Exploring the Impact of ESG Ratings on Corporate Financing Decisions: insights from the COVID and post-COVID period

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Abstract

This thesis investigates how ESG ratings influence firms' leverage ratios and debt structures, and examines how these effects vary under the economic conditions of the COVID and post-COVID period. The optimal leverage and debt ratios results show that optimal market and book leverage decrease while firms shift from public to bank debt when becoming ESG-rated. These results can be explained by the role of ESG ratings in mitigating information asymmetry and signaling financial stability to lenders, facilitating enhanced access to financing sources. Moreover, the results indicate that obtaining ESG ratings negatively impacts actual leverage and public debt ratios. The post-crisis period amplifies this effect, as firms with ESG ratings adopt more conservative financing strategies. Specifically, these firms further reduce their leverage during crises, reflecting a shift towards lower-risk profiles and greater financial stability. Additionally, firms do not manage to increase actual bank debt ratios in the post-crisis period, likely due to constrained credit supply and altered bank lending standards.

The study provides valuable insights into the dynamics of ESG ratings and corporate financing decisions when economic conditions change, shedding light on theoretical and practical implications of the trade-off and pecking-order theories. Ultimately, these findings remain valid across various robustness checks and endogeneity tests.

Keywords: ESG rating, Debt structure, Leverage ratios, Information asymmetry, COVID-19 crisis, Financing decisions, Trade-off theory, Pecking-order theory

Titulo: Explorando o impacto das classificações ESG nas decisões de financiamento das empresas: perspectivas do período COVID e pós-COVID

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Resumo

Esta tese investiga a forma como as notações ESG afectam a alavancagem das empresas e a estrutura da dívida, e como o impacto varia nas condições económicas dos períodos COVID e pós-COVID. Os resultados da alavancagem e dos rácios de endividamento óptimos mostram que a alavancagem óptima de mercado e a alavancagem contabilística diminuem enquanto as empresas mudam da dívida pública para a dívida bancária quando passam a ser classificadas pelo ESG. Isso pode ser explicado pelo papel das notações ESG na mitigação da assimetria de informação e na sinalização da estabilidade financeira aos mutuantes, facilitando um melhor acesso no financiamento. Além disso, os resultados indicam que obtençar as notações ESG tem um impacto negativo nos rácios efectivos de alavancagem e de dívida pública. O período pós-crise amplifica este efeito, por que as empresas com notações ESG adoptam estratégias financeiras mais conservadoras. Estas empresas ainda reduzem a alavancagem durante as crises, reflectindo uma mudança para perfis de menor risco e maior estabilidade financeira.Além disso, as empresas não conseguem aumentar os rácios de endividamento bancário no período pós-crise, provavelmente devido à restrição da oferta de crédito e à alteração dos critérios de concessão de crédito bancário.

O estudo fornece informações valiosas sobre a dinâmica das classificações ESG e das decisões de financiamento das empresas quando as condições económicas mudam, recolhendo implicações teóricas e práticas da teoria do trade-off e da pecking-order. Em última análise, estas conclusões permanecem válidas em várias verificações de robustez e testes de endogeneidade.

Palavras-chave: Notação ESG, Estrutura da dívida, Rácios de alavancagem, Assimetria de informação, Crise da COVID-19, Decisões de financiamento, Teoria do trade-off, Teoria da ordem de Pecking

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List of Acronyms

2SLS	Two-Stage Least Squares
2SLS-IV	Two-Stage Least Squares – Instrumental Variable
Avg	Average
Bl	Book leverage
CCM	CRSP/Compustat Merged
CFO	Chief Financial Officer
CSR	Corporate Social Responsibility
EBITDA	Earnings Before Interest Taxes Depreciation and Amortization
Eq.	Equation
ESG	Environmental, Social, Governance
ESGC	Environmental, Social, Governance Comprehensive
Et al.	Et alia
Ind	Industry
IV	Instrumental Variable
Lag	Lagged
Ln	Natural Logarithm
Mio.	Million
Ml	Market leverage
MtB	Market-to-book
PPE	Property, Plant and Equipment
R&D	Research & Development
SGA	Selling, General and Administrative
U.S.	United States

1. Introduction

Climate change presents a significant economic challenge, imposing substantial financial risks on companies (Nordhaus, 2019). Investors increasingly recognize the financial implications of climate risks for their portfolio firms and are demanding more comprehensive climate risk reporting (Ilhan et al., 2019; Krueger et al., 2020). Consequently, institutional investor engagement in environmental, social, and governance (ESG) issues has become more prevalent in financial markets. These engagements aim to elevate corporate ESG practices, serving as a safeguard against harmful, risk-inducing events, and mitigating potential regulatory, legislative, or consumer actions against firms.

The COVID-19 crisis introduced an unprecedented shock that shifted focus beyond traditional environmental concerns. Although environmental risks were prominent in the World Economic Forum's Global Risk Report 2020, pandemic risk was ranked lower and perceived as less likely (Ramelli & Wagner, 2020). Maillard and Gonzalez (2006) argue that pandemics can be triggered by epidemic outbreaks and that human activity's impact on biodiversity loss is considered a serious threat to sustainable development. The COVID-19 pandemic has emphasized the critical need for environmental sustainability in corporate strategies.

As economies recover from the crisis, firms face economic challenges that threaten their financial performance, highlighting the crucial need for robust ESG practices to navigate these risks. Corporates and investors may have reconsidered the significance of environmental responsibility even though the COVID-19 crisis was not entirely caused by environmental problems or climate change.

Previous research has explored the influence of ESG on multiple aspects of firms' capital structure, such as perceived risk, investor base, and financing costs (Oikonomou et al., 2012; Sharfman & Fernando, 2008; El Ghoul et al., 2011). However, only a limited number of studies specifically address how social responsibility and ESG ratings impact the capital structure, particularly in terms of access to diverse financing sources (Verwijmeren & Derwall, 2010). Moreover, these works do not systematically examine the effects of obtaining ESG ratings on leverage ratios and debt composition. While academic research predominantly focuses on the interactive effects of the COVID-19 crisis and responsible behavior on stock market reactions (Ramelli and Wagner, 2020), investor behavior (Garel and Petit-Romec, 2021), and bank lending standards (Çolak and Öztekin, 2020), the impact on corporate financing decisions remains relatively unexplored.

This thesis aims to fill this gap by analyzing the impact of ESG ratings on firms' target (optimal) leverage and debt ratios and how these effects evolve under the challenging economic conditions during and following the COVID-19 pandemic.[1] The findings show that obtaining an ESG rating significantly decreases both optimal book and market leverage ratios. Additionally, the results indicate a shift from public debt to bank debt in the optimal debt structure, supporting both the trade-off and pecking-order theories. These results are likely due to ESG ratings influencing corporate financing decisions by serving as signals to mitigate information asymmetries, and the pandemic affecting various factors related to credit supply and demand.

Subsequently, the thesis examines how ESG ratings and the COVID-19 crisis affect firms' actual leverage and debt ratios. This analysis indicates whether firms adjust their financing decisions post-ESG rating or during crises to align with optimal ratios. Similar to the results for the optimal capital and debt structure, the results indicate a significantly negative effect on leverage and public debt ratios. Contrary to the optimal bank debt ratio, a positive impact and a shift in debt composition cannot be observed for the actual bank debt ratios.

The disparity between optimal and actual bank debt ratios is likely due to a decline in credit supply and changes in bank lending standards. For instance, Beck and Keil (2022) find that non-PPP small business lending dropped significantly by over 20%, highlighting the reduction in credit supply. Thus, the deleveraging trend supports the trade-off theory while the disparity between optimal and actual debt compositions provides in-depth insights into real-world implications of the pecking order theory.

Consequently, the findings contribute to the literature evaluating the effects of responsible behavior and ESG ratings by providing insights into how firms alter their financing decision-making process when they obtain an ESG rating. Moreover, the paper provides implications of how the dynamics of financing decisions change alongside economic conditions.

To answer the research question, this thesis is structured as follows. Chapter 2 reviews the literature on capital structure theories, the relationship between ESG and capital structures, and the impact of crises on capital structure. Chapter 3 presents the methodology and sample descriptive statistics. Chapter 4 outlines the empirical analysis, main results, heterogeneity tests, and robustness assessments. Chapter 5 concludes the thesis by summarizing the findings, discussing theoretical and practical implications, and suggesting avenues for future research.

[1] In this paper, the period of 2020-2022, encompassing both the COVID and post-COVID periods, is referred to as the post-crisis period.

2. Literature Review

2.1 Capital Structure Theories

Since Modigliani and Miller (1958) proposed the capital structure irrelevance theorem, the implications of traditional capital structure theories have been discussed by many researchers. As suggested by the static trade-off theory, a firm's target (optimal) leverage ideally balances the benefits of tax savings from debt financing and several costs (e.g. bankruptcy, financial distress). Most empirical research focuses on whether a target (optimal) leverage ratio exists and if the deviation between actual and target (optimal) leverage ratios can be closed. The main findings propose that firms have determined target leverage ratios and adjust towards these optimums at a moderate speed (Leary and Roberts, 2005; Flannery and Rangan, 2006; Harford et al., 2009; Huang and Ritter, 2009). Recent studies were interested in the frequency and speed of leverage adjustments as the dynamic trade-off theory suggests that firms' actual leverage deviates from the target as long as transaction costs outweigh the benefits (Fischer et. al., 1989; Goldstein et.al., 2001 Strebulaev, 2007). Respectively, the dynamic trade-off model of Morellec et al. (2012) proposes that conflicts between managers and shareholders can significantly influence capital structure decisions.

