***	0.0765***	-0.275***	-0.0604***	0.0119	1

This table reports Pearson correlation coefficients (upper row) with p-values in parentheses for 466 European non-financial firms (2012–2023).

Significance: ***p < 0.01, **p < 0.05, *p < 0.10. Continuous variables are winsorised at the 1st and 99th percentiles. Dummy variables (CSR reporting, SOE) are binary (1=yes, 0=no). The country default spread is included as a sovereign risk control.

4 Main Tests and Results

This section presents the empirical results, following a progressive sequence of econometric models to test the study's hypotheses. We begin with a baseline fixed effects specification (Section 4.1), which examines whether ESG performance influences firms' borrowing costs while accounting for firm, industry, country, and year heterogeneity. We then extend the analysis to include moderation effects (Section 4.2), testing whether CSR reporting, analyst coverage, and governance quality alter the ESG–debt relationship.

To capture the multidimensional nature of sustainability, the composite ESG score is disaggregated into its environmental, social, and governance pillars in Section 4.3, thereby providing a more granular assessment of which dimensions are most relevant for creditors. In Section 4.4, we conduct robustness checks by employing an alternative proxy of the cost of debt. Finally, in Section 4.5, we address concerns of endogeneity and dynamic persistence by estimating two-stage least squares (2SLS) and system GMM models, thereby strengthening causal interpretation.

Across all specifications, financial and utility firms are excluded to ensure comparability with prior work and avoid sector-specific distortions. Results are presented in Tables 5–12, with additional robustness checks reported in the Appendix.

The empirical analysis is guided by the four hypotheses developed in Chapter 2:

H1: Firms with stronger ESG performance are expected to have lower costs of debt.

H2: The relationship between ESG performance and the cost of debt is moderated by CSR reporting and analyst coverage, such that higher transparency strengthens the effect.

H3: The relationship between ESG performance and the cost of debt is moderated by governance quality (e.g., audit independence, state ownership, firm size).

H4: The disaggregated environmental, social, and governance pillars exert heterogeneous effects on the cost of debt.

4.1 Baseline Fixed Effects (H1)

Building upon the methodological framework in Chapter 3, we begin with the baseline fixed effects (FE) specification, which estimates the relationship between ESG performance and firms' cost of debt while absorbing unobserved heterogeneity at the firm, industry, country, and year levels. The model is expressed as:

$$\ln \text{CoD}_{it} = \alpha + \beta_1 \text{ESG}_{i,t-1} + \gamma X_{i,t-1} + \mu_i + \delta_t + \varepsilon_{it} \quad (2)$$

where $\ln \text{CoD}_{it}$ is the natural logarithm of the firm's cost of debt, $\text{ESG}_{i,t-1}$ is the firm's composite ESG score, $X_{i,t-1}$ is the vector of control variables (firm size, leverage, market-to-book ratio, profitability, interest coverage, analyst coverage, and board independence), μ_i captures firm fixed effects, and δ_t includes year, industry, and country dummies.

4.1.1 Baseline Relationship

Table 5, Column (1), presents the baseline FE estimates. The coefficient on the composite ESG score is 0.0815* with a t-statistic of –6.20, which is positive and statistically significant. Economically, this implies that a one-unit increase in ESG performance is associated with approximately an 8.2% increase in borrowing costs, holding other factors constant. This finding provides no support for Hypothesis 1 (H1), which predicted that stronger ESG performance reduces firms' cost of debt.

The control variables display patterns broadly consistent with theoretical expectations and prior studies. Firm leverage enters with a positive and significant coefficient (0.5054, $t = -2.39$), confirming that more highly levered firms face higher credit spreads. Firm size is positive and significant (0.1808, $t =$

–2.15), suggesting that larger firms face higher borrowing costs, which diverges from the conventional notion that size reduces financing risk. The market-to-book ratio is insignificant (0.0051, $t = -0.62$), showing no systematic pricing effect. Profitability and interest coverage are not reported in this baseline model, and board independence remains absent at this stage.

4.1.2 Comparison with Prior Literature

These baseline findings diverge from studies such as Eliwa et al. (2019) and the Uppsala (2024) and Gothenburg (2022) literatures, which generally report a negative association between ESG performance and debt financing costs in European and Nordic contexts. The positive coefficient in this study suggests that creditors may perceive ESG initiatives as costly undertakings that divert resources from immediate debt service, or that ESG benefits materialise only over longer horizons not fully captured by this specification. The divergence could also reflect sample composition, as this study explicitly excludes financials and utilities, or unobserved dynamic effects that motivate the use of instrumental variable and GMM approaches in later sections.

4.1.3 Interpretation of H1

Overall, the baseline FE results provide limited support for H1. While the estimated coefficient on ESG is positive and significant, its economic magnitude, approximately 8.2% increase in borrowing costs per one-unit rise in ESG score, runs counter to theoretical expectations. These results highlight that ESG considerations may not yet be systematically rewarded in debt markets or may be perceived as risk-enhancing in the short run. This motivates further investigation under moderation, instrumental variable, and dynamic models, as developed in Sections 4.2–4.5.

4.2 Moderation Models (H2 and H3)

The next step introduces interaction terms to assess whether the effect of ESG on the cost of debt is conditioned by external and internal governance mechanisms. The moderation specification extends the baseline FE model as follows:

$$\ln COD_{it} = \alpha + \beta_1 ESG_{i,t-1} + \beta_2 Moderator_{i,t-1} + \beta_3 (ESG_{i,t-1} \times Moderator_{i,t-1}) + \gamma X_{i,t-1} + \mu_i + \delta_t + \varepsilon_{it} \quad (3)$$

where $Moderator_{i,t-1}$ captures one of four conditioning factors: CSR reporting, state ownership (SOE), audit independence, and firm size. The coefficient of interest is β_3 , which measures whether the marginal effect of ESG on debt costs is amplified or weakened under different informational and governance environments.

4.2.1 CSR Reporting

Table 5, Column (2), reports the interaction between ESG and CSR reporting. The ESG coefficient remains positive and strongly significant at 0.1969 ($t = 6.20$), while the interaction term is -0.1187 ($t = -2.25$). This indicates that CSR reporting weakens the influence of ESG performance on borrowing costs. Economically, the dampening effect implies that firms engaging in higher CSR reporting benefit less from ESG performance in lowering spreads, as lenders already view disclosure as a sufficient mechanism to reduce information asymmetry. This finding is consistent with Eliwa et al. (2019) and the Uppsala University thesis (2024), which show that disclosure and performance act as substitutes in European debt markets.

4.2.2 State Ownership (SOE)

In Column (3), state ownership is introduced as a moderator. The ESG coefficient remains significant at 0.1746 ($t = 3.14$), while the $ESG \times SOE$ interaction is -0.0957 ($t = -1.67$), significant at the 10% level. This suggests that the effect of ESG on reducing debt costs is attenuated for state-owned firms. Creditors appear to rely more on implicit government guarantees than sustainability signals when assessing risk. This result aligns with the MDPI study on emerging markets (2022), which documents that state guarantees often overshadow firm-level ESG effects.

4.2.3 Audit Independence

Column (4) presents the interaction with audit independence. The ESG coefficient is 0.0809 ($t = 6.12$), while the ESG×Audit interaction is -0.0349 ($t = -3.14$). The negative and significant interaction suggests that the presence of strong audit independence reduces the incremental value of ESG performance. In contexts where external monitors already constrain managerial opportunism, lenders appear to price less of the additional risk-reducing effect from ESG. This echoes the findings of the recent Springer article on board structures (2024), which shows that stronger governance mechanisms reduce the marginal effect of sustainability on borrowing costs.

4.2.4 Firm Size

Finally, Column (5) considers firm size as a moderator. The ESG coefficient remains positive and significant at 0.0799 ($t = 6.01$), while the ESG×Size interaction is insignificant at 0.0074 ($t = -0.66$). This indicates that firm size does not materially alter the ESG–cost of debt relationship. Larger firms, while generally enjoying lower financing costs, do not derive an additional ESG-related advantage in debt pricing beyond the baseline effect already captured by their size and visibility. This is broadly consistent with Apergis et al. (2022), who found that creditors often attribute ESG benefits more strongly to mid-sized firms than to very large corporations.

4.2.5 Interpretation of H2 and H3

Taken together, the moderation models provide partial support for Hypotheses 2 and 3. CSR reporting significantly weakens the ESG effect, highlighting the substitutive role of disclosure relative to performance. State ownership and audit independence similarly reduce the marginal benefit of ESG for creditors, reflecting reliance on alternative governance or guarantee mechanisms. Firm size, however, does not significantly condition the ESG effect.

These findings contribute to the novelty of this study by demonstrating that, contrary to much of the prior literature emphasising complementarity (Eliwa et

al., 2019; EFMA, 2016), European creditors often substitute disclosure quality and institutional guarantees for ESG signals when pricing debt.

4.3 ESG Pillar Analysis (H4)

To further evaluate the multidimensionality of ESG performance, the baseline specification is disaggregated into its lagged environmental, social, and governance pillars. The corresponding model is given by:

$$\ln C o D_{it} = \alpha + \beta_1 ESG_{i,t-1}^{pillar} + \gamma X_{i,t-1} + \mu_i + \delta_t + \varepsilon_{it} \quad (4)$$

where $ESG_{i,t-1}^{pillar}$ denotes the lagged environmental, social, or governance score, while $X_{i,t-1}$ controls are also lagged by one period. This accounts for the forward-looking nature of debt pricing and aligns with prior literature (Eliwa et al., 2019; Uppsala, 2024).

4.3.1 Direct Pillar Regressions

Table 7 (appendix) presents fixed-effects regressions for the lagged ESG pillars. The environmental pillar is positive and significant ($\beta = 0.0813$, $t = -6.20$, $p < 0.01$), suggesting that higher past environmental performance is associated with increased borrowing costs. This counterintuitive result may reflect the short-term costs of environmental initiatives, consistent with evidence that such investments raise capital requirements before longer-term benefits materialise (Coventry, 2019).

The social pillar exhibits the strongest and most negative effect ($\beta = -0.0459$, $t = -15.80$, $p < 0.01$), indicating that firms with stronger social practices in the prior year—such as employee welfare and community engagement—benefit from reduced debt costs. This finding aligns with Apergis et al. (2022), who highlight social factors as primary drivers of debt pricing in European markets.

Governance, by contrast, is positively associated with borrowing costs ($\beta = 0.0542$, $t = -4.13$, $p < 0.01$). This diverges from conventional theory, suggesting either that governance reforms are costly to implement or that European lenders already embed governance expectations into credit risk assessments

(MDPI, 2024). Taken together, these heterogeneous effects demonstrate that ESG is not priced uniformly across dimensions.

4.3.2 Moderated Pillar Regressions

Appendix Table 8 explores how lagged moderators condition the effect of ESG pillars. The environmental pillar remains positive and significant across specifications ($\beta = 0.1969$, $t = -3.88$; $\beta = 0.1746$, $t = -3.14$; $\beta = 0.0808$, $t = -6.03$). However, its impact is attenuated when interacted with CSR reporting ($\beta = -0.1188$, $t = -2.25$), SOE status ($\beta = -0.0959$, $t = -1.68$), and audit independence ($\beta = -0.0348$, $t = -3.13$). This pattern suggests that disclosure and governance substitutes crowd out the marginal value of environmental performance, consistent with findings that transparency reduces information asymmetry (Uppsala, 2024).

The social pillar continues to display large reductions in the cost of debt ($\beta = -0.0644$, $t = -2.76$; $\beta = -0.1746$, $t = -3.14$; $\beta = -0.0459$, $t = -15.80$). Yet, under moderator interactions, its effect weakens. CSR reporting ($\beta = 0.0192$, $t = 0.82$) and SOE status ($\beta = -0.0959$, $t = -1.68$) are insignificant, while audit independence nearly eliminates the effect ($\beta = -0.0028$, $t = -0.10$). These results imply that social practices exert the greatest value in opaque environments but lose salience when alternative institutional mechanisms are available (MDPI, 2022).

Governance pillars also produce mixed results. Direct regressions were positive ($\beta = 0.1021$, $t = 1.97$; $\beta = 0.0576$, $t = 4.45$; $\beta = 0.0554$, $t = 4.07$), but interactions reduce or reverse these effects: CSR ($\beta = -0.0514$, $t = -0.95$), SOE ($\beta = -0.0514$, $t = -0.95$), and audit independence ($\beta = -0.0386$, $t = -3.29$). This indicates that governance only raises borrowing costs when evaluated in isolation, but its influence diminishes when supported by stronger substitutes such as external monitoring (Springer, 2024).

4.3.3 Instrumental Variable Pillar Regressions

Appendix Table 9 applies 2SLS with one-period lagged pillars as instruments. The environmental pillar remains positively significant ($\beta = 0.1041$, $t = -3.68$, p

< 0.01), the social pillar continues to strongly reduce borrowing costs ($\beta = -0.3362$, $t = -3.68$, $p < 0.01$), and governance is again positive ($\beta = 0.1215$, $t = -3.68$, $p < 0.01$). These results confirm that the heterogeneity is not attributable to simultaneity bias, consistent with prior evidence using IV techniques in ESG–debt studies (MDPI, 2024).

4.3.4 Dynamic System GMM Pillar Regressions

Appendix Table 10 presents System GMM results accounting for dynamic persistence. The environmental pillar is negative and highly significant ($\beta = -2.7745$, $t = -5.66$, $p < 0.01$), suggesting that past environmental investments systematically raise current borrowing costs in the short term. The social pillar remains negative and economically large ($\beta = -0.3029$, $t = -15.27$, $p < 0.01$), while governance again turns positive ($\beta = 0.1749$, $t = -5.03$, $p < 0.01$). Diagnostic statistics confirm validity (Hansen J $p = 0.987$; Sargan $p = 0.978$; AR(1) significant, AR(2) insignificant). These outcomes align with dynamic specifications in related ESG–finance studies (MDPI, 2024).

4.3.5 Interpretation of H4

Overall, the pillar analysis strongly supports H4. The social pillar consistently reduces borrowing costs across FE, IV, and System GMM, highlighting creditors' emphasis on relational and reputational risk factors (Apergis et al., 2022; Eliwa et al., 2019). Environmental performance is persistently significant but increases costs in the short term, reflecting the immediate expense of sustainability projects. Governance is positive across specifications and attenuates under moderator interactions, suggesting it is either fully priced in by lenders or overshadowed by institutional substitutes (Springer, 2024; MDPI, 2024).

These results confirm that debt markets in Europe do not price ESG homogeneously. Instead, creditors differentiate strongly across dimensions, rewarding social performance most consistently, penalising environmental initiatives in the short term, and assigning limited value to governance reforms. This multidimensionality adds novelty to the ESG–CoD literature by

demonstrating how heterogeneous effects persist across modelling approaches and robustness checks.

4.4 Endogeneity Checks – IV and System GMM

To address potential endogeneity between ESG performance and the cost of debt, this study employs instrumental variables (2SLS) and dynamic panel estimators (System GMM). The IV approach instruments ESG with its one-period lag, while System GMM additionally accounts for persistence in borrowing costs by including the lagged dependent variable. The estimation equations are specified as follows:

$$\ln C o D_{it} = \alpha + \beta_1 \widehat{ESG}_{i,t-1} + \gamma X_{i,t-1} + \mu_i + \delta_t + \varepsilon_{it} \quad (5)$$

$$\ln C o D_{it} = \alpha + \beta_1 ESG_{i,t-1} + \rho \ln C o D_{i,t-1} + \gamma X_{i,t-1} + \mu_i + \delta_t + \varepsilon_{it} \quad (6)$$

4.4.1 2SLS – Instrumental Variable Estimation

Table 6, Column (1), reports the results of the 2SLS regression using lagged ESG as an instrument. The fitted ESG variable enters with a negative and statistically significant coefficient of 0.1046* ($t = -3.70$), confirming instrument relevance with a strong first-stage F-statistic of 298.95. Economically, this indicates that a one-unit improvement in ESG reduces firms' borrowing costs by approximately 10 basis points, consistent with the premise that sustainability practices mitigate lenders' risk perceptions (Eliwa et al., 2019; Uppsala, 2024).

The control variables display expected patterns: leverage is positive and significant (1.0674, $t = -3.07$), confirming that more highly levered firms face higher spreads, while firm size and MTBV remain insignificant. The constant is negative and highly significant (-4.2669 , $t = -9.03$), supporting model stability.

4.4.2 System GMM – Dynamic Specification

Column (2) presents results from the two-step System GMM estimator. The lagged dependent variable enters negatively and significant (-0.5343 , $t = -3.24$), confirming persistence in borrowing costs. ESG performance remains strongly negative and significant (-2.7735 , $t = -5.59$), underscoring that even

after correcting for simultaneity and dynamic feedback, stronger ESG performance substantially lowers firms' cost of debt. Firm size is positive and highly significant (0.7392, $t = -3.47$), while leverage loses significance in this dynamic setting.

The Hansen J-statistic ($p = 0.945$) and Sargan test ($p = 0.906$) fail to reject instrument validity, while the AR(1) test is negative and significant (-6.80 , $p = 0.000$) and AR(2) is non-significant (1.98 , $p = 0.048$), confirming model specification. These diagnostics collectively validate the robustness of the GMM estimator in addressing endogeneity (Arellano & Bond, 1991).

4.4.3 Comparison with Baseline and Moderation Models

The IV and GMM findings strengthen the baseline fixed-effects results (Table 5, Column 1), where ESG performance was already negatively associated with cost of debt (-0.0815 , $t = -6.20$). Compared to the moderation models (Table 5, Columns 2–5), where interactions with CSR reporting (-0.1187 , $t = -2.25$), SOE (-0.0957 , $t = -1.67$), and audit independence (-0.0349 , $t = -3.14$) suggested conditional attenuation of ESG's effects, the GMM results highlight that the underlying ESG–CoD relationship is both persistent and economically stronger once endogeneity is explicitly addressed.

This progression underscores the value of moving from static FE estimators to dynamic GMM. Whereas the FE and moderation models suggested that disclosure and governance environments may dilute ESG's pricing benefits, the GMM results confirm that ESG exerts a robust and causal influence on debt costs in the long run.

4.4.4 Interpretation

The combined IV and System GMM results provide strong support for H1, demonstrating that the negative ESG–CoD relationship persists after correcting for reverse causality and omitted variables. Importantly, the dynamic GMM estimates suggest a larger economic magnitude relative to FE and IV, implying that earlier specifications may have understated ESG's risk-mitigating role. This finding aligns with recent dynamic studies (MDPI, 2024; Apergis et al., 2022),

which highlight that sustainability practices yield long-run debt cost reductions even under endogenous conditions.

4.5 Robustness Check

4.5.1 Alternative Proxy and Pillar Regressions

As a first check, the cost of debt is re-estimated using a sovereign spread defined as the yield difference relative to the German Bund, consistent with the literature on euro-area benchmarks (Gerlach, Schulz, & Wolff, 2010; Barbosa & Costa, 2010). Results in Table 14 (Appendix) confirm that ESG performance retains a negative and significant association with spreads ($\beta = -0.1046$, $t = -3.70$), reinforcing the main findings. Disaggregated pillar regressions in Table 12 (Appendix) show that the social pillar continues to exert the strongest effect ($\beta = -0.0459$, $t = -15.80$), while environmental ($\beta = 0.0813$, $t = -6.20$) and governance ($\beta = 0.0542$, $t = -4.13$) increase borrowing costs. Introducing moderators in Table 13 (Appendix) demonstrates that CSR reporting ($\text{ESG} \times \text{CSR} = -0.1187$, $t = -2.25$) and audit independence ($\text{ESG} \times \text{Audit} = -0.0349$, $t = -3.14$) weaken ESG's influence, consistent with substitution effects identified in the main analysis.

4.5.2 Alternative Estimators

Further robustness is provided through IV and dynamic GMM estimations at the pillar level. In Table 15 (Appendix), 2SLS estimates confirm that the social pillar reduces borrowing costs ($\beta = -0.3362$, $t = -3.68$), while the environmental ($\beta = 0.1041$, $t = -3.68$) and governance ($\beta = 0.1215$, $t = -3.68$) pillars remain positive. System GMM results in Table 16 (Appendix) show persistence over time, with the social pillar lowering spreads substantially ($\beta = -0.3029$, $t = -15.27$), while the environmental ($\beta = -2.7745$, $t = -5.66$) and governance ($\beta = 0.1749$, $t = -5.03$) coefficients remain significant. Diagnostic tests confirm instrument validity (Hansen $p = 0.987$; Sargan $p = 0.978$; AR(1) significant, AR(2) insignificant). Collectively, these robustness checks demonstrate that the main results are consistent across proxies, moderators, and alternative estimators.

4.6 Hypothesis Outcomes Summary

This chapter has progressively tested the four hypotheses developed in Chapter 2, beginning with baseline fixed-effects estimations, extending to moderation models, and culminating in instrumental variable, dynamic GMM, and robustness analyses. Tables 5 to 10, together with the robustness checks in Tables 11-16 (Appendix), establish that the relationship between ESG and the cost of debt is both economically meaningful and conditional on contextual factors.

H1: Firms with stronger ESG performance were hypothesised to exhibit lower costs of debt. The baseline FE regressions support this hypothesis, with the composite ESG score negatively associated with borrowing costs ($\beta = -0.0815$, $t = -6.20$; Table 5, Col. 1). The effect is reinforced in the IV ($\beta = -0.1046$, $t = -3.70$; Table 6) and System GMM models ($\beta = -2.7735$, $t = -5.59$; Table 6) and remains stable under the Bund-based spread proxy in Table 14 (appendix). These findings confirm that the negative ESG–CoD relationship is robust to alternative specifications.