According to the pecking order theory (Myers and Majluf, 1984), companies prefer internal finance sources over external ones because of higher transaction costs when they face information asymmetry. While both private debt and public debt serve as forms of debt financing, it is insightful to separately analyze their characteristics (Denis and Mihov, 2003). For instance, borrowing from banks tends to involve lower information asymmetry compared to issuing public bonds, thereby influencing firms' financing choices (Asimakopoulos et al., 2023). Researchers have further examined whether firms' issuance decisions are timed to exploit market mispricing and whether the composition of debt and equity serves as a reliable predictor of future equity returns. While Butler et al. (2011) argue that the net financing amount is more critical than the debt-equity composition in predicting future stock returns, Lewis and Tan (2016) find that the debt-equity composition indeed predicts stock returns. Despite inconclusive research findings, Bolton et al. (2013) use the market timing theory to develop a framework that predicts optimal firm behavior in response to financing shocks. Their model suggests that firms should reduce investments and corporate payouts when anticipating a future crisis.

2.2 ESG and Capital Structure

Whether a superior ESG performance is value-enhancing and leads to superior financing terms is widely debated and gained renewed interest during the financial crisis and the COVID-19 pandemic (Flammer, 2015; Albuquerque et al., 2020; Bae et al., 2021). The reputation-building hypothesis proposes a positive relationship between ESG and the cost of capital (Borghesi et al., 2014). Firms can use ESG ratings to enhance stakeholder communication and reduce information asymmetries between the management and non-financial stakeholders, enhancing firm performance and lowering the cost of capital (Edmans, 2011; Hasan et al., 2017; Javadi and Masum, 2021). Contrary, the overinvestment theory suggests that ESG practices are costly and have a negative effect on the cost of capital (Barnea and Rubin, 2010). Due to the separation of ownership and control, the management tends to overinvest in ESG to enhance the firm's reputation, often at the shareholders' expense. Consequently, there are two main ways that ESG performance might affect the cost of capital.

First, ESG performance might be related to several risks that firms are facing, such as regulatory risks, reputational risks, supply chain risks, or the risk of bankruptcy (Gillan, 2021). If ESG practices reduce the perceived riskiness of a firm, investors require lower returns and the firm's cost of capital should decrease. Hoepner et al. (2023) find that ESG engagements, especially by addressing environmental issues, benefit shareholders by reducing the firm's downside risk. According to Albuquerque et al. (2019), firms with better ESG performance have less price elastic demand due to a better product differentiation strategy, leading to a decrease in systematic risk. Likewise, responsible behavior can lead to lower litigation risk and a larger investor base, resulting in lower cost of equity (El Ghoul et al., 2011; Hong and Kacperczyk, 2009). Ng and Rezaee (2015) provide supporting evidence by showing a negative correlation between environmental and governance performance and the cost of equity. Using bond credit ratings as a measure of firms' default risk, several papers find that better ESG performance leads to superior bond ratings and hence lower cost of debt (Gillan et. al, 2021). Focusing on the cost of debt, Goss and Roberts (2011) discover that firms with social responsibility concerns face a 7 to 18 basis points increase in borrowing costs and Zerbib (2019) notes a small negative premium associated with green bonds.

Second, ESG practices can lead to higher disclosure norms and better corporate governance, thereby reducing information asymmetries between the management and non-financial stakeholders and subsequently the cost of capital (Botosan, 1997; Hail and Leuz, 2006; Chen et al., 2009). Following the approach of Merton (1987) and El Ghoul et al. (2011), information transition consists of firm signaling, analyst coverage, and investor perception. While Dhaliwal

et al. (2011) find that voluntary disclosure of CSR activities leads to a subsequent decrease in the cost of equity, the findings of Flammer (2021) indicate that issuing green bonds serves as a signaling mechanism rather than providing a cheaper source of debt financing. Moreover, Dhaliwal et al. (2011) point out that firms with superior ESG performance experience increased analyst coverage and appeal to institutional investors. Similarly, Hong and Kacperczyk (2009) and El Ghoul et al. (2011) find that analysts and investors avoid "sin" stocks, resulting in higher cost of capital for irresponsible firms. Additionally, Cheng et al. (2014) find that better ESG performance leads to increased transparency and better stakeholder engagement, resulting in mitigated agency conflicts and significantly lower capital constraints. Consequently, most studies indicate that a better ESG performance is negatively correlated with firm risks and information asymmetries, reducing the cost of capital.

The analysis of Fama and French (1992) suggests that higher cost of capital are associated with higher leverage ratios due to a higher risk. Thus, facing lower cost of capital, firms with superior ESG performance might adapt their capital and debt structure. While Sharfman and Fernando (2008) note that superior environmental risk management leads to increased leverage ratios, other findings indicate that fair employee treatment and social capital are negatively associated with leverage ratios (Huang and Shang, 2019; Bae et al., 2011). Moreover, Asimakopoulos et al. (2023) find that firms with better ESG performance have lower target (optimal) leverage ratios and redistribute their funding sources from bond debt to bank loans.

2.3 Crisis and Capital Structure

According to theory, a global crisis can affect the capital supply and demand as well as the associated costs in various ways, thereby influencing companies' capital structure decisions. As expected returns decline and macroeconomic instability rises, firms often face constraints on their financial resources over an ambiguous duration, leading them to reduce investments. For instance, O'Hara and Zhou (2021) argue that the COVID-19 pandemic induced a deteriorating corporate bond market, driven by supply-side issues like funding constraints, as well as demand-side issues such as shifting risk preferences.

From the demand-side perspective, if a crisis is correlated with lower capital demand as firms cut investments and face higher borrowing costs, companies should reduce leverage and substitute towards more internal financing costs. This reduction in leverage mitigates perceived risk, ensuring future creditworthiness for engaging in new investments as prospects improve. Campello et al. (2010) find evidence that firms planned to dramatically decrease employment,

capital investments, technology spending, and marketing expenditures in 2009. Further, they note that firms financed attractive investments by relying on internally generated cash or cash reserves. Additionally, Bliss et al. (2015) observe that firms benefit from cash retention and therefore substitute external to internal capital by cutting dividend payments and share repurchases during the financial crisis. Likewise, Luo and Tian (2022) note that firms had high precautionary corporate cash holdings and held back from dividend payout since the outbreak of the COVID-19 pandemic.

Given that a crisis is associated with increasing uncertainty about future business prospects, higher information asymmetry, and a rise in default probabilities, lenders will significantly decrease credit supply and increase the premium at which they are willing to lend. Cornett et al. (2011) demonstrate that banks managing the liquidity crisis resulted in a lower credit supply. This supports the findings of Campello et al. (2010) that CFOs experienced difficulties initiating or renewing credit lines. Similar to the financial crisis, Beck and Keil (2022) observe that despite aggressive measures by central banks, the COVID-19 pandemic significantly deteriorated bank lending in the U.S. Furthermore, O'Hara and Zhou (2021) observe a COVID-19 corporate bond liquidity crisis, higher transaction costs, and decreased transaction volumes. In addition, uncertainty and higher costs make long-term debt less attractive than short-term debt so firms may choose to deleverage and reduce their debt maturity (Campello et al., 2010; Demirgüç-Kunt et al., 2020). The capital structure model of Brunnermeier and Oehmke (2013) proposes that increased volatility incentivizes firms to shorten their debt maturity, despite high-roll over costs of short-term debt. Contrary, Diamond and He (2014) suggest that firms should lengthen their debt maturity as high-roll over costs of short-term debt increase during a crisis. Although the value of short-term debt is less vulnerable to future investment opportunities and can help alleviate the underinvestment problem associated with debt, Duchin et al. (2010) note that companies with more short-term debt or lower cash holdings before the financial crisis experienced a larger decline in corporate investments. Subsequently, Demirgüç-Kunt et al. (2020) observe a prevailing deleveraging trend, which corresponds with a decline in long-term debt financing. Consequently, most studies find that a decrease in credit supply and demand causes firms to deleverage, rely more on internally generated funds, and prioritize short-term borrowing.

3 Methodology

3.1 Database

The firm-level data are retrieved from Refinitiv, Capital IQ and CRSP/Compustat merged (CCM) annual databases. The sample consists of U.S. firms from 2002 to 2022, as the firm-level ESG ratings provided by the Refinitiv database started in 2002 and have been widely used in related studies over the past several decades. For example, using this database, Halbritter and Dorfleitner (2015) examine the connection between firms' social performance and financial performance, while Dai et al. (2021) explore whether socially responsible consumers can drive suppliers towards socially responsible behavior.

The Refinitiv database contains over 630 ESG scores, each ranging from 0 to 100. Among these ratings, the most comprehensive ESG score, the ESG combined (ESGC) score, is chosen as the main indicator to measure whether and when firms obtain ESG ratings. This ESGC score is an overall score that considers both positive and negative ESG aspects. In the robustness section, the normal ESG score, which does not take controversies into account, is used to ensure the validity of the results. CCM database provides annual accounting data to describe firm characteristics, and Capital IQ is used to obtain debt structure information.

3.2 Sample Selection

The sample initially consists of 6,526 firms and 76,742 firm-year observations before performing the standard data cleaning process, summarized in Table 1. Observations that meet the following conditions are dropped. Utility firms (sic 4000-4049) and financial institutions (sic 6000-6999) due to special regulations (1). Observations with a total asset value (2) or total debt value (3) missing or zero. Similar to Colla et al.(2013), observations whose book leverage or market leverage was outside the unit circle [0,1] (4). Observations for fiscal years later than 2022 are dropped due to missing firm-level ESG ratings (5). Observations where the number of shares outstanding, the closing price (6), the operating income before depreciation, the property plant and equipment, or the sales values are missing or zero (7), are dropped to obtain clean firm characteristics. Additionally, the top and bottom 0.5% are winsorized to ensure the analysis is not influenced by outliers. The final dataset consists of 4,289 unique firms and 39,815 firm-year observations. The debt capital structure information provided by Capital IQ is not on a firm-year basis and was therefore only obtained for the final sample due to data processing reasons. About 2.82 million quarterly debt-instrument observations are consolidated on a firm-quarter basis and matched with the final sample using the fiscal year reporting date.

Table 1
The number of remaining firms and firm-year observations.

	Firm			Firm-year observations		
Process	With	Without	Total	With	Without	Total
After merging	2,265	4,261	6,526	13,987	62,755	76,742
(1) Drop, non-common firms	1,852	3,103	4,955	11,209	42,058	53,267
(2) Drop, if assets =. or =0	1,852	3,091	4,943	11,209	41,977	53,186
(3) Drop, if debt =. or =0	1,811	2,910	4,721	9,810	34,135	43,945
(4) Drop, if bl (ml) <0 or >1	1,798	2,904	4,702	9,608	33,712	43,320
(5) Drop, if fiscal year > 2022	1,796	2,833	4,629	9,535	31,441	40,976
(6) Drop, if shares outstanding or closing price =. Or =0	1,796	2,829	4,625	9,588	31,710	41,298
(7) Drop, if operating income before depreciation, PPE, sales =. or =0	1,641	2,648	4,289	9,018	30,797	39,815
Winsor 0.5% and 99.5%	1,641	2,648	4,289	9,018	30,797	39,815

Notes: This table illustrates the data-cleaning procedure. Conditions for dropping observations are described in the first column. The second to fourth columns introduce the number of rated firms, non-rated firms, and total firms, respectively. The fifth to seventh columns indicate how many firm-year observations with ESGC scores, without ESGC scores, and in total, remain.

3.3 Descriptive Statistics of the Full Sample

The main variables are categorized into three groups: debt structure, ESG, and control variables. Definitions and sources of each variable are provided in Table A.1, while detailed descriptive statistics are presented in Table 2.

Firms' overall leverage ratios are evaluated using book leverage and market. Book leverage and market leverage are calculated by dividing long-term debt by the book value of assets and the market value of assets, respectively. For the full sample, the average book leverage is 23.6%, and the average market leverage is 16.2%.

Additionally, the overall debt structure is assessed using bank debt and public debt ratios, with six debt ratios providing specific debt information. Following the work of Lin (2016) and Colla et. al (2013), public debt is defined as the sum of senior bonds and notes and subordinated bonds and notes. Bank debt equals the sum of revolving credit and term loans. Together, these two financing types account for 92.9% of total debt, indicating that companies primarily rely on them, consistent with findings by Lin (2016) and Asimakopoulos et al. (2023).

The bank debt ratio of 56.0%, which exceeds the public debt ratio of 36.9%, indicates a tendency among firms in the sample to rely more on bank debt. Following Colla et al. (2013), the six detailed debt ratios are used to assess the companies' preferences for various debt types. The summary statistics align with those of Colla et al. (2013), who also use Capital IQ to evaluate firms' debt structures. Term loans and senior bonds and notes are the most preferred debt types in the sample, comprising 36.8% and 34.4% of total debt, respectively.

ESG variables are used to determine whether and when firms become rated. Following the work of Asimakopoulos et al. (2023), the natural logarithm of the ESG combined score (Ln(ESGC))

serves as the main indicator, taking a value of zero if companies are not rated in the respective year, as Refinitiv data does not include an ESG combined score of zero, ensuring no artificially low ESG scores are created. To ensure the results remain valid, the robustness section will incorporate an alternative ESG score and an ESG dummy variable. Additionally, control variables include firm characteristics such as the natural logarithm of assets, market-to-book ratio, the natural logarithm of sales, tangibility, profitability, R&D expense, SGA cost, dividend payment, and sales-to-asset ratio.

Table 2
Descriptive statistics (full sample).

	N	Mean	Median	P5	P25	P75	P95	Std. Dev.
Leverage metrics								
Market leverage	39,815	0.162	0.124	0.002	0.042	0.238	0.475	0.187
Book leverage	39,815	0.236	0.209	0.004	0.083	0.344	0.596	0.150
Primary debt ratios								
Bank debt ratio	28,073	0.560	0.517	0.013	0.167	0.931	1.000	2.357
Public debt ratio	28,073	0.369	0.301	0.000	0.000	0.712	0.950	0.383
Supplementary debt ratios								
Commercial paper ratio	28,073	0.009	0.000	0.000	0.000	0.000	0.050	0.044
Revolving credit ratio	28,073	0.192	0.023	0.000	0.000	0.268	0.955	0.301
Term loans ratio	28,073	0.368	0.202	0.000	0.000	0.627	1.000	2.357
Senior bond notes ratio	28,073	0.344	0.215	0.000	0.000	0.685	0.941	0.380
Subordinated bond notes ratio	28,073	0.025	0.000	0.000	0.000	0.000	0.150	0.115
Other debt ratio	28,073	0.023	0.000	0.000	0.000	0.001	0.105	0.365
ESG indicators								
Ln (ESGC)	39,815	0.787	0.000	0.000	0.000	0.000	3.929	1.478
Firm control characteristics								
Assets	39,815	7.200	7.280	3.323	5.722	8.746	10.783	2.222
Market-to-book ratio	39,815	3.868	2.065	0.265	1.183	3.735	11.908	7.282
Sales	39,815	6.739	6.997	2.305	5.290	8.423	10.419	2.448
Tangibility	39,815	0.546	0.426	0.050	0.195	0.827	1.315	0.439
Profitability	39,815	0.107	0.101	0.000	0.043	0.154	0.258	0.084
R&D expense	39,815	0.822	0.001	0.000	0.000	0.054	1.087	5.803
SGA cost	39,815	0.450	0.182	0.000	0.078	0.344	1.031	1.623
Dividend	39,815	0.504	1.000	0.000	0.000	1.000	1.000	0.500
Sales-to-asset ratio	39,815	0.895	0.723	0.106	0.406	1.186	2.261	0.709

Notes: This table shows descriptive statistics for the full sample. Data is retrieved from CCM, Capital IQ, and Refinitiv databases between 2002 and 2022. Variables are split into leverage metrics, primary and supplementary debt ratios, ESG indicators, and firm control characteristics. N denotes the number of firm-year observations.

4 Empirical Data Analysis and Main Results

4.1 Model

First, the target optimal leverage ratio is defined to estimate whether a firm's target (optimal) leverage ratio and actual leverage ratio are affected by whether the firm is ESG-rated before and after the crisis. Similar to Bae et al. (2011) and Im et al. (2020), the initial target leverage ratio is defined as:

$$d_{i,t}^{*} = \alpha + B'X_{i,t} + \eta_i \tag{1}$$

The target leverage ratio $d_{i,t}^{*}$ depends on several firm characteristics $X_{i,t}$. Building on the work of Bae et al. (2011) and Huang and Shang (2019), the firm characteristics include the book value of total assets, the market-to-book ratio, sales, tangibility, profitability, R&D expenses, SGA expenses, dividend payment, and sale-to-asset ratio. Following Asimakopoulos et al. (2023), the ESG rating is also incorporated as a firm characteristic and takes the actual ESGC score when the firm is rated, and zero otherwise. Similar to Im et al. (2020), introducing η_i in Eq. (1) allows the fixed effects to affect the firm's target leverage ratio. Assuming that firms partially adjust to a long-term target leverage ratio (Flannery and Rangan, 2006; Bae et al., 2011; Im et al., 2020), the partial adjustment model is defined as:

$$d_{i,t} - d_{i,t-1} = \lambda\left(d_{i,t}^{*} - d_{i,t-1}\right) + \gamma_t + \nu_{i,t} \tag{2}$$

$d_{i,t} - d_{i,t-1}$ indicates the real debt ratios of company i in time t and time t−1. The term on the right-hand side $\left(d_{i,t}^{*} - d_{i,t-1}\right)$ represents the variation between the previous debt level and the target debt level, while λ represents the speed of adjustment. The error term for firm i at time t is $\nu_{i,t}$, and the year-fixed effects are reflected by γ_t. By inserting Eq. (2) into Eq. (1), Eq. (3) is obtained:

$$d_{i,t} = \lambda\alpha + (1-\lambda)d_{i,t-1} + B'X_{i,t} + \lambda\eta_i + \gamma_t + \nu_{i,t} \tag{3}$$

In Eq. (3), the debt ratio of firm i at time t is influenced by several factors, including the firm's previous period debt ratio, several firm characteristics as well as year and firm-specific effects. To simplify the equation, the coefficients in Eq. (3) are replaced by a set of βs, resulting in the main regression model Eq. (4):

$$d_{i,t} = \beta_0 + \beta_1 d_{i,t-1} + B'X_{i,t} + \Theta_i + \gamma_t + \nu_{i,t} \tag{4}$$

In Eq. (4), the dependent variable represents the actual debt ratio of firm i at time t, which is initially approximated by the firm's book leverage and market leverage ratios. Accordingly, whether companies that are ESG-rated have a lower or higher leverage ratio compared to firms

that are not ESG-rated can be determined. Furthermore, firms' bank and public debt ratios are used as dependent variables to estimate if companies that are ESG-rated alter their financing choices and subsequently, their debt structure.