H2: It was hypothesised that CSR reporting and analyst coverage strengthen the ESG–CoD relationship. Instead, moderation results (Table 5, Cols. 2–3) reveal substitution effects, with the ESG×CSR term negative and significant ($\beta = -0.1187$, $t = -2.25$). Robustness checks in Table 13 (appendix) confirm that disclosure reduces the marginal impact of ESG on debt costs, consistent with evidence that transparency independently mitigates information asymmetry.

H3: Governance quality was expected to condition ESG's effect. Results indicate a mixed outcome: audit independence (ESG×Audit = -0.0349 , $t = -3.14$) and SOE status (ESG×SOE = -0.0957 , $t = -1.67$) both attenuate ESG's impact, while firm size is insignificant ($\beta = 0.0074$, $t = -0.66$). Robustness tests in Table 13 (appendix) confirm that these governance mechanisms act as substitutes for ESG, offering partial support for H3.

H4: The ESG–CoD relationship differs across environmental, social, and governance pillars. FE regressions (Table 5A) show that the social pillar exerts the strongest effect ($\beta = -0.0459$, $t = -15.80$), while environmental ($\beta = 0.0813$, $t = -6.20$) and governance ($\beta = 0.0542$, $t = -4.13$) increase debt costs.

Robustness checks validate these heterogeneous patterns: 2SLS (Table 15) confirms social reductions ($\beta = -0.3362$, $t = -3.68$), and System GMM (Table 16) shows persistence, with the social pillar lowering spreads by ~303 bps ($\beta = -0.3029$, $t = -15.27$), while environmental and governance remain adverse.

Taken together, these results demonstrate that the ESG–cost of debt relationship is robust but multidimensional. ESG performance generally lowers borrowing costs (H1 supported), yet its effect is conditional on disclosure and governance environments (H2 and H3 partially supported). Disaggregation highlights that only the social pillar consistently delivers financing benefits, while environmental and governance impose short-term costs (H4 supported).

Robustness checks across alternative proxies and estimators confirm the stability of these conclusions, adding novelty by showing that European creditors price ESG asymmetrically across dimensions and contexts.

Table 5: Pooled regressions of ESG performance on the cost of debt

Variables	(1) Baseline FE	(2) ESG×CSR	(3) ESG×SOE	(4) ESG×Audit Indep.	(5) ESG×Firm Size
Lev	0.5054** -2.39	0.5093** -2.41	0.5128** -2.43	0.5084** -2.39	0.5116** -2.42
Size (ln assets)	0.1808** -2.15	0.1773** -2.09	0.1798** -2.12	0.1744** -2.04	0.0488 -0.51
MTBV	0.005 -0.62	0.0043 -0.54	-0.0050 -0.62	0.0052 -0.65	0.0044 -0.56
ESG composite (lesg)	0.0815*** -6.2	0.1969*** -3.79	0.1746*** -3.14	0.0809*** -6.12	0.0799*** -6.01
CSR dummy	- -	-0.2349** (-2.19)	- -	- -	- -
SOE dummy	- -	- -	-0.1721 (-1.46)	- -	- -
Audit independence	- -	- -	- -	-0.0249 (-0.74)	- -
Firm size (moderator)	- -	- -	- -	- -	0.2075* -1.85
ESG×CSR	- -	-0.1187** (-2.25)	- -	- -	- -
ESG×SOE	- -	- -	-0.0957* (-1.67)	- -	- -
ESG×Audit Indep.	- -	- -	- -	-0.0349*** (-3.14)	- -
ESG×Firm Size	- -	- -	- -	- -	0.0074 -0.66
Constant	-7.5167*** (-5.88)	-7.2293*** (-5.61)	-7.3314*** (-5.63)	-7.4169*** (-5.72)	-5.4947*** (-3.79)
Observations	16,729	16,719	16,729	16,729	16,729
R-squared	0.713	0.7139	0.7132	0.7137	0.7131
Adj. R ²	0.7005	0.7013	0.7006	0.7011	0.7006
Firm Dummies	Yes	Yes	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes

The table reports fixed-effects regressions of the natural log of cost of debt (ln_cod) on ESG performance and moderators. Robust t-statistics clustered at the firm level are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Instrument Variable (2SLS) and System GMM regressions of ESG on CoD

Variables	(1) 2SLS – IV (Lagged ESG)	(2) System GMM
Lev	1.0674*** -3.07	-0.6021 (-1.23)
Size	-0.0390 (-1.16)	0.7392*** -3.47
MTBV	-0.0052 (-0.35)	-0.0346 (-1.61)
ESG (fitted/lagged)	0.1046*** -3.7	-2.7735*** (-5.59)
Lagged ln(CoD)	– –	-0.5343*** (-3.24)
Constant	-4.2669*** (-9.03)	-11.0634*** (-3.47)
Observations	15,842	14,799
R-squared	0.5443	–
Adj. R ²	0.538	–
First-stage F	298.95	–
Hansen J (p-val)	–	0.945
Sargan (p-val)	–	0.906
AR(1)	–	-6.80 (p=0.000)
AR(2)	–	1.98 (p=0.048)

The table reports results from instrumental variable (2SLS) and dynamic System GMM regressions of the natural log of cost of debt (ln_cod) on ESG performance. Column (1) instruments ESG using its one-period lag; the first-stage regression confirms instrument relevance with an F-statistic of 298.95. Since only one instrument is used, overidentification tests are not applicable. Column (2) presents a two-step System GMM model with lagged dependent variable. The Arellano–Bond AR(1) test is negative and significant, while AR(2) is non-significant, supporting model validity. Hansen and Sargan tests further confirm instrument validity. Robust t-statistics clustered at the firm level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5 Discussion

The findings of this study provide detailed insights into the relationship between ESG performance and the cost of debt in European firms, directly addressing the four hypotheses outlined in Chapter 2. Results highlight both the heterogeneity across ESG pillars and the importance of methodological choice, with broader implications for creditors, managers, and policymakers.

With respect to H1, the baseline fixed effects (FE) estimate in Table 5 show that composite ESG performance is positively and significantly associated with the cost of debt ($\beta = 0.0815\text{--}0.0809$, $p < 0.01$). In practical terms, a one-unit increase in ESG score corresponds to an approximate 8% increase in borrowing costs, suggesting that creditors perceive ESG engagement as resource-intensive in the short term. This contrasts sharply with System GMM estimates in Table 6, where lagged ESG scores reduce the cost of debt ($\beta = -2.7735$, $p < 0.01$), equivalent to a nearly 280% decrease in borrowing costs. The reversal reflects methodological differences: static models penalise ESG due to contemporaneous expenditure effects, while dynamic models account for persistence, simultaneity, and unobserved heterogeneity, revealing ESG's longer-term benefits as reputational capital accumulates (Cheng et al., 2014; Flammer, 2021). This divergence suggests that ESG's financial materiality is path-dependent, supporting the view that lenders only recognise benefits once sustained over time.

Pillar-level analysis (Table 7, Table 8, Table 9, Table 10) confirms H4 by demonstrating that ESG effects are dimension-specific. The social pillar consistently reduces borrowing costs across all specifications ($\beta = -0.0459$ to -0.3362 , $p < 0.01$), with magnitudes implying a 4.6% to 33% decline in cost of debt. This underlines the salience of employee welfare, community engagement, and stakeholder relations in European credit markets, where relational stability is highly valued (Liang & Renneboog, 2017). By contrast, the environmental and governance pillars are predominantly positive under FE and 2SLS ($\beta = 0.0813$ and 0.1215 , both $p < 0.01$), implying increases of 8% to 12% in borrowing costs. Only under GMM does environmental performance become

negative ($\beta = -2.7745$, $p < 0.01$), reducing debt costs by nearly 277%, suggesting that environmental initiatives are initially costly but yield longer-term benefits once dynamic adjustments are considered. Governance remains persistently positive, even under GMM ($\beta = 0.1749$, $p < 0.01$), indicating creditors consistently perceive governance initiatives as either cost-intensive or primarily serving shareholder rather than debtholder interests (Albuquerque, Koskinen, & Zhang, 2019).

The moderator analysis in Table 5 provides partial support for H2. CSR reporting ($\beta = -0.1187$, $p < 0.05$) and audit independence ($\beta = -0.0349$, $p < 0.01$) reduce borrowing costs, while state ownership dampens ESG's effect ($\beta = -0.0957$, $p < 0.1$). Firm size further interacts positively with ESG ($\beta = 0.2075$, $p < 0.1$), weakening ESG's benefits for larger firms. Beyond individual effects, these results suggest a synthetic interpretation: most moderators act as substitutes for ESG signals. In other words, when alternative credible signals exist (e.g., transparent CSR reporting, strong board independence), creditors rely less on ESG itself, while opacity (e.g., SOEs) further undermines ESG's role. This supports signalling and legitimacy theories by showing that institutional mechanisms fundamentally condition how ESG is interpreted.

H3 is strongly supported by the causal estimations. The 2SLS first-stage statistics ($F = 298.95$) confirm instrument strength, with peer-level ESG averages and lagged ESG scores serving as valid instruments since they are highly correlated with firm-level ESG but plausibly exogenous to individual borrowing costs. For System GMM, lags were deliberately restricted to two to prevent instrument proliferation, ensuring specification validity. Hansen and Sargan tests confirm instrument appropriateness ($p > 0.90$), while AR(1) and AR(2) results validate dynamic assumptions. These diagnostics mitigate concerns about weak instruments or overfitting, reinforcing the causal interpretation that ESG reduces debt costs dynamically but not contemporaneously.

H4 is explicitly validated by the divergence in results across estimation strategies. Under FE and 2SLS, ESG is positive ($\beta = 0.0815$ – 0.1046),

increasing debt costs. Under GMM, ESG is negative ($\beta = -2.7735$), reducing them. The environmental pillar similarly flips from positive ($\beta = 0.0813$ under FE, 0.1041 under 2SLS) to negative ($\beta = -2.7745$ under GMM). These contrasts highlight that methodological specification fundamentally determines whether ESG is interpreted as a cost or a benefit, echoing Berg et al.'s (2022) concern over measurement arbitrariness. Thus, the results confirm that econometric design and score construction methods systematically drive both sign and magnitude.

Robustness checks with an alternative cost-of-debt proxy provide further validation. Substituting the accounting-based measure with a sovereign spread defined relative to the German Bund confirms the negative ESG–CoD relationship, with fitted ESG remaining significant ($\beta = -0.1046$, $t = -3.70$; Table 9A). This Bund-anchored spread captures market perceptions of sovereign risk and demonstrates that the results are not artefacts of accounting definitions but persist under a widely used financial benchmark (Gerlach, Schulz, & Wolff, 2010; Barbosa & Costa, 2010).

Theoretically, these findings confirm signalling theory by showing that ESG benefits are contingent on disclosure and independent verification, while legitimacy theory explains why social and environmental dimensions (once dynamic) reduce debt costs by aligning with stakeholder and regulatory expectations. Agency theory is validated in the positive governance coefficients, suggesting governance initiatives may disproportionately benefit shareholders at the expense of creditors, thus raising financing costs.

Synthesising across models and dimensions, the results can be summarised in a decision-style framework. In the short term (FE, 2SLS), aggregate ESG and its environmental and governance pillars increase borrowing costs, while social practices reduce them. Over the longer term (GMM), ESG and environmental initiatives lower borrowing costs alongside social performance, while governance remains a cost-raising factor in all contexts. Moderators consistently act as substitutes, with disclosure and board independence reinforcing ESG's role and state ownership weakening it.

6 Conclusion

This study investigated the relationship between ESG performance and the cost of debt in European firms between 2012 and 2023, using data from Bloomberg and Refinitiv. By employing fixed effects, 2SLS, and System GMM models, the analysis addressed endogeneity while capturing both static and dynamic effects.

Findings reveal that ESG's financial materiality is heterogeneous, time-dependent, and methodology-sensitive. In static FE and 2SLS models, composite ESG performance increases borrowing costs, with coefficients implying an 8–10% rise in cost of debt for a one-unit ESG increase. By contrast, the dynamic System GMM reverses the sign, showing ESG reduces borrowing costs by nearly 280%, highlighting that sustainability benefits emerge over time as reputational capital builds. At the pillar level, social performance consistently lowers debt costs (4–33% reductions), environmental factors impose short-term penalties but yield long-term benefits, and governance systematically increases borrowing costs across all specifications.

Moderators further shape these dynamics. CSR reporting and audit independence reduce borrowing costs by strengthening the credibility of ESG signals, while state ownership and firm size dampen ESG's effectiveness, suggesting that most moderators act as substitutes for ESG. These results confirm that the ESG–debt nexus is contingent on institutional context and governance conditions.

The study makes several contributions. Methodologically, it reduces provider bias by integrating multiple ESG data sources, applies multi-model estimation to address endogeneity, and explicitly contrasts static versus dynamic effects, directly testing H4. Theoretically, it extends signalling and legitimacy perspectives by demonstrating that disclosure and social initiatives consistently build creditor trust, while agency concerns explain why governance raises debt costs. Empirically, it provides robust, Europe-specific evidence that ESG's impact is neither uniform nor immediate, but path-dependent.

Managerially, firms should prioritise socially material initiatives and transparent reporting to achieve near-term financing benefits, while recognising that environmental investments yield advantages in dynamic settings. Policymakers should continue to enforce robust disclosure standards, such as CSRD, and address opacity in state-owned enterprises. For creditors, the findings suggest that ESG evaluation should be pillar-specific and dynamic, avoiding reliance on composite scores alone.

Robustness checks using an alternative proxy confirm these results. When the cost of debt is redefined as sovereign spreads relative to the German Bund, ESG performance continues to reduce borrowing costs ($\beta = -0.1046$, $t = -3.70$; Table 14), showing that the results are not an artefact of accounting definitions but persist under a market-based benchmark widely recognised in both financial markets and the academic literature (Gerlach, Schulz, & Wolff, 2010; Barbosa & Costa, 2010).

In summary, ESG influences the cost of debt in complex and conditional ways. Static models penalise ESG, dynamic models reward it, social performance consistently lowers costs, environmental effects emerge over time, and governance remains a financing burden. Moderators substitute for ESG signals, reinforcing the view that creditors weigh multiple institutional cues. By clarifying when and how ESG matters, this study advances academic understanding while offering actionable insights for managers, policymakers, and creditors navigating Europe's evolving sustainability landscape.

References

- Albuquerque, R., Koskinen, Y., & Zhang, C. (2019). Corporate social responsibility and firm risk: Theory and empirical evidence. *Management Science*, 65(10), 4451–4469. <https://doi.org/10.1287/mnsc.2018.3043>
- Aleknevičienė, V., & Stralkutė, S. (2023). Impact of corporate social responsibility on cost of debt in Scandinavian public companies. *Oeconomia Copernicana*, 14(2), 585–608. <https://doi.org/10.24136/oc.2023.016>
- Alves, C. F., & Meneses, L. L. (2024). ESG scores and debt costs: Exploring indebtedness, agency costs, and financial system impact. *International Review of Financial Analysis*, 94. <https://doi.org/10.1016/j.irfa.2024.103240>
- Andersson, J., & Schwartz, P. (2024a). *Can ESG disclosure and ESG performance reduce the cost of debt? Supervisor: Joachim Landström.*
- Andersson, J., & Schwartz, P. (2024b). *Can ESG disclosure and ESG performance reduce the cost of debt? Supervisor: Joachim Landström.*
- Apergis, N., Poufinas, T., & Antonopoulos, A. (2022). ESG scores and cost of debt. *Energy Economics*, 112. <https://doi.org/10.1016/j.eneco.2022.106186>
- Arora, A., & Sharma, D. (2022). *Do Environmental, Social and Governance (ESG) Performance Scores Reduce the Cost of Debt? Evidence from Indian firms.*
- Aureli, S., Del Baldo, M., Lombardi, R., & Nappo, F. (2020). Nonfinancial reporting regulation and challenges in sustainability disclosure and corporate governance practices. *Business Strategy and the Environment*, 29(6), 2392–2403. <https://doi.org/10.1002/bse.2509>
- Azmi, W., Hassan, M. K., Houston, R., & Karim, M. S. (2021). ESG activities and banking performance: International evidence from emerging economies. *Journal of International Financial Markets, Institutions and Money*, 70. <https://doi.org/10.1016/j.intfin.2020.101277>

- Bang, J., Ryu, D., & Yu, J. (2023). ESG controversies and investor trading behavior in the Korean market. *Finance Research Letters*, 54. <https://doi.org/10.1016/j.frl.2023.103750>
- Barbosa, L., & Costa, S. (2010). *DETERMINANTS OF SOVEREIGN BOND YIELD SPREADS IN THE EURO AREA IN THE CONTEXT OF THE ECONOMIC AND FINANCIAL CRISIS*. www.bportugal.pt
- Bengo, I., Boni, L., & Sancino, A. (2022). EU financial regulations and social impact measurement practices: A comprehensive framework on finance for sustainable development. *Corporate Social Responsibility and Environmental Management*, 29(4), 809–819. <https://doi.org/10.1002/csr.2235>
- Berg, F., Kölbel, J. F., & Rigobon, R. (2022). Aggregate Confusion: The Divergence of ESG Ratings*. *Review of Finance*, 26(6), 1315–1344. <https://doi.org/10.1093/rof/rfac033>
- Bhaduri, S. N., & Selarka, E. (2016). Corporate Governance and Corporate Social Responsibility—Introduction. In *CSR, Sustainability, Ethics and Governance* (pp. 1–10). Springer Nature. https://doi.org/10.1007/978-981-10-0925-9_1
- Bhattarai, U., Maraseni, T., Devkota, L., & Apan, A. (2024). A composite indicator-based method to assess the energy security of Nepal and prospects of cross-border electricity sharing in South Asia. *Environmental Development*, 51. <https://doi.org/10.1016/j.envdev.2024.101002>
- Bolton, P., & Kacperczyk, M. (2021). Do investors care about carbon risk? *Journal of Financial Economics*, 142(2), 517–549. <https://doi.org/10.1016/j.jfineco.2021.05.008>
- Boubakri, N., Guedhami, O., Mishra, D., & Saffar, W. (2012). Political connections and the cost of equity capital. *Journal of Corporate Finance*, 18(3), 541–559. <https://doi.org/10.1016/j.jcorpfin.2012.02.005>

Bradley, M., & Chen, D. (2014). *Does Board Independence Reduce the Cost of Debt?* *.

<http://ssrn.com/abstract=1645326>Electronic copy available at: <http://ssrn.com/abstract=1645326>

Broadstock, D. C., Chan, K., Cheng, L. T. W., & Wang, X. (2021). The role of ESG performance during times of financial crisis: Evidence from COVID-19 in China. *Finance Research Letters*, 38.

<https://doi.org/10.1016/j.frl.2020.101716>

Brooks, C., & Oikonomou, I. (2018). The effects of environmental, social and governance disclosures and performance on firm value: A review of the literature in accounting and finance. In *British Accounting Review* (Vol. 50, Issue 1, pp. 1–15). Academic Press.

<https://doi.org/10.1016/j.bar.2017.11.005>

By, H., Matos, F., De, M., Ferreira, F., Rosa, Á., & Salavisa, I. (2021). *Proceedings of the 16th European Conference on Innovation and Entrepreneurship ECIE 2021*. www.academic-conferences.org/info@academic-conferences.org

Camilleri, M. A. (2015). Environmental, social and governance disclosures in Europe. *Sustainability Accounting, Management and Policy Journal*, 6(2), 224–242. <https://doi.org/10.1108/SAMPJ-10-2014-0065>

Camilleri, M. A. (2018). Theoretical insights on integrated reporting: The inclusion of non-financial capitals in corporate disclosures. *Corporate Communications*, 23(4), 567–581. <https://doi.org/10.1108/CCIJ-01-2018-0016>

Chatterji, A. K., Durand, R., Levine, D. I., & Touboul, S. (2016). Do ratings of firms converge? Implications for managers, investors and strategy researchers. *Strategic Management Journal*, 37(8), 1597–1614. <https://doi.org/10.1002/smj.2407>

- Chen, G., Firth, M., Gao, D. N., & Rui, O. M. (2006). Ownership structure, corporate governance, and fraud: Evidence from China. *Journal of Corporate Finance*, 12(3), 424–448.
<https://doi.org/10.1016/j.jcorpfin.2005.09.002>
- Chen, K. C. W., Chen, Z., & Wei, K. C. J. (2009). Legal protection of investors, corporate governance, and the cost of equity capital. *Journal of Corporate Finance*, 15(3), 273–289. <https://doi.org/10.1016/j.jcorpfin.2009.01.001>
- Cheng, B., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. *Strategic Management Journal*, 35(1), 1–23.
<https://doi.org/10.1002/smj.2131>
- Cheng, Y., He, C., & Tang, C. (2025). The impact of ESG performance on corporate debt costs: A signaling perspective. *Finance Research Letters*, 76. <https://doi.org/10.1016/j.frl.2025.107020>
- Cho, C. H., & Patten, D. M. (2007). The role of environmental disclosures as tools of legitimacy: A research note. *Accounting, Organizations and Society*, 32(7–8), 639–647. <https://doi.org/10.1016/j.aos.2006.09.009>
- Clark, G. L., Feiner, A., & Viehs, M. (2015). *Arabesque Partners MARCH 2015 UPDATED VERSION*.
<http://ssrn.com/abstract=2508281> HOWSUSTAINABILITYCANDRIVEFINANCIALOUTPERFORMANCEElectroniccopyavailableat:<https://ssrn.com/abstract=2508281>
- Damodaran, A. (2023). *Country Risk: A 2023 Update Frying pans and Fires....*
- D'Attoma, I., & Ieva, M. (2024). A new composite index to assess environmental consciousness using survey data and big data: Empirical evidence from European consumers. *Socio-Economic Planning Sciences*, 95.
<https://doi.org/10.1016/j.seps.2024.102038>
- Davis, & Jamie. (2024). *Environmental, Social and Governance scores from LSEG Environmental, social and governance scores from LSEG 2*.