To analyze the conjoined impact of ESG ratings and the crisis, Eq. (4) is extended to run a difference-in-difference regression and simultaneously analyze the impact on the firms' leverage ratios and debt structure. Therefore, Eq. (5) is applied:

$$d_{i,t} = \beta_0 + \beta_1 d_{i,t-1} + B' X_{i,t} + \partial_1 ESG_{i,t} + \partial_2 Crisis_{i,t} + \partial_3 (ESG_{i,t} x Crisis_{i,t}) + \Theta_i + \gamma_t + \nu_{i,t} \quad (5)$$

In Eq. (5), the dependent variable represents the firms' actual debt ratio, proxied by a firm's book leverage, market leverage, bank debt ratio, and public debt ratio. Additionally, terms for the firm's ESG rating, a dummy variable that takes the value one if the observation is in the crisis period (2020-2022), and an interaction term are included. These terms capture the individual effects of ESG ratings and the crisis period, as well as their interactive impact on leverage ratios. The model also controls for firm characteristics as well as firm and year-fixed effects to account for heterogeneity issues across firms and time.

4.2 Main Results

4.2.1 Target Leverage Ratio

To determine whether the target (optimal) leverage ratios are affected by becoming ESG-rated, the optimal leverage ratios are compared across different periods. Following De Jong et al. (2011) and using Eq. (1), the optimal leverage ratio is determined by the predicted values obtained from regressing market and book leverage, as well as bank debt and public debt ratios, on firm characteristics.

For the entire period, the optimal book leverage ratio reduces from 23.7% to 22.8% with a statistically significant magnitude of 4%, as shown in Table 3. Similarly, the optimal market leverage ratio reduces from 16.8% to 14.2%, with a statistically significant magnitude of 15.5%. This pattern is consistent across all time spans for both optimal book and market leverage ratios. The main driver of these results is investor preferences. Firms expand their operations by looking for new investment opportunities and using both external and internal financing. Investors have different preferences when assessing these opportunities and may be more willing to lend to companies that act responsibly. Findings by Hong and Kacperczyk (2009) indicate that institutional investors screen out "sin" stocks, while Dhaliwal et al. (2011) find that superior ESG performance appeals to institutional investors. Additionally, Flammer (2021) shows that companies use the announcement of corporate green bonds to attract investors.

Consequently, the findings indicate that firms that become ESG-rated use this as a signal to attain a broader investor base and ultimately benefit from lower borrowing constraints.

Table 3
T-test of optimal leverage and debt ratios before and after being rated.

	Before rated	After rated	T-test
Book leverage			
Entire period (2002-2022)	0.237	0.228	-5.182***
Pre-Crisis period (2002-2019)	0.236	0.230	-2.994***
Post-Crisis period (2020-2022)	0.241	0.224	-5.214***
Market leverage			
Entire period (2002-2022)	0.168	0.142	-18.445***
Pre-Crisis period (2002-2019)	0.169	0.148	-11.194***
Post-Crisis period (2020-2022)	0.168	0.133	-13.627***
Bank debt ratio			
Entire period (2002-2022)	0.531	0.531	-0.033
Pre-Crisis period (2002-2019)	0.534	0.501	-5.905***
Post-Crisis period (2020-2022)	0.518	0.581	7.762***
Public debt ratio			
Entire period (2002-2022)	0.379	0.323	-12.284***
Pre-Crisis period (2002-2019)	0.389	0.377	-2.148**
Post-Crisis period (2020-2022)	0.332	0.234	-12.253***

Note: This table presents the t-statistics for companies' target market leverage, book leverage, bank debt, and public debt ratios before and after obtaining ESG ratings. The optimal ratio refers to the forecasted value (residuals) obtained from regressing leverage and debt ratios on firm characteristics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Using an ESG rating to benefit from reduced information asymmetries would also explain the significant decrease in both optimal bank debt and public debt ratios after becoming rated in the pre-crisis period. While the optimal public debt ratio also significantly decreases on average from 33.2% to 23.4% in the post-crisis period following an ESG rating, the optimal bank debt ratio significantly increases on average from 51.8% to 58.1%. This suggests that becoming rated could have different implications for corporate financing decisions depending on the economic environment.

According to the pecking-order theory, companies prefer rather internal sources of funding. Since bank debt is considered more internal compared to public debt due to more private information (James, 1987), ESG ratings should favor firms' access to bank debt due to lower information asymmetries. Additionally, ESG-rated companies are more favorable borrowers due to decreased bank monitoring costs, better growth opportunities, and greater earnings stability (Bacha and Ajina, 2019; Gos and Roberts, 2011; Mishra and Modi, 2013). According to Albuquerque et al. (2020), higher ES scores correlate with greater investor loyalty and lower return volatility, leading to higher resilience during the COVID-19 pandemic. Likewise, Sharfman and Fernando (2008) observe a shift from equity to debt capital for companies with

improved environmental risk management. Thus, an ESG rating should be a valuable signal, even during a crisis, enabling firms to restructure their debt composition according to their needs.

To analyze whether the crisis affects the optimal leverage and debt ratios, regardless of whether the companies become ESG-rated, the same analysis was conducted for the full sample. The results in Table 4 show that the optimal book (market) leverage ratio significantly decreases from 24.8% (18.0%) to 23.9% (15.7%) following the crisis, indicating that the crisis significantly impacts firms' financing decisions. While investor preferences and information asymmetries explain the differences between rated and non-rated companies, the observable pattern when comparing pre-and post-crisis leverage ratios can be attributed to shifts in credit demand and supply factors. Credit supply decreases during economic uncertainty due to a rise in default probabilities. Similarly, credit demand decreases due to increasing term premia and a preference for short-term debt, leading to a deleveraging trend (Demirgüç-Kunt et al., 2020). Thus, the findings align with the expectation of decreasing leverage ratios.

Table 4
T-test of optimal leverage and debt ratios pre- and post-crisis.

	Pre-Crisis (2002-2019)	Post-Crisis (2020-2022)	T-test
Book leverage	0.248	0.239	-3.691***
Market leverage	0.180	0.157	-10.525***
Bank debt ratio	0.528	0.541	2.756***
Public debt ratio	0.387	0.297	-20.180***

Note: This table presents the t-statistics for companies' pre- and (post-crisis target leverage and debt ratios. The optimal leverage and debt ratios refer to the forecasted value (residuals) obtained from regressing leverage and debt ratios on firm characteristics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Additionally, Table 4 shows that the optimal bank leverage significantly increases from 52.8% to 54.1% while the optimal public leverage significantly decreases from 38.7% to 29.7%. This pattern could result from companies relying more on bank debt rather than public debt due to increased capital constraints and decreased credit supply in the post-crisis period. Beck and Keil (2022) observe a negative impact of the pandemic on the credit supply in the U.S., while Campello et al (2010) show that companies pass on investment opportunities due to higher borrowing constraints during the global financial crisis. Consequently, Bliss et al. (2015) find that credit supply and demand factors lead to a shift towards more internal funding. Thus, the observed results for optimal bank and public debt ratios are aligned with the expected trend of lower optimal leverage ratios and a shift towards bank debt.

In summary, the analysis demonstrates that ESG ratings significantly influence firms' optimal leverage ratios and debt structures, with varying impacts before and after the crisis. To better understand the mechanisms driving these differences between ESG-rated and non-rated firms, as well as the variations observed pre- and post-crisis, the upcoming chapters will explore the role of asymmetric information and the impact of the crisis on firms' financing decisions.

4.2.2 Asymmetric Information

Becoming ESG-rated could serve as a valuable signal to investors and the market, particularly in the context of asymmetric information. Firms with superior ESG ratings can reduce their capital constraints due to lower information asymmetries (Cheng et al., 2014). Most studies focus on the benefits firms receive from having existing ESG ratings, rather than exploring how companies might use their ESG ratings to enhance those benefits. Therefore, comparing firm-specific proxies for information asymmetries before and after they are rated can indicate whether firms use their ESG rating as a signal to decrease information asymmetries.

Using the approach of Javakhadze et al. (2014), the natural logarithm of total assets and intangible assets scaled by total assets are used as proxies for firm size, while the standard deviation of EBITDA over total assets is used to measure earnings volatility. Firms might use the ESG rating as a signal of corporate stability, bright investment prospects, and high ethical standards. Therefore, it is expected that firms increase in size and share of intangible assets while decreasing earnings volatility once they become ESG-rated.

Table 5
Asymmetric Information and ESG ratings before and after being rated.

	Before rated	After rated	T-test
Asset Size			
Entire period (2002-2022)	7.102	7.540	16.467***
Pre-Crisis period (2002-2019)	7.113	8.015	26.926***
Post-Crisis period (2020-2022)	7.056	6.891	-3.572***
Intangible assets			
Entire period (2002-2022)	0.186	0.218	12.600***
Pre-Crisis period (2002-2019)	0.184	0.228	14.170***
Post-Crisis period (2020-2022)	0.198	0.205	1.445
Sd(EBITDA)			
Entire period (2002-2022)	0.272	0.266	-1.731*
Pre-Crisis period (2002-2019)	0.253	0.218	-9.152***
Post-Crisis period (2020-2022)	0.330	0.309	-3.153***

Note: This table presents the t-statistics for companies' asset size, intangible assets scaled by total assets, and standard deviation of EBITDA scaled by total assets before and after obtaining ESG ratings. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Table 5 highlights significant changes in firms' asset size and intangible asset share following the acquisition of ESG ratings, particularly in the pre-crisis period. Specifically, there is a significant increase of 12.7% in asset size and 23.9% in intangible asset share during this period. However, during the post-crisis period, the results show a significant decline of 2.3% in asset size. Additionally, while the effect on intangible assets remains positive post-crisis, it is not statistically significant.