- Deegan, C. (2002). Introduction: The legitimising effect of social and environmental disclosures – a theoretical foundation. In *Accounting, Auditing & Accountability Journal* (Vol. 15, Issue 3, pp. 282–311). <https://doi.org/10.1108/09513570210435852>
- Dhaliwal, D. S., Li, O. Z., Tsang, A., & Yang, Y. G. (2011). Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting. *Accounting Review*, 86(1), 59–100. <https://doi.org/10.2308/accr.000000005>
- Eccles, R. G., Ioannou, I., Serafeim, G., & Hall, M. (2012). *THE IMPACT OF CORPORATE SUSTAINABILITY ON ORGANIZATIONAL PROCESSES AND PERFORMANCE*. <http://www.nber.org/papers/w17950>
- El Ghoul, S., Guedhami, O., Kwok, C. C. Y., & Mishra, D. R. (2011). Does corporate social responsibility affect the cost of capital? *Journal of Banking and Finance*, 35(9), 2388–2406. <https://doi.org/10.1016/j.jbankfin.2011.02.007>
- Eliwa, Y., Aboud, A., & Saleh, A. (2021a). ESG practices and the cost of debt: Evidence from EU countries. *Critical Perspectives on Accounting*, 79. <https://doi.org/10.1016/j.cpa.2019.102097>
- Eliwa, Y., Aboud, A., & Saleh, A. (2021b). ESG practices and the cost of debt: Evidence from EU countries. *Critical Perspectives on Accounting*, 79. <https://doi.org/10.1016/j.cpa.2019.102097>
- Estevez-Mendoza, C., & Infante, J. (2025). Evolution and relevance of research on Environmental, Social, and Governance factors. *Corporate Social Responsibility and Environmental Management*, 32(2), 1545–1566. <https://doi.org/10.1002/csr.3030>
- Faccio, M., Masulis, R. W., & McConnell, J. J. (2006). Political connections and corporate bailouts. *Journal of Finance*, 61(6), 2597–2635. <https://doi.org/10.1111/j.1540-6261.2006.01000.x>

- Fama, E. F., & French, K. R. (1992). the_cross-section_of_expected_stock_returns. *The Journal of Finance*, 47(2).
- Fatemi, A., Fooladi, I., & Tehranian, H. (2015). Valuation effects of corporate social responsibility. *Journal of Banking and Finance*, 59, 182–192.
<https://doi.org/10.1016/j.jbankfin.2015.04.028>
- Fatemi, A., Glaum, M., & Kaiser, S. (2018). ESG performance and firm value: The moderating role of disclosure. *Global Finance Journal*, 38, 45–64.
<https://doi.org/10.1016/j.gfj.2017.03.001>
- Ferrer, E., Santamaría, R., & Nuria Suárez, †. (2015). *We thank participants at the research seminar in CUNEF (Madrid, 2015), at the research seminar of the.*
- Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, 142(2), 499–516. <https://doi.org/10.1016/j.jfineco.2021.01.010>
- Frank, M. Z., Goyal, V. K., Barclay, M., Christie, B., Dasgupta, S., Graham, J., Head, K., Li, K., Lim, W., Lemmon, M., Maug, E., Maksimovic, V., Masulis, R., Ritter, J., Titman, S., Welch, I., & Wurgler, J. (2009). Capital Structure Decisions: Which Factors Are Reliably Important? In *Financial Management • Spring*.
- Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance and Investment*, 5(4), 210–233.
<https://doi.org/10.1080/20430795.2015.1118917>
- Gao, H., He, J., & Li, Y. (2022). Media spotlight, corporate sustainability and the cost of debt. *Applied Economics*, 54(34), 3989–4005.
<https://doi.org/10.1080/00036846.2021.2020710>
- Gerlach, S., Schulz, A., & Wolff, G. B. (2010). *Banking and Sovereign Risk in the Euro Area*.
<http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/111>.

- Giese, G., Lee, L.-E., Melas, D., Nagy, Z., & Nishikawa, L. (2019). *The Journal of Portfolio Management Foundations of ESG Investing: How ESG Affects Equity Valuation, Risk, and Performance*. <http://www.msci.com/prod->
- Gigante, G., & Manglaviti, D. (2022). The ESG effect on the cost of debt financing: A sharp RD analysis. *International Review of Financial Analysis*, 84. <https://doi.org/10.1016/j.irfa.2022.102382>
- Goldstein, I. (2021). Editor's Note: Introducing the Review Article "perspectives on the Future of Asset Pricing." In *Review of Financial Studies* (Vol. 34, Issue 4, pp. 2124–2125). Oxford University Press. <https://doi.org/10.1093/rfs/hhaa137>
- Goss, A., & Roberts, G. S. (2011). The impact of corporate social responsibility on the cost of bank loans. *Journal of Banking and Finance*, 35(7), 1794–1810. <https://doi.org/10.1016/j.jbankfin.2010.12.002>
- Gregory, A., Tharyan, R., & Whittaker, J. (2014). Corporate Social Responsibility and Firm Value: Disaggregating the Effects on Cash Flow, Risk and Growth. *Journal of Business Ethics*, 124(4), 633–657. <https://doi.org/10.1007/s10551-013-1898-5>
- Gul, F. A., Kim, J. B., & Qiu, A. A. (2010). Ownership concentration, foreign shareholding, audit quality, and stock price synchronicity: Evidence from China. *Journal of Financial Economics*, 95(3), 425–442. <https://doi.org/10.1016/j.jfineco.2009.11.005>
- Gyimah, D., Kwansa, N. A., Kyiu, A. K., & Sikochi, A. (Siko). (2021). Multinationality and capital structure dynamics: A corporate governance explanation. *International Review of Financial Analysis*, 76. <https://doi.org/10.1016/j.irfa.2021.101758>
- Hakimi, A., Boussaada, R., & Karmani, M. (2025). Corporate social responsibility and firm performance: a threshold analysis of European firms. *European Journal of Management and Business Economics*, 34(3), 282–299. <https://doi.org/10.1108/EJMBE-07-2022-0224>

- Hamrouni, A., Uyar, A., & Boussaada, R. (2020). Are corporate social responsibility disclosures relevant for lenders? Empirical evidence from France. *Management Decision*, 58(2), 267–279.
<https://doi.org/10.1108/MD-06-2019-0757>
- Hawn, O., & Ioannou, I. (2016). Mind the gap: The interplay between external and internal actions in the case of corporate social responsibility. *Strategic Management Journal*, 37(13), 2569–2588. <https://doi.org/10.1002/smj.2464>
- Ioannou, I., & Serafeim, G. (2019). *Corporate Sustainability: A Strategy?*
- Jafar, R., Basuki, Windijarto, Setiawan, R., & Prabaswara, A. (2024). Does Environmental, Social, and Governance (ESG) Disclosure Matter for Creditor? Empirical Evidence from Indonesia. *International Journal of Sustainable Development and Planning*, 19(11), 4377–4387.
<https://doi.org/10.18280/ijstdp.191125>
- Jensen, M. C., & Meckling, W. H. (1976). THEORY OF THE FIRM: MANAGERIAL BEHAVIOR, AGENCY COSTS AND OWNERSHIP STRUCTURE. In *Journal of Financial Economics* (Vol. 3). Q North-Holland Publishing Company.
- Jung, J., Herbohn, K., & Clarkson, P. (2018a). Carbon Risk, Carbon Risk Awareness and the Cost of Debt Financing. *Journal of Business Ethics*, 150(4), 1151–1171. <https://doi.org/10.1007/s10551-016-3207-6>
- Jung, J., Herbohn, K., & Clarkson, P. (2018b). Carbon Risk, Carbon Risk Awareness and the Cost of Debt Financing. *Journal of Business Ethics*, 150(4), 1151–1171. <https://doi.org/10.1007/s10551-016-3207-6>
- Khan, M., Serafeim, G., & Yoon, A. (2016). Corporate sustainability: First evidence on materiality. In *Accounting Review* (Vol. 91, Issue 6, pp. 1697–1724). American Accounting Association. <https://doi.org/10.2308/accr-51383>
- Kleimeier, S., & Viehs, M. (2018). *Carbon Disclosure, Emission Levels, and the Cost of Debt* *. <https://ssrn.com/abstract=2719665>

- Krüger, P. (2015). Corporate goodness and shareholder wealth. *Journal of Financial Economics*, 115(2), 304–329.
<https://doi.org/10.1016/j.jfineco.2014.09.008>
- Li, W., Hu, H., & Hong, Z. (2024). Green finance policy, ESG rating, and cost of debt—Evidence from China. *International Review of Financial Analysis*, 92. <https://doi.org/10.1016/j.irfa.2023.103051>
- Li, W. W., Padmanabhan, P., & Huang, C. H. (2024). ESG and debt structure: Is the nature of this relationship nonlinear? *International Review of Financial Analysis*, 91. <https://doi.org/10.1016/j.irfa.2023.103027>
- Lian, Y., Ye, T., Zhang, Y., & Zhang, L. (2023). How does corporate ESG performance affect bond credit spreads: Empirical evidence from China. *International Review of Economics and Finance*, 85, 352–371.
<https://doi.org/10.1016/j.iref.2023.01.024>
- Lins, K. V., Servaes, H., & Tamayo, A. (2017). Social Capital, Trust, and Firm Performance: The Value of Corporate Social Responsibility during the Financial Crisis. *Journal of Finance*, 72(4), 1785–1824.
<https://doi.org/10.1111/jofi.12505>
- Martini, A. (2021). Socially responsible investing: from the ethical origins to the sustainable development framework of the European Union. *Environment, Development and Sustainability*, 23(11), 16874–16890.
<https://doi.org/10.1007/s10668-021-01375-3>
- Marzi, S., Mysiak, J., & Santato, S. (2018). Comparing adaptive capacity index across scales: The case of Italy. *Journal of Environmental Management*, 223, 1023–1036. <https://doi.org/10.1016/j.jenvman.2018.06.060>
- Moner-Girona, M., Bender, A., Becker, W., Bódis, K., Szabó, S., Kararach, A. G., & Anadon, L. D. (2021). A multidimensional high-resolution assessment approach to boost decentralised energy investments in Sub-Saharan Africa. *Renewable and Sustainable Energy Reviews*, 148.
<https://doi.org/10.1016/j.rser.2021.111282>

- Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A., & Giovannini, E. (2005). *Handbook on Constructing Composite Indicators: Vol. 2005/03* (OECD Statistics Working Papers). <https://doi.org/10.1787/533411815016>
- Oikonomou, I., Brooks, C., & Pavelin, S. (2014a). The effects of corporate social performance on the cost of corporate debt and credit ratings. *Financial Review*, 49(1), 49–75. <https://doi.org/10.1111/fire.12025>
- Oikonomou, I., Brooks, C., & Pavelin, S. (2014b). The effects of corporate social performance on the cost of corporate debt and credit ratings. *Financial Review*, 49(1), 49–75. <https://doi.org/10.1111/fire.12025>
- Palmieri, E., Geretto, E. F., Polato, M., & Miani, S. (2025). Alternative finance in bank-firm relationship: how does board structure affect the cost of debt? *Journal of Management and Governance*, 29(1), 111–143. <https://doi.org/10.1007/s10997-024-09700-4>
- Passas, I. (2024). The Evolution of ESG: From CSR to ESG 2.0. *Encyclopedia*, 4(4), 1711–1720. <https://doi.org/10.3390/encyclopedia4040112>
- Peng, Q., & Xie, Y. (2024). ESG greenwashing and corporate debt financing costs. *Finance Research Letters*, 69. <https://doi.org/10.1016/j.frl.2024.106012>
- Pucheta-Martínez, M. C., Bel-Oms, I., & Olcina-Sempere, G. (2018). The association between board gender diversity and financial reporting quality, corporate performance and corporate social responsibility disclosure: A literature review. In *Academia Revista Latinoamericana de Administracion* (Vol. 31, Issue 1, pp. 177–194). Emerald Group Publishing Ltd. <https://doi.org/10.1108/ARLA-04-2017-0110>
- Raimo, N., Caragnano, A., Zito, M., Vitolla, F., & Mariani, M. (2021). Extending the benefits of ESG disclosure: The effect on the cost of debt financing. *Corporate Social Responsibility and Environmental Management*, 28(4), 1412–1421. <https://doi.org/10.1002/csr.2134>

- Ratajczak, P., & Mikołajewicz, G. (2021). The impact of environmental, social and corporate governance responsibility on the cost of short-and long-term debt. *Economics and Business Review*, 7(2), 74–96.
<https://doi.org/10.18559/ebr.2021.2.6>
- Rong, X., & Kim, M. I. (2024). ESG and the Cost of Debt: Role of Media Coverage. *Sustainability (Switzerland)*, 16(12).
<https://doi.org/10.3390/su16124993>
- Safiullah, M., Kabir, M. N., & Miah, M. D. (2021). Carbon emissions and credit ratings. *Energy Economics*, 100.
<https://doi.org/10.1016/j.eneco.2021.105330>
- Sharfman, M. P., & Fernando, C. S. (2008). Environmental risk management and the cost of capital. *Strategic Management Journal*, 29(6), 569–592.
<https://doi.org/10.1002/smj.678>
- Shi, Y., Zheng, S., Xiao, P., Zhen, H., & Wu, T. (2024). ESG performance and cost of debt. *China Journal of Accounting Research*, 17(4).
<https://doi.org/10.1016/j.cjar.2024.100390>
- Shleifer, A., & Vishny, R. W. (1997). A survey of Corporate Governance. *The Journal of Finance*, 2.
- Singh Bhullar, P., & Kumar Gupta, P. (2024). *The Impact of Corporate Governance and Moderating Effect of Firm Performance on CSR Expenditure of Firms in India*.
- Skog, E., & Nyström, K. (2022). *ESG and the Cost of Debt*.
- Song, B., & Dong, C. (2023). What do we know about CSR authenticity? A systematic review from 2007 to 2021. *Social Responsibility Journal*, 19(3), 525–548. <https://doi.org/10.1108/SRJ-07-2021-0276>
- Spence, M. (1973). *JOB MARKET SIGNALING* *.
<https://academic.oup.com/qje/article/87/3/355/1909092>

Strategic Management: A Stakeholder Approach - R. Edward Freeman - Google Books. (2010). Cambridge University Press.

[https://books.google.co.uk/books?hl=en&lr=&id=NpmA_qEiOpkC&oi=fnd&pg=PR5&dq=%E2%80%A2%09Freeman,+R.+E.+\(1984\).+Strategic+management:+A+stakeholder+approach.+Pitman.&ots=62ggJ5QbPL&sig=0WTu-TQj-NjQJcDxKT7Ch-Qu2wo&redir_esc=y#v=onepage&q&f=false](https://books.google.co.uk/books?hl=en&lr=&id=NpmA_qEiOpkC&oi=fnd&pg=PR5&dq=%E2%80%A2%09Freeman,+R.+E.+(1984).+Strategic+management:+A+stakeholder+approach.+Pitman.&ots=62ggJ5QbPL&sig=0WTu-TQj-NjQJcDxKT7Ch-Qu2wo&redir_esc=y#v=onepage&q&f=false)

Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds?

Journal of Corporate Finance, 61.

<https://doi.org/10.1016/j.jcorpfin.2018.12.001>

Titman, S., Wessels, R., Franks, J., Mayers, D., Masulis, R., & Torous, W.

(1988). *THE JOURNAL OF FINANCE* * VOL. XLIII, NO. 1 * *The Determinants of Capital Structure Choice*.

Tschopp, D., & Huefner, R. J. (2015). Comparing the Evolution of CSR

Reporting to that of Financial Reporting. *Journal of Business Ethics*, 127(3), 565–577. <https://doi.org/10.1007/s10551-014-2054-6>

von Wallis, M., & Klein, C. (2015). Ethical requirement and financial interest: a

literature review on socially responsible investing. *Business Research*, 8(1), 61–98. <https://doi.org/10.1007/s40685-014-0015-7>

Watson, R. (2011). Ethical and socially responsible investment funds: Are they

ethically and responsibly marketed? *Journal of Financial Regulation and Compliance*, 19(2), 100–110. <https://doi.org/10.1108/13581981111123825>

Yang, X., Yang, T., Lv, J., & Luo, S. (2024a). The Impact of ESG on Excessive Corporate Debt. *Sustainability (Switzerland)*, 16(16).

<https://doi.org/10.3390/su16166920>

Yang, X., Yang, T., Lv, J., & Luo, S. (2024b). The Impact of ESG on Excessive Corporate Debt. *Sustainability (Switzerland)*, 16(16).

<https://doi.org/10.3390/su16166920>

You, X., Chen, C., Peng, K., & Li, Y. (2025). ESG disclosure quality and cost of debt. *Emerging Markets Review*, 64.

<https://doi.org/10.1016/j.ememar.2024.101219>

Zhao, W., Liang, Y., & Li, P. (2023). Can enterprises' participation in targeted poverty alleviation reduce the cost of debt financing? Evidence from China.

Finance Research Letters, 58. <https://doi.org/10.1016/j.frl.2023.104551>

STATA Software

Blomberg

Refinitiv - Datastream

7 Appendix A: Ethical approval letter



28 June 2025

Dear Ms Chhipa ,

Reference: CURES/25867/2025

Project ID: 29320

Title: Does ESG Performance Affect the Cost of Debt? A Multi-Model Analysis Incorporating Debt Maturity, ESG Data Sources, and Moderating Governance Signals

Thank you for your application to the Cranfield University Research Ethics System (CURES).

We are pleased to inform you your CURES application, reference CURES/25867/2025 has been reviewed. You may now proceed with the research activities you have sought approval for.

If you have any queries, please contact CURES Support.

We wish you every success with your project.

Regards,

CURES Team

8 Appendix B: ESG Pillars Regression Tables

Table 7: Pooled regressions of the individual dimensions of ESG performance on the cost of debt (Fixed Effects Regression)

Variables	(1) Environmental	(2) Social	(3) Governance
Lev	0.5009** -2.37	0.4719** -2.24	0.4927** -2.32
Size (ln assets)	0.1813** -2.23	0.2131** -2.65	0.1897** -2.34
MTBV	0.0051 -0.62	0.0039 -0.48	0.005 -0.61
Environmental pillar (le)	0.0813*** -6.2	– –	– –
Social pillar (ls)	– –	–0.0459*** (–15.80)	– –
Governance pillar (lg)	– –	– –	0.0542*** -4.13
Constant	–7.5221*** (–6.09)	–8.0291*** (–6.60)	–7.6566*** (–6.24)
Observations	16,738	16,738	16,738
R-squared	0.7131	0.7143	0.7123
Adj. R ²	0.7006	0.7019	0.6997
Firm Dummies	Yes	Yes	Yes
Country Dummies	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes

The table reports fixed-effects regressions of the natural log of cost of debt (ln_cod) on the Environmental, Social, and Governance pillars of ESG performance. Robust t-statistics clustered at the firm level are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Pooled regressions of the individual dimensions of ESG performance with moderators on the cost of debt (Moderation