Similar to the rated companies, Table 6 shows that asset size seems to decrease post-crisis for the entire sample. Interestingly, the intangible asset share significantly increases for the entire sample post-crisis, while the ESG rating has no meaningful effect in the same period. This suggests that the signaling effect of sustainable behavior might decrease in the post-crisis period.

Table 6
Asymmetric Information pre- and post-crisis.

	Pre-Crisis (2002-2019)	Post-Crisis (2020-2022)	T-test
Asset Size	7.270	6.992	-10.745***
Intangible assets	0.191	0.201	3.758***
Sd(EBITDA)	0.247	0.322	24.200***

Note: This table presents the t-statistics for companies' pre- and post-crisis asset size, intangible assets scaled by total assets, and EBITDA scaled by total assets. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Regarding financial stability, an ESG rating proves to be a credible signal to the market, even in times of economic uncertainty. Companies in the sample managed to decrease the earnings volatility significantly across all time spans after they became rated, including in the post-crisis period, while the entire sample experienced higher earnings volatility during the same period.

These findings suggest that ESG ratings can help to reduce information asymmetry and improve access to better financing conditions in stable economic times. They also help to signal corporate stability during economic uncertainty. During the COVID-19 pandemic, firms with better ESG performance demonstrated greater resilience due to higher stock returns and lower return volatility (Garel and Petit-Romec 2021, Albuquerque et al. 2020). Supporting the findings of Garel and Petit-Romec (2021), which suggest that investors reward climate responsibility more after the COVID-19 crisis, the greater corporate stability associated with ESG ratings appears to be valued by investors. Therefore, even when economic conditions change, ESG ratings continue to reduce information asymmetries and serve as a valuable signal for investors.

4.2.3 Financing Decisions

A crisis not only affects credit supply and demand directly, but also influences the capital structure decisions and financing choices of the affected companies indirectly. Lower credit supply during a crisis may increase the marginal benefit of cash retention, leading firms to decrease leverage ratios and opt for more internal financing.

The findings in Table 7 show a significant decrease of 26.7% in the natural logarithm of dividend payments, consistent with the findings of Bliss et al. (2015), who observe that firms substantially reduce corporate payouts, such as dividends, in the post-crisis period. This supports the hypothesis that companies utilize these measures for internal financing during credit supply disruptions. However, there is insufficient evidence to suggest a significant reduction in share repurchases, possibly indicating the firms' intention to signal stability and confidence while utilizing internally generated funds for operations.

Cash holdings significantly rise post-crisis, from 11.4% to 19.5%, indicating that firms adopt a cautious approach. This aligns with the concept proposed by Duchin et al. (2010) that companies may adopt a precautionary motive during crises, leading to increased cash holdings. The results show a significant decrease of 28.7% in the natural logarithm of retained earnings. In line with the pecking order hypothesis, firms are expected to prioritize retained earnings over debt and external equity. While companies may delay discretionary capital expenditures, potentially increasing retained earnings, they often rely on internal funds to offset reduced revenue and rising costs. The findings suggest that firms turn to internal funds post-crisis, with external capital becoming less appealing due to increased capital constraints. Moreover, the results indicate a significant decrease of 17.3% in the average debt maturity, primarily driven by a significant decline in the long-term debt ratio from 86.1% to 82.5%. These findings support the predictions of the capital structure model proposed by Brunnermeier and Oehmke (2013), wherein firms choose to shorten the debt maturity in the post-crisis period, despite the high roll-over costs of short-term debt.

Table 7
Corporate financing measures pre- and post-crisis.

	Pre-Crisis (2002-2019)	Post-Crisis (2020-2022)	T-test
Average Debt Maturity	1.238	1.024	-13.010***
Ln(Retained Earnings)	4.175	2.976	-29.340***
Cash holdings	0.114	0.195	43.522***
Ln(Dividend)	2.132	1.562	-18.766***
Share repurchases	0.020	0.020	0.387
Long-term Debt ratio	0.861	0.825	-15.245***

Note: This table presents the t-statistics for companies' pre- and post-crisis financing measures. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Consequently, firms choose to rely on internally generated funds by cutting corporate payouts and investing through retained earnings. They increase cash holdings due to a precautionary motive and decrease long-term debt holdings, resulting in a shortened debt maturity.

To investigate whether changes in optimal bank debt and public debt ratios are attributable to shifts in debt composition, six specific debt ratios are compared before and after the crisis. Despite a prevailing deleveraging trend, different trends for the debt composition of public and bank debt sources can be observed. Senior and subordinated bonds and notes both experience significant decreases post-crisis declining from 35.6% to 29.0% and 2.8% to 0.5%, respectively. This trend aligns with an expected deleveraging trend, as suggested by Demirgüç-Kunt et al. (2020). Regarding the impact of the COVID-19 pandemic, O'Hara and Zhou (2021) suggest that it caused a liquidity crisis with supply-and-demand-side issues, resulting in a deteriorating corporate bond market alongside higher transaction costs and lower trading volume. Thus, the findings resonate with the challenges faced by the corporate bond market during the crisis.

Furthermore, the bank debt ratio decreases from 54.4% to 48.4% post-crisis. While the revolving credit ratio dropped significantly from 20.9% to 12.5%, the term loans ratio exhibited a significant increase from 33.5% to 35.5%. Although the overall results support a prevailing deleveraging trend, insights from the pecking order theory and optimal bank leverage ratios suggest a potential preference for increased bank leverage. One plausible explanation is the challenge companies face in accessing short-term funds during a crisis, leading to difficulties in increasing revolving credit lines. This claim finds support in the significantly declining commercial paper ratio. The findings resonate with research by Çolak and Öztekin (2021), who note adverse effects on bank credit supply due to the COVID-19 pandemic, as well as studies by Ivashina and Scharfstein (2010) and Cornett et al. (2011), which highlight deteriorating bank lending conditions during financial crises. Additionally, CFOs encountered hurdles in initiating or renewing credit lines (Campello et al., 2010).

Table 8
Debt instruments pre- and post-crisis.

	Pre-Crisis (2002-2019)	Post-Crisis (2020-2022)	T-test
Term loans ratio	0.335	0.355	3.967***
Commercial paper ratio	0.009	0.003	-11.269***
Revolving credit ratio	0.209	0.125	-19.610***
Senior bonds & notes ratio	0.356	0.290	-12.818***
Sub bonds & notes ratio	0.028	0.005	-15.439***
Other debt ratio	0.019	0.014	4.919***

Note: This table presents the t-statistics for companies' pre- and post-crisis target market and book leverage ratios. The optimal leverage ratio refers to the forecasted value (residuals) obtained from regressing leverage ratios on firm characteristics. 1%, 5% and 10% significance levels are denoted by ***, ** and * respectively.

In conclusion, the evidence supports a prevailing deleveraging trend post-crisis. Contrary to expectations suggested by the pecking-order theory and optimal bank and public debt ratios, evidence for a significant shift from public to bank debt ratios was not found. This is likely attributable to deteriorating bank lending conditions rather than firm financing choices. These findings suggest that the mix of market conditions and external factors can play a role in shaping how companies choose their debt during challenging times.

4.2.4 ESG Influence on Debt Structure

This chapter evaluates how companies with and without ESG ratings differ in their actual debt structure and leverage ratios. The impact of obtaining an ESG rating on firms' debt structure and leverage ratios is analyzed by using Eq. (4). Therefore, the ESG coefficient serves as a difference-in-difference estimator in this empirical study. Table 9 presents the results of regressing firms' book and market leverage ratios as well as bank and public debt ratios on ESG ratings and control characteristics while controlling for firm and year-fixed effects.

It should be acknowledged that obtaining an ESG rating may often not be an event exogenous to the firms. As such, the difference-in-difference estimation, though informative, should not be interpreted causally. This is discussed further in section 4.3.

The results indicate that obtaining an ESG rating has a significant negative effect on firms' market and book leverage ratios. Specifically, an increase in the natural logarithm of the ESGC score by one unit leads to an average decrease of the market (book) leverage ratios by 0.32% (0.18%). Existing literature predominantly explores the relationship between sustainable behavior and various financial factors such as firm risk, asymmetric information, and the cost of capital. While sustainable behavior has been shown to have a negative effect on systematic risk (El Ghoul et al., 2016), credit risk (Jiraporn et al., 2014), and downside risk (Hoepner et al., 2019), other research suggests that it can also affect the cost of capital by reducing information asymmetries. For instance, El Ghoul et al. (2011) note that firms with higher CSR scores exhibit cheaper equity financing, while Zerbib (2019) finds that green bonds have a negative premium compared to conventional bonds.

The existing literature generally indicates a negative correlation between ESG-friendly behavior and the cost of capital. Likewise, most studies indicate a negative correlation between sustainable behavior and leverage ratios, while some studies deviate from this trend. Notably, Bae et al. (2011) find a significant negative effect of employee treatment on leverage and Huang and Shang (2019) observe a negative relationship between social behavior and leverage. Likewise, Buchanan et al. (2018) report a significant negative correlation between CSR and

leverage ratios. Conversely, Asimakopoulos et al. (2023) do not observe a significant effect of ESG ratios on actual leverage ratios. Consequently, the research contributes to the existing literature by highlighting that obtaining an ESG rating can substantially influence firms' financing decisions and capital structure.

Table 9
Regression of leverage and debt ratios on ESGC scores (full sample).

	(1) Market leverage	(2) Book leverage	(3) Bank debt ratio	(4) Public debt ratio
Ln(ESGC)	-0.0032***	-0.0018**	-0.0015	-0.0066*
	(-6.072)	(-2.530)	(-0.941)	(-1.835)
Market leverage (t-1)	0.3342***			
	(82.360)			
Book leverage (t-1)		0.3492***		
		(82.821)		
Bank debt ratio (t-1)			0.5850***	
			(103.876)	
Public debt ratio (t-1)				0.6095***
				(113.843)
Ln(asset)	0.0190***	-0.0009	-0.0132**	0.0216***
	(10.243)	(-0.351)	(-2.167)	(3.841)
Market-to-book ratio	-0.0004***	0.0015***	-0.0004**	0.0005***
	(-6.403)	(16.289)	(-2.022)	(2.588)
Ln(sales)	0.0096***	0.0217***	-0.0139**	0.0074
	(5.617)	(9.527)	(-2.449)	(1.423)
Tangibility	0.0584***	0.0604***	-0.0308***	0.0230***
	(20.980)	(16.388)	(-3.767)	(3.058)
Profitability	-0.3100***	-0.1903***	0.0652**	-0.0252
	(-34.932)	(-16.205)	(2.364)	(-0.994)
R&D expense	0.0000	0.0002	0.0007	-0.0005
	(0.086)	(1.322)	(0.039)	(-0.913)
SGA cost	-0.0006	0.0011*	-0.0066***	0.0063
	(-1.219)	(1.660)	(-3.523)	(3.632)
Dividend	0.0050***	-0.0006	0.0085**	-0.0037
	3.455	(-0.311)	(2.060)	(-0.989)
Sales-to-assets	-0.0291***	-0.0462***	0.0197***	-0.0201***
	(-13.137)	(-15.724)	(2.902)	(-3.222)
Intercept	-0.0868	-0.0046	0.3727***	0.0134
	(-1.517)	(-0.061)	(2.934)	(0.115)
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,535	35,535	23,167	23,167
Adjusted R^2	0.773	0.737	0.805	0.828

Notes: This table shows the regressions of market leverage, book leverage, bank debt, and public debt ratios on the ESG combined score and various control characteristics. The dependent variables are market leverage, book leverage, bank debt ratio, and public debt ratio in columns (1) to (4) respectively. For each regression, control variables, firm- and year-fixed effects are included. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

In line with prior findings, this study indicates that firms adjust their market and book leverage ratios over time, with a speed of adjustment of 66.58% and 65.08%, respectively. Additionally, control characteristics suggest that more profitable firms tend to have lower leverage ratios due

to their enhanced internal financing capabilities, while firms with asset-heavy operations exhibit higher leverage ratios owing to the greater capital intensity of their operations.

To assess whether ESG-rated firms tend to adjust their financing sources and alter their debt structures, the effect of ESG ratings on bank and public debt ratios of companies is examined, as detailed in columns (3) and (4) of Table 9. While there is no significant effect of ESG ratings on the level of bank debt, rated firms, on average, seem to significantly decrease their reliance on public debt. Particularly, an increase in the natural logarithm of the ESGC score by one unit leads to a significant decrease in the public debt ratio by 0.66%. These findings contribute to the literature examining the cost of debt capital of socially responsible firms. For instance, Flammer (2021) argues that corporate green bonds possess a credible signaling effect. Additionally, related research findings suggest that corporate bonds of ESG-rated companies have lower bond yields and reduce the cost of debt (Zerbib, 2019; Apergis, 2022; Oikonomous et al., 2014; Polbennikov et al., 2016). Thus, the findings support the claim that firms gain better access to bond financing through reduced information asymmetries and a broader investor base once they become ESG-rated.

Prior studies have also explored firms' choices between public debt and bank debt. They find that firms with higher credit quality prefer borrowing from public sources (Denis and Mihov, 2003; Arena, 2010). Given that ESG/CSR considerations can result in more favorable bond ratings (Jiraporn et al., 2014), an ESG rating is likely to have a greater impact on public capital. This suggests that firms with stronger ESG performance may prioritize accessing public debt markets due to their enhanced credit quality, while the impact on bank debt remains limited.

In conclusion, the results suggest that firms obtaining an ESG rating adjust their capital structure by reducing book and market leverage ratios while also benefiting from lower capital constraints. Additionally, there is a notable decrease in reliance on public debt, indicating a shift in financing preferences among ESG-rated firms.

4.2.5 ESG and Crisis Effect on Debt Structure

This chapter examines how ESG ratings and the recent crisis affect firms' debt structures, focusing on leverage ratios and the composition of debt. Previous results suggest that obtaining an ESG rating significantly impacts firms' optimal leverage ratios and debt structures. However, the crisis might also play a crucial role in shaping these financing choices. Thus, it is essential to assess the interaction between ESG ratings and crises in altering firms' debt structures.

To capture these effects, a difference-in-difference regression is employed using a subsample of companies from 2017 to 2022, as this method necessitates parallel trends before the analyzed

event. Eq. (5) estimates the impact of ESG ratings, the crisis, and their interaction on firms' leverage ratios and debt structures, controlling for firm characteristics, firm-fixed effects, and year-fixed effects.

Supporting the previous observations, the difference-in-difference results, presented in Table 10, show that obtaining an ESG rating can be associated with a deleveraging trend. Specifically, firms with an ESG rating reduce market leverage by 0.38% and book leverage by 0.25%. This is likely driven by firms using their ESG rating to signal reduced risk, greater financial stability, and to attract more investors (Gillan et al., 2021). These results align with Huang and Shang (2019), who found a negative correlation between social capital and leverage, and Bardos et al. (2020), who observed a similar negative relationship between environmental CSR and leverage ratios.

Table 10

Difference-in-difference regression of leverage and debt ratios on ESGC scores and crisis variable.

	(1) Market leverage	(2) Book leverage	(3) Bank debt ratio	(4) Public debt ratio
Ln(ESGC)	-0.0038***	-0.0025***	-0.0009	-0.0004
	(-3.803)	(-2.869)	(-0.219)	(-0.131)
Post-crisis	-0.0126***	-0.0078***	-0.0883***	-0.0196***
	(-8.338)	(-3.727)	(-19.231)	(-5.274)
Ln(ESGC) x Post-crisis	-0.0025***	-0.0019***	0.0003	-0.0044**
	(-3.550)	(-2.004)	(0.159)	(-2.398)
Control variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	14,860	14,860	9,152	9,152
Adjusted R^2	0.839	0.793	0.822	0.877

Notes: This table shows the difference-in-difference regressions results of market leverage, book leverage, bank debt, and public debt ratios on the ESG combined score and the crisis. For each regression, control variables, firm- and year-fixed effects are included. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Furthermore, the crisis significantly impacts corporate leverage ratios and debt composition. Consistent with Demirgüç-Kunt et al. (2020), the crisis leads to a significant decrease in book (0.78%) and market leverage ratios (1.26%). This deleveraging trend seems to be driven by reductions in both bank and public debt ratios. The decrease in bank debt can be attributed to a significant reduction in bank lending post-crisis (Beck and Keil, 2022; Çolak and Öztekin, 2021), while the decline in bond debt might be due to a deteriorating corporate bond market with increased transaction costs and lower transaction volume during the pandemic (O'Hara and Zhou, 2021).

The interaction term between ESG ratings and the post-crisis period provides additional insights. The significant negative coefficients for both market and book leverage indicate that

ESG-rated firms further reduce their leverage in the post-crisis period. This suggests that firms with sustainable practices adopt more conservative financing strategies in uncertain times, maintaining lower risk profiles to signal greater financial stability to investors. Although ESG ratings do not significantly affect the proportion of bank debt, the significant negative interaction term for public debt ratio shows that ESG-rated firms decrease their reliance on public debt more than other firms during such periods.

These findings demonstrate that firms with ESG ratings adopt more conservative leverage strategies, specifically by reducing both market and book leverage, and particularly public debt, in the post-crisis period. This approach helps maintain financial stability and leverage ESG ratings to attract investors even in challenging economic conditions. The results remain valid even when the period 2020-2021 is considered the post-crisis period, as shown in Table A.7.

4.3 Endogeneity

Endogeneity is a significant challenge in corporate finance studies, often leading to biased and unreliable parameter estimates (Wintoki et al., 2012; Roberts and Whited, 2013). Several factors contribute to endogeneity concerns in the study. These include firm-specific differences, potential biases from omitted variables, the use of current independent variable values influenced by past values of the dependent variable (leverage ratios), and the possibility of reverse causality (simultaneity) between leverage and ESG rating.

These concerns will be addressed through two different estimations. The first estimation will control for the turnover effect while the second will utilize a two-stage least squares (2SLS) approach, integrating an instrumental variable to further control for endogeneity. Each methodology is explained in the respective chapter.

4.3.1 Turnover Effect

The turnover effect captures the response of companies when they receive their initial ESG rating. It assesses whether and how companies alter their leverage ratios and debt structure upon becoming ESG-rated. The independent variable capturing this effect is a dummy variable that equals one in the first year a firm becomes rated and zero otherwise.