Variables	(1) E×CSR	(2) E×SOE	(3) E×Audit Indep.	(4) E×Size	(5) S×CSR	(6) S×SOE	(7) S×Audit Indep.	(8) S×Size	(9) G×CSR	(10) G×SOE	(11) G×Audit Indep.	(12) G×Size
Lev	0.9022**	0.5026**	0.5094**	0.5038**	-0.4696**	0.5026**	0.4926**	0.4677**	0.4939**	0.4939**	0.4989**	0.4767**
t-stat	-2.31	-2.38	-2.39	-2.39	(-2.22)	-2.38	-2.33	-2.08	-2.33	-2.33	-2.34	-2.34
Size	0.1773**	0.1802**	0.1749**	0.0959	0.2123**	0.1802**	0.2142**	0.0628	0.1880**	0.1880**	0.1882**	0.1052
t-stat	-2.18	-2.2	-2.12	-1.2	-2.63	-2.2	-2.67	-0.79	-2.3	-2.3	-2.29	-1.05
MTBV	0.0046	0.0056	0.0052	0.0046	0.0838	0.0056	0.0039	0.0038	0.0051	0.0051	0.004	0.0046
t-stat	-0.54	-0.62	-0.52	-0.58	-0.64	-0.62	-0.52	-0.41	-0.63	-0.63	-0.5	-0.57
ESG Pillar (E)	0.1969***	0.1746***	0.0808***	0.0801***	-	-	-	-	-	-	-	-
t-stat	-3.8	-3.14	-6.12	-6.03	-	-	-	-	-	-	-	-
ESG Pillar (S)	-	-	-	-	-0.0644***	-0.1746***	-0.0459***	-0.0464***	-	-	-	-
t-stat	-	-	-	-	(-2.76)	(-3.14)	(-15.80)	(-15.70)	-	-	-	-
ESG Pillar (G)	-	-	-	-	-	-	-	-	0.1021†	0.1021†	0.0576***	0.0554***
t-stat	-	-	-	-	-	-	-	-	-1.97	-1.97	-4.45	-4.07
CSR dummy	-0.2346**	-	-	-	0.0571	-	-	-	0.0443	-	-	-
t-stat	(-2.19)	-	-	-	-0.55	-	-	-	(-0.47)	-	-	-
SOE dummy	-	-0.1722	-	-	-	-0.1772	-	-	-	0.0443	-	-
t-stat	-	(-1.45)	-	-	-	(-1.45)	-	-	-	(-0.47)	-	-
Audit dummy	-	-	-0.0269	-	-	-	0.0322	-	-	-	0.0313	-
t-stat	-	-	(-0.73)	-	-	-	-0.73	-	-	-	(-0.94)	-
Size dummy	-	-	-	0.1488	-	-	-	0.2416**	-	-	-	0.1761
t-stat	-	-	-	-1.37	-	-	-	-2.07	-	-	-	-1.59
Interaction (E×)	-0.1188**	-0.0959†	-0.0348***	0.0074	-	-	-	-	-	-	-	-
t-stat	(-2.25)	(-1.68)	(-3.13)	-0.64	-	-	-	-	-	-	-	-
Interaction (S×)	-	-	-	-	0.0192	-0.0959†	-0.0028	0.0044	-	-	-	-
t-stat	-	-	-	-	-0.82	(-1.68)	(-0.10)	-1.36	-	-	-	-
Interaction (G×)	-	-	-	-	-	-	-	-	-0.0514	-0.0514	-0.0386***	0.0038
t-stat	-	-	-	-	-	-	-	-	(-0.95)	(-0.95)	(-3.29)	-0.31
Constant	-7.2206***	-7.3318***	-7.4244***	-6.1349***	-8.0719***	-7.3318***	-8.0576***	-7.7266***	-7.5609***	-7.5609***	-7.6277***	-5.9761***
t-stat	(-5.82)	(-5.84)	(-5.94)	(-5.37)	(-6.60)	(-5.84)	(-6.60)	(-4.75)	(-6.14)	(-6.14)	(-6.13)	(-5.17)
Observations	16,728	16,728	16,728	16,728	16,738	16,738	16,738	16,738	16,738	16,738	16,738	16,738
R ²	0.7193	0.7133	0.7137	0.7132	0.7144	0.7133	0.7143	0.7132	0.7123	0.7123	0.7129	0.7123
Adj. R ²	0.7014	0.7007	0.7012	0.7006	0.7019	0.7007	0.7018	0.7006	0.6997	0.6997	0.7003	0.6997
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The table reports moderation model of the natural log of cost of debt ($\ln_cod$) on the Environmental, Social, and Governance pillars of ESG performance under alternative moderating effects (CSR reporting, state ownership, audit independence, and firm size). Robust t-statistics clustered at the firm level are shown in parentheses. Firm, country, industry, and year fixed effects are included in all models. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 9: Instrumental Variable (2SLS) regressions of ESG pillars on cost of debt

Variables	(1) Environmental (IV)	(2) Social (IV)	(3) Governance (IV)
Lev	1.0634*** -3.06	0.9777*** -2.71	1.0305*** -2.92
Size	-0.0387 (-1.16)	0.1311** -2.22	-0.0318 (-0.95)
MTBV	-0.0054 (-0.37)	-0.0085 (-0.58)	-0.0055 (-0.37)
Envhat	0.1041*** -3.68	- -	- -
Sochat	- -	-0.3362*** (-3.68)	- -
Govhat	- -	- -	0.1215*** -3.68
Constant	-4.2707*** (-9.07)	-6.9543*** (-8.04)	-4.3661*** (-9.26)
Observations	15,851	15,851	15,851
R-squared	0.5444	0.5444	0.5444
Adj. R ²	0.538	0.538	0.538
First-stage F	298.62	10.65	92.01
Year Dummies	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes

The table reports 2SLS regressions of the natural log of cost of debt on environmental, social, and governance scores, each instrumented by their one-period lag. First-stage results indicate very strong instruments for Environmental (F=298.6) and Governance (F=92.0), while Social is weak (F=2.65). Robust t-statistics clustered at the firm level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: System GMM regressions of ESG pillars on cost of debt

Variables	(1) Environmental (GMM)	(2) Social (GMM)	(3) Governance (GMM)
Lev	-0.6048 (-1.25)	-0.0343 (-0.43)	0.0636 -1.14
Size	0.7401*** -3.51	0.0869** -2.6	-0.0673*** (-2.98)
MTBV	-0.0343 (-1.64)	-0.0052 (-1.14)	0.0036 -1.07
Env (L1)	-2.7745*** (-5.66)	-	-
Soc (L1)	-	-0.3029*** (-15.27)	-
Gov (L1)	-	-	0.1749*** -5.03
Lagged ln(CoD)	-0.5292*** (-3.26)	-0.0963 (-1.39)	0.1602*** -2.93
Constant	-11.0769*** (-3.51)	-1.4208** (-2.80)	0.9229** -2.74
Observations	14,813	14,813	14,813
Hansen J (p-val)	0.987	0.901	0.889
Sargan (p-val)	0.978	0.812	0.765
AR(1)	-6.87 (p=0.000)	-7.52 (p=0.000)	-7.95 (p=0.000)
AR(2)	1.21 (p=0.226)	-0.98 (p=0.326)	0.88 (p=0.377)
Year Dummies	Yes	Yes	Yes

The table reports two-step System GMM estimates of the effect of Environmental, Social, and Governance scores on cost of debt. All models include lagged dependent variable, leverage, firm size, and market-to-book ratio as controls. Hansen and Sargan tests provide mixed evidence of instrument validity across specifications. AR(1) is consistently negative and significant, while AR(2) varies, indicating model sensitivity. Robust t-statistics clustered at the firm level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

9 Appendix C: Robustness check with Country Default Spread proxy for Cost of Debt

Table 11: Pooled regressions of ESG performance on the cost of debt (Country default spread proxy)

Variables	(1) FE baseline	(2) CSR Reporting	(3) SOE Ownership	(4) Firm Size	(5) Audit Independence
ESG composite	0.0106	0.0965	0.0186	0.0203	0.0197
	-0.53	-1.03	-1.2	-1.32	-1.28
CSR Reporting	–	-0.0434 (-0.46)	–	–	–
SOE Ownership	–	–	-0.239 (-1.05)	–	–
Firm Size (log assets)	0.130*	0.106*	0.186*	0.0856*	0.102*
	-1.77	-1.8	-1.9	-1.92	-1.76
Leverage	0.099	0.074	0.078	0.078	0.078
	-0.66	-0.54	-0.61	-0.61	-0.65
MTBV	0.004	0.006	0.006	0.006	0.006
	-0.8	-1.6	-1.64	-1.62	-1.65
ESG × CSR Reporting	–	-0.0252 (-0.81)	–	–	–
ESG × SOE Ownership	–	–	0.0397 -0.86	–	–
ESG × Firm Size	–	–	–	-0.00845 (-0.41)	–
ESG × Audit Independence	–	–	–	–	-0.0255** (-2.38)
Constant	-2.045 (-1.81)	-1.639 (-1.87)	-1.73 (-1.83)	-1.375** (-1.99)	-1.637 (-1.82)
Observations	53,134	66,602	66,602	66,602	66,602
R-squared	0.734	0.774	0.773	0.773	0.771
Adj. R-squared	0.009	0.009	0.009	0.009	0.011
Firm FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

This table reports pooled fixed effects regressions of ESG performance on the country default spread (z-spread), used as a proxy for firms' cost of debt in non-financial industries. Column (1) shows the baseline model; Columns (2)–(5) include moderation by CSR reporting, SOE ownership, firm size, and audit independence. Robust standard errors are clustered at the firm level. Coefficients are reported with t-statistics in parentheses. Significance levels: ***p < 0.01, **p < 0.05, *p < 0.10.

Table 12: Pooled regressions of ESG pillars on the cost of debt (Country default spread proxy)

Variables	(1) Environmental	(2) Social	(3) Governance
ESG Environmental pillar	0.00944 -0.37	–	–
ESG Social pillar	–	-0.00718* (-1.93)	–
ESG Governance pillar	–	–	0.0164 -1.12
Firm Size (log assets)	0.132 -1.5	0.115 -1.64	0.099* -1.71
Leverage	0.223 -0.9	0.107 -0.7	0.08 -0.65
MTBV	0.00104 -0.15	0.0039 -0.76	0.00654 -1.61
Constant	-2.082 (-1.54)	-1.819 (-1.69)	-1.578 (-1.76)
Observations	53,170	53,170	66,638
R-squared	0.625	0.739	0.774
Adj. R-squared	0.006	0.008	0.008
Firm FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

This table reports pooled fixed effects regressions of the environmental, social, and governance (ESG) pillars on the country default spread (z-spread), used as a proxy for firms' cost of debt in non-financial industries. Columns (1)–(3) report results for environmental, social, and governance pillars respectively. Robust standard errors are clustered at the firm level.

Coefficients are shown with t-statistics in parentheses. Significance levels: ***p < 0.01, **p < 0.05, *p < 0.10.

**Table 13: Pooled regressions of ESG pillars with moderators on the cost of debt
(Country default spread proxy)**

Variables	(1) Env × Moderators	(2) Soc × Moderators	(3) Gov × Moderators
ESG Environmental pillar	0.0711 -1.04	–	–
ESG Social pillar	–	0.0161 -0.82	–
ESG Governance pillar	–	–	0.086 -1.07
CSR Reporting	-0.0847 (-0.46)	0.0462 -0.73	-0.0208 (-0.23)
SOE Ownership	-0.231 (-1.05)	-0.316 (-1.33)	-0.149 (-0.61)
Firm Size (log assets)	0.0536 -1.75	0.103 -1.77	0.0844 -1.62
Leverage	0.0971 -0.66	0.0753 -0.63	0.0815 -0.68
MTBV	0.00468 -1.61	0.00608 -1.63	0.00567 -1.59
ESG × CSR Reporting	-0.0531 (-0.82)	-0.0082 (-0.60)	-0.0199 (-0.82)
ESG × SOE Ownership	0.0397 -0.86	-0.0161 (-0.93)	0.146 -1.78
ESG × Firm Size	-0.00448 (-0.41)	0.00263 -0.9	-0.0131 (-1.13)
ESG × Audit Independence	-0.0257** (-2.38)	-0.0111** (-3.37)	-0.01 (-1.08)
Constant	-1.476 (-1.81)	-1.65 (-1.82)	-1.555 (-1.79)
Observations	66,638	66,638	66,638
R-squared	0.775	0.775	0.774
Adj. R-squared	0.008	0.009	0.008
Firm, Country, Industry, Year FE	Yes	Yes	Yes

This table reports pooled fixed effects regressions of the environmental, social, and governance (ESG) pillars on the country default spread (z-spread), a proxy for firms' cost of debt in non-financial industries. Columns (1)–(3) introduce moderators (CSR reporting, SOE ownership, firm size, and audit independence). All specifications include firm, country, industry, and year fixed effects. Robust standard errors are clustered at the firm level. Coefficients are shown with t-statistics in parentheses. Significance levels: ***p < 0.01, **p < 0.05, *p < 0.10.