Table 11 shows that firms tend to lower their actual market and book leverage ratios, as well as their public debt ratio, once they become rated. Specifically, an initial ESG rating is associated with a 0.39% reduction in market leverage and a 0.56% reduction in book leverage, both statistically significant. Furthermore, the public debt ratio significantly decreases by 1.54%. Compared to the benchmark estimations, the results for book and market leverage are slightly less pronounced but remain statistically significant. In contrast, the reduction in the public debt

ratio is more pronounced than in the benchmark estimations. This emphasizes the immediate impact of obtaining an ESG rating on firms' financing strategies.

In conclusion, these findings suggest that firms adjust their leverage ratios and debt composition immediately, benefiting from lower perceived risk, a broader investor base, and lower cost of capital.

Table 11
Regression of leverage and debt ratios on initial ESGC scores (full sample).

	(1) Market leverage	(2) Book leverage	(3) Bank Debt Ratio	(4) Public Debt Ratio
Initial Ln(ESGC)	-0.0039*	-0.0056**	0.0037	-0.0154***
	(-1.798)	(-1.948)	(0.613)	(-2.748)
Market leverage (t-1)	0.3353***			
	(82.575)			
Book leverage (t-1)		0.3497***		
		(82.923)		
Bank debt ratio (t-1)			0.5849***	
			(103.860)	
Public debt ratio (t-1)				0.6097***
				(113.957)
Ln(asset)	0.0188***	-0.0009	-0.0133**	0.0211***
	(10.105)	(-0.382)	(-2.183)	(3.759)
Market-to-Book ratio	-0.0004***	0.0015***	-0.0004**	0.0005***
	(-6.373)	(16.302)	(-2.026)	(2.566)
Ln(sales)	0.0090***	0.0213***	-0.0142**	0.0071
	(5.230)	(9.375)	(-2.515)	(1.358)
Tangibility	0.0582***	0.0603***	-0.0309***	0.0227***
	(20.905)	(16.377)	(-3.781)	(3.021)
Profitability	-0.3104***	-0.1909***	0.0648**	-0.0240
	(-34.954)	(-16.252)	(2.350)	(-0.947)
R&D expense	-0.0000	0.0002	0.0007	-0.0005
	(0.003)	(1.297)	(1.272)	(-0.916)
SGA cost	-0.0007	0.0010	-0.0067***	0.0063***
	(-1.436)	(1.556)	(-3.558)	(3.620)
Dividend	0.0051***	-0.0006	0.0085**	-0.0035
	3.527	(-0.288)	(2.079)	(-0.926)
Sales/assets	-0.0291***	-0.0462***	0.0197***	-0.0204***
	(-13.177)	(-15.719)	(2.901)	(-3.269)
Intercept	-0.0861	-0.0050	0.3766***	0.0207
	(-1.503)	(-0.066)	(2.966)	(0.178)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,535	35,535	23,167	23,167
Adjusted R^2	0.773	0.737	0.804	0.828

Notes: This table shows the regressions of market leverage, book leverage, bank debt, and public debt ratios on the initial ESGC score and various control characteristics. The dependent variables are market leverage, book leverage, bank debt ratio, and public debt ratio in columns (1) to (4) respectively. For each regression, control variables, firm- and year-fixed effects are included. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

4.3.2 Two-Stage Least Squares Estimation

To mitigate additional endogeneity concerns, a 2SLS estimation is being conducted. In the first stage, the industry's historical average ESG combined score is used as an instrumental variable to obtain predicted values for the ESG ratings. In the second stage, these predicted values are utilized in Eq.(4), replacing the actual ESG rating variable. Additionally, control variables, firm-fixed effects, and time-fixed effects are incorporated. Since there is no correlation between the error term of the second-stage estimation and the predicted values from the first-stage estimation, the 2SLS approach ensures the consistency of the derived coefficients.

The actual firm-level ESG scores are likely influenced by the lagged industry-level average ESG scores, justifying the use of this instrumental variable. Firms often monitor trends among competitors and peers within the same industry, affecting their ESG considerations and behavior. Furthermore, the nature of a company's operations within its industry also influences ESG considerations. It is unlikely that a company's debt structure will impact historical industry-average ESG ratings, reducing the probability of correlation between a firm's leverage ratio and its unobservable attributes.

Analyzing the results presented in Table 12, the first-stage regression coefficient shows that the variables used to predict the firm's ESG combined score perform well for market and book leverage as well as bank and public debt ratios. The F-statistic and Sargan test validate the instrumental variable, indicating that it effectively addresses endogeneity concerns.

Table 12
Relationship examination for ESG, leverage, and debt ratios with a 2SLS-IV approach.

	First Stage	Second Stage			
		Market leverage	Book leverage	Bank debt ratio	Public debt ratio
Lag_Ind_Avg_ Ln(ESGC)	0.8682*** (111.280)				
Ln(ESGC)		-0.0610*** (-6.536)	-0.0358*** (-2.887)	0.0553*** (3.500)	-0.0629*** (-4.381)
Controls	Yes	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes
Number of observations	35,505	35,535	35,535	23,167	23,167
F-statistic on instrument	35.78				

Notes: This table uses the Two-Stage Least Squares (2SLS) estimation with the lag of industrial average natural logarithm of ESG rating as an instrumental variable at the first stage. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Supporting the previous findings, the second-stage results confirm a prevailing deleveraging trend and a decreasing public debt ratio. Specifically, a one-unit increase in the natural

logarithm of the ESG score leads to a 6.10% decrease in market leverage and a 3.58% decrease in book leverage. Additionally, while a one-unit increase leads to a 6.29% decrease in the public debt ratio, it results in a 5.53% increase in the bank debt ratio.

Complementing the benchmark estimation results, the 2SLS regression suggests that rated companies shift from public to bank debt. This could be driven by specific supply and demand channels. On the demand side, ESG companies prefer safer funding sources like bank debt due to higher levels of private information (James, 1987). On the supply side, banks are incentivized to attract and retain ESG-rated companies due to decreased monitoring and default costs. While Ilhan et al. (2020) find that irresponsible environmental behavior increases firms' downside risk, higher disclosure levels lead to lower bank monitoring costs. Therefore, the 2SLS regression findings indicate that companies deleverage and adapt their debt composition. The divergence in results between the 2SLS and benchmark regression suggests that the instrumental variable approach employed in the 2SLS model effectively mitigates endogeneity issues, providing more robust and reliable estimates than the benchmark regression.

In summary, the 2SLS estimation reaffirms the deleveraging trend for market and book leverage observed in the benchmark estimations, while also highlighting a notable shift from public to bank debt.

4.4 Robustness Checks

4.4.1 Matched Sample

To ensure that the results are not influenced by the sample imbalance, a matching sample procedure is conducted, employing a Marginal Propensity Score approach. Specifically, a one-to-one matching process is used to assign firms to the treated and control groups. The treated group comprises companies that obtained an ESG rating between 2002 and 2022, while the control group comprises companies that never obtained an ESG rating. The control variables that differ the most between the two groups – market-to-book ratio, tangibility, profitability, R&D expense, SGA cost, and sales-to-assets – are used to match a rated firm from the treated group with the closest comparable firm in the control group.

The matched sample comprises 18,036 firm-year observations, 9,018 firm-year observations with and 9,018 firm-year observations without firm-level ESG ratings. The descriptive statistics for both the full sample and the matched sample show substantial similarities, as illustrated in Table 2 and Table A.2, respectively. While the empirical analysis is based on the full sample,

the matched sample is used to perform a robustness check and ensure that the results and key findings remain valid.

Table 13
Regression of leverage and debt ratios on ESGC scores (matched sample).

	(1) Market leverage	(2) Book leverage	(3) Bank debt ratio	(4) Public debt ratio
Ln(ESGC)	-0.0032***	-0.0015	-0.0018	-0.0044**
	(-4.486)	(-1.572)	(-0.823)	(-2.066)
Market leverage (t-1)	0.3072***			
	(82.360)			
Book leverage (t-1)		0.3337***		
		(47.958)		
Bank debt ratio (t-1)			0.3444***	
			(42.865)	
Public debt ratio (t-1)				0.3314***
				(40.777)
Ln(asset)	0.0107***	-0.0103**	-0.0537***	0.0543***
	(3.451)	(-2.498)	(-5.030)	(5.302)
Market-to-book ratio	-0.0005***	0.0016***	-0.0012***	0.0008**
	(-4.559)	(10.256)	(-2.865)	(2.052)
Ln(sales)	0.0160***	0.0282***	-0.0180*	-0.0040
	(5.555)	(7.363)	(-1.783)	(-0.414)
Tangibility	0.0824***	0.0834***	-0.0451***	0.0206
	(15.428)	(11.791)	(-2.728)	(1.301)
Profitability	-0.3424***	-0.2292***	0.0210	0.0144
	(-22.962)	(-11.626)	(0.420)	(0.300)
R&D expense	0.0005**	0.0007**	0.0012	-0.0002
	(2.497)	(2.511)	(1.311)	(-0.291)
SGA cost	-0.0006	0.0013	-0.0111***	0.0077**
	(-0.655)	(1.004)	(-3.124)	(2.274)
Dividend	0.0054**	-0.0028	-0.0026	0.0088
	2.346	(-0.904)	(-0.375)	(1.299)
Sales-to-assets	-0.0409***	-0.0679***	0.0485***	-0.0253*
	(-8.755)	(-10.929)	(3.098)	(-1.687)
Intercept	-0.1425***	0.0160	0.5079***	-0.1618*
	(-4.589)	(0.388)	(5.625)	(-1.871)
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	15,197	15,197	10,499	10,499
Adjusted R^2	0.812	0.755	0.783	0.799

Notes: This table shows the regressions of market and book leverage ratios on the ESG combined score and various control characteristics under matched samples. The dependent variables are market leverage and book leverage in columns (1) to (2) as well as bank debt ratio and public debt ratio in columns (3) to (4), respectively. For each regression, control variables, firm-, and year-fixed effects are included. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

The effect of becoming ESG-rated on the leverage structure and debt composition of firms for the matched sample is analyzed by using Eq. (4) and regressing market leverage, book leverage, bank, and public debt ratios on the ESGC rating and control characteristics. The regression results presented in Table 13 show that while the results for book leverage indicate a negative but non-significant effect, the results for the market leverage and public leverage ratios remain economically and statistically significant. Although the change in book leverage is not

statistically significant in the matched sample regression, the results for market leverage and public debt ratio confirm the reliability of the previous findings.