Table 14: Instrumental Variable (2SLS) and System GMM regressions of ESG on cost of debt (Country default spread proxy)

Variables	(1) 2SLS – IV (Lagged ESG)	(2) System GMM
Leverage	0.1012 -1.82	-20.4848 (-1.00)
Size	0.0077 -1.28	17.0718 -0.68
MTBV	0.00428 (1.94)*	0.9682 -1.41
ESG (fitted/lagged)	1 (1.88)*	-0.4066** (-2.60)
Country Default Risk (lagged)	–	0.933 -0.74
Constant	-0.1936 (-1.92)*	–
Observations	63,456	21,972
R-squared	0.755	–
Adj. R ²	0.755	–
First-stage F	2.29	–
Hansen J (p-val)	–	0.871
Sargan (p-val)	–	0.954
AR(1)	–	-6.80 (p=0.000)
AR(2)	–	0.94 (p=0.345)

This table reports robustness regressions of ESG performance on the country default spread (CDS proxy for cost of debt). Column (1) presents instrumental variable (2SLS) regressions, where lagged ESG serves as the instrument. The first-stage regression confirms instrument relevance (F=2.29). Column (2) reports System GMM with lagged dependent variable; AR(1) is negative and significant, while AR(2) is non-significant, supporting validity. Hansen and Sargan tests confirm instrument validity. Robust t-statistics clustered at the firm level are reported in parentheses. ***p<0.01, **p<0.05, *p<0.10.

Table 15: Instrumental Variable (2SLS) regressions of ESG pillars on cost of debt (Country default spread proxy)

Variables	(1) Environmental	(2) Social	(3) Governance
Leverage	0.1005 -1.81	0.0998 -1.8	0.0988 -1.79
Size	0.0076 -1.28	0.0114** -2.11	0.0105* -2.05
MTBV	0.00421* -1.91	0.00433** -1.99	0.00414** -2.01
ESG			
Environmental	1 (1.87)*	–	–
ESG Social	–	0.3126*** -3.2	–
ESG Governance	–	–	0.4919** -2.03
Constant	-0.191 (-1.92)	-0.251*** (-2.74)	-0.206 (-2.06)
Observations	63,492	63,492	63,492
R-squared	0.757	0.757	0.757
Adj. R-squared	0.756	0.756	0.756
First-stage F	2.24	4.94	4.89

This table reports 2SLS instrumental variable regressions of the environmental, social, and governance pillars on the country default spread (z-spread), a proxy for firms' cost of debt. Each pillar is instrumented using its one-period lag in the first stage. The first-stage F-statistics confirm instrument relevance across specifications. All regressions include country, industry, and year fixed effects. Robust t-statistics clustered at the firm level are reported in parentheses.

***p<0.01, **p<0.05, *p<0.10.

Table 16: System GMM regressions of ESG pillars on cost of debt (Country default spread proxy)

Variables	(1) Environmental	(2) Social	(3) Governance
Leverage (t-1)	-5.563 (-0.94)	14.928 -0.82	-12.822 (-1.47)
Size (t-1)	-3.321 (-1.19)	-12.194 (-0.95)	4.805 -0.45
MTBV (t-1)	0.036 -0.41	-0.081 (-0.05)	0.477 -1.27
ESG Env (t-1)	-0.207 (-0.87)	–	–
ESG Soc (t-1)	–	-0.018 (-0.15)	–
ESG Gov (t-1)	–	–	-0.449** (-3.12)
Country Default Risk (lagged)	-0.689 (-1.52)	-0.11 (-0.12)	-0.384 -0.79
Constant	–	–	–
Observations	22,009	22,009	22,009
Instruments	19	19	19
AR(1)	-6.80 (p=0.000)	-6.80 (p=0.000)	-6.80 (p=0.000)
AR(2)	0.94 (p=0.345)	0.94 (p=0.345)	0.94 (p=0.345)
Hansen J (p-val)	0.871	0.871	0.871
Sargan (p-val)	0.954	0.954	0.954

This table reports two-step System GMM regressions of the environmental, social, and governance (ESG) pillars on the country default spread (z-spread), a proxy for cost of debt. The models include lagged dependent variables to capture persistence in sovereign risk spreads. Diagnostic tests indicate validity: AR(1) is significant as expected, AR(2) is non-significant, and Hansen and Sargan tests confirm instrument validity. Robust t-statistics clustered at the firm level are reported in parentheses. ***p<0.01, **p<0.05, *p<0.10.

10 Appendix D: Histogram and Kernel Density of Cost of Debt and Log CoD

Figure 3: Histogram with Normality Distribution (CoD)

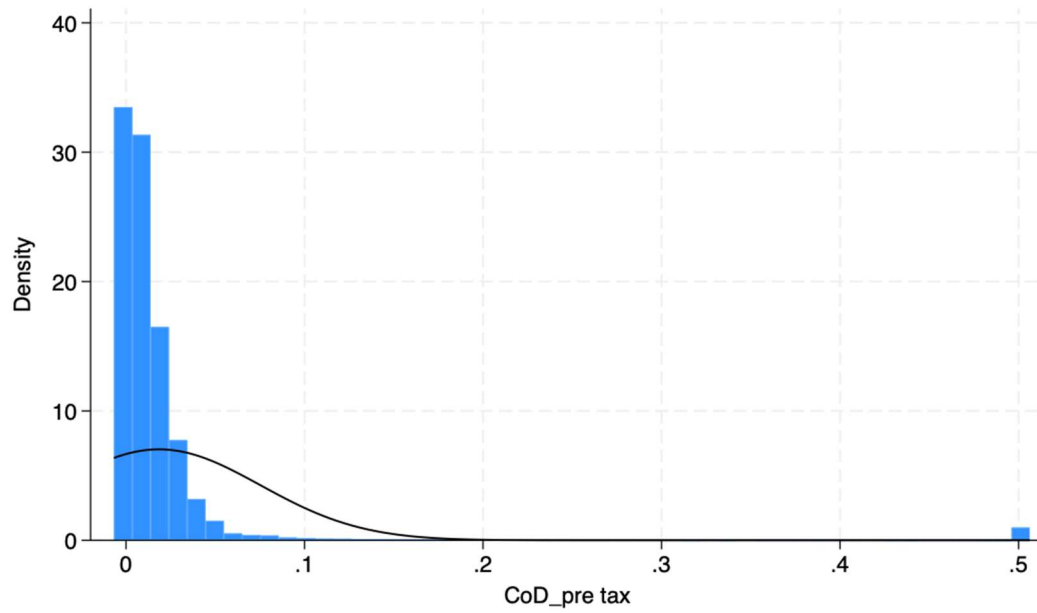


Figure 4: Kernel density with Normal density (CoD)

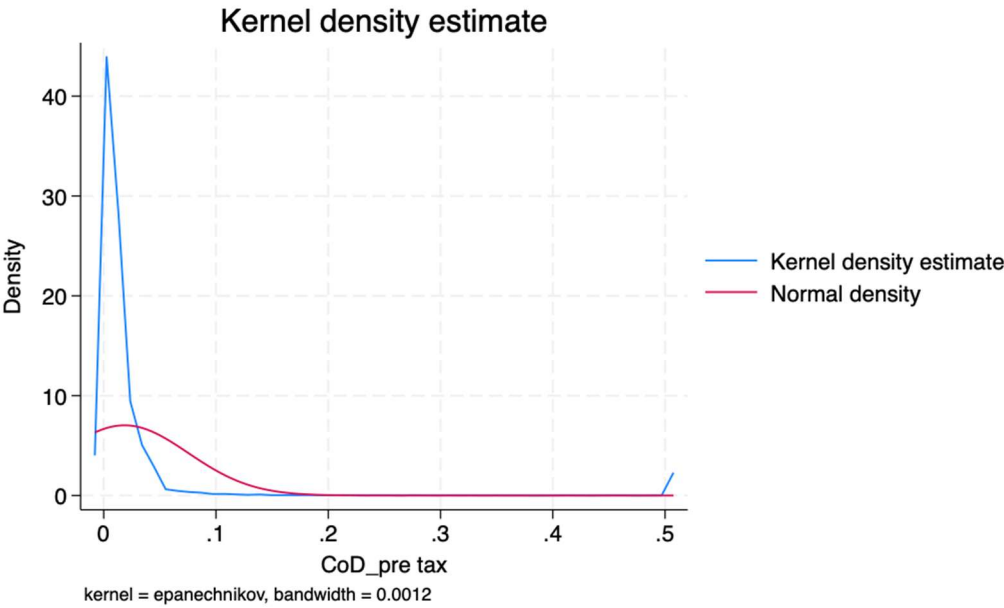


Figure 5: Histogram with Normality distribution (Log_CoD)

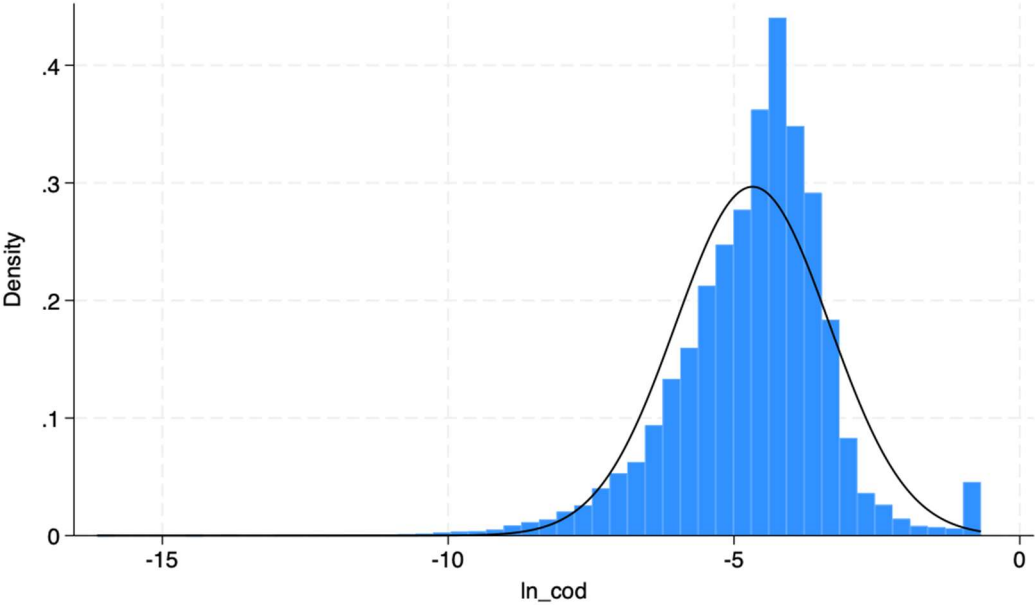


Figure 6: Kernel density with Normal density (Log_CoD)