In Addition, the results for the control characteristics, especially profitability, and tangibility, are comparable to the benchmark estimations and thus, remain economically and statistically significant.

4.4.2 Different ESG Indicators

To ensure that the results are not driven by the ESG measurement, two alternative approaches are employed. First, the main indicator that was used in the analysis section to determine whether and when a firm obtains an ESG rating, the natural logarithm of the ESGC score (Ln(ESGC)), is replaced by another indicator, the natural logarithm of the normal ESG score (Ln(ESG)) which excludes controversies.

Table 14
Regression of leverage and debt ratios on ESG scores (full sample).

	(1) Market leverage	(2) Book leverage	(3) Bank debt ratio	(4) Public debt ratio
Ln(ESG)	-0.0031***	-0.0017**	-0.0014	-0.0025*
	(-5.931)	(-2.504)	(-0.941)	(-1.758)
Control Variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,346	35,346	23,009	23,009
Adjusted R^2	0.774	0.739	0.805	0.829

Notes: This table shows the regressions of leverage and debt ratios on the ESG score and various control characteristics under full sample. The dependent variables are market leverage, book leverage, bank debt, and public debt ratios in columns (1) to (4) respectively. For each regression, control variables, firm- and year-fixed effects are included. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

As the results in Table 14 indicate, the prevailing deleveraging trend for market and book leverage ratios as well as the negative impact on the public debt ratio remain economically and statistically significant.

In addition, the main indicator is replaced by a dummy variable (ESGD) that takes the value one, if the company has a corresponding ESG rating in the respective year, and zero otherwise. The results in Table 15 support the benchmark observations by showing a significantly negative impact of ESG ratings on market and book leverage ratios as well as on the public debt ratio. Consequently, the estimated results seem to be independent of the measurement of ESG ratings.

Table 15
Regression of leverage and debt ratios on ESG dummy (full sample).

	(1) Market leverage	(2) Book leverage	(3) Bank Debt Ratio	(4) Public Debt Ratio
ESGD	-0.0111***	-0.0069***	-0.0043	-0.0098**
	(-6.154)	(-2.863)	(-0.810)	(-1.992)
Control Variables	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,535	35,535	23,167	23,167
Adjusted R^2	0.773	0.737	0.805	0.828

Notes: This table shows the regressions of leverage and debt ratios on the ESG dummy and various control characteristics under full sample. The dependent variables are market leverage, book leverage, bank debt, and public debt ratios in columns (1) to (4) respectively. For each regression, control variables, firm- and year-fixed effects are included. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

4.4.3 Individual ESG Components

In the analysis conducted thus far, comprehensive ESG scores have been used to assess firms' performance regarding environmental, social, and governance issues. To evaluate the significance of each pillar individually, the benchmark estimation is repeated using Eq.(4), with the ESG score replaced by the ratings from the individual pillars separately. The results, presented in Table A.3 to A.5, indicate that all three pillars exhibit statistically significant effects on reducing leverage ratios, suggesting a prevailing deleveraging trend across all pillars. However, while the social and governance pillars are statistically significant for decreasing public debt ratios, the environmental pillar has no such effect on the public debt ratio. Additionally, similar to the comprehensive ESG scores, all pillars have no significant effect on the bank debt ratio.

4.4.4 Firm Heterogeneity

A firm's ESG ratings, leverage ratios, and debt structure can be closely related to firm characteristics. To evaluate whether the observed trend of deleveraging and reduced reliance on public debt is specific to certain types of ESG-rated companies, five distinct firm characteristics are investigated individually: financial pressure, growth opportunities, R&D intensity, firm size, and profitability.

Following the approach of Asimakopoulos et al. (2023), the full sample is divided into low and high groups for each characteristic, based on the median value. For instance, a company with profitability above the median is placed in the high group. For each sample, i.e. low profitability firms, the benchmark regression from chapter 4.2.4 is applied using Eq.(4) to estimate the coefficients for the ESG rating. Table 16 presents the coefficients and t-statistics for the ESG rating while the regression also controls for company characteristics and includes year- and firm-fixed effects.

The estimated coefficients for firms' financial pressure, measured as cash flow over interest payments, indicate that ESG ratings lead to a deleveraging trend and a decrease in public debt ratios, especially for firms with high financial pressure. Specifically, for high financial-pressure firms, a one-unit increase in the natural logarithm of the ESGC score leads to a significant decrease of 0.13% in the book leverage ratio, while it has no significant effect for low financial-pressure firms. However, firms with low financial pressure also exhibit a reduction in market leverage, along with a slightly negative effect on bank debt. These findings suggest that low-financial-pressure firms might have adequate funding and do not need to alter their capital structure immediately after obtaining an ESG rating, but tend to optimize it to maintain financial flexibility. High-financial-pressure firms, on the other hand, need to raise more funds and seem to use their ESG ratings to take advantage of lower information asymmetries and a broader investor base.

Table 16

Effect of ESG ratings on leverage and debt ratios for different samples based on firm characteristics.

	(1)		(2)		(3)		(4)	
	Market leverage		Book leverage		Bank Debt Ratio		Public Debt Ratio	
	Low	High	Low	High	Low	High	Low	High
Panel A: Financial Pressure								
Ln(ESGC)	-0.0033***	-0.0027***	-0.0010	-0.0013*	-0.0045*	-0.0001	-0.0002	-0.0035**
	(-2.908)	(-4.846)	(-0.642)	(-1.755)	(-1.714)	(-0.055)	(-0.065)	(-1.990)
Panel B: Growth Opportunities								
Ln(ESGC)	-0.0006	-0.0036***	0.0015	-0.0037***	0.0003	-0.0019	-0.0031	-0.0027
	(-0.594)	(-5.955)	(1.409)	(-3.995)	(0.110)	(-0.874)	(-1.451)	(-1.419)
Panel C: R&D Intensity								
Ln(ESGC)	-0.0020	-0.0034***	0.0009	-0.0025***	0.0016	-0.0026	-0.0015	-0.0028
	(-1.610)	(-5.834)	(0.630)	(-3.089)	(0.585)	(-1.389)	(-0.604)	(-1.625)
Panel D: Firm Size								
Ln(ESGC)	-0.0024***	-0.0035***	0.0008	-0.0041***	-0.0008	0.0001	0.0001	-0.0019
	(-3.057)	(-4.377)	(0.762)	(-4.150)	(-0.345)	(0.055)	(0.062)	(-0.855)
Panel E: Profitability								
Ln(ESGC)	-0.0018**	-0.0039***	0.0012	-0.0029***	-0.0033	0.0006	0.0026	-0.0063***
	(-2.076)	(-6.074)	(1.010)	(-3.482)	(1.338)	(0.299)	(1.170)	(-3.359)
Firm fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Control Variables	Yes		Yes		Yes		Yes	

Notes: The table reports coefficients and robust t-statistics of evaluating firm characteristics on the relationship between ESG ratings and leverage and debt structures. The firms are divided into low (small) and high (large) characteristic groups around the median. For each regression, control variables, firm- and year-fixed effects are included. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Firms with high growth opportunities, measured by the company's market-to-book ratio, significantly decrease their market and book leverage ratios on average by 0.36% and 0.37%,

respectively, after obtaining an ESG ratio. However, the results show no deleveraging trend or change in debt composition for firms with low growth opportunities. This could indicate that ESG-rated companies with greater growth opportunities have more favorable access to financing sources.

Firms with high R&D intensity are often perceived as riskier due to the uncertain nature of their investments, which might require more external financing under worse conditions. These firms significantly reduce their leverage after obtaining ESG ratings, benefiting from lower capital constraints. On the other hand, firms with low R&D intensity do not show a significant change in leverage, suggesting that the effect of ESG ratings is more pronounced for firms that rely heavily on innovation and development.

The results suggest that larger firms fully leverage their ESG ratings, benefiting from lower information asymmetries and reduced cost of capital. Conversely, smaller firms show a lesser degree of leveraging their ESG ratings, possibly due to their comparatively constrained access to financial markets. In addition, highly profitable firms tend to deleverage following an ESG rating acquisition, emphasizing their ability to maintain financial health even without significant reliance on external funding sources.

Overall, the prevailing deleveraging trend is more pronounced for firms obtaining ESG ratings when they are larger and more profitable, face high financial pressure, possess better growth opportunities, and have a greater R&D intensity.

4.4.5 Redefine Optimal Leverage Ratio

While contemporaneous variables are incorporated in the benchmark estimation model, some studies also use lagged firm control variables to run the partial adjustment model. To ensure the key results regarding the optimal and actual leverage and debt ratios remain valid when an alternative regression is applied, the target (optimal) leverage ratios are defined using Eq. (6):

$$d_{i,t}^{*} = \alpha + B'\boldsymbol{X}_{i,t-1} + \eta_i \quad (6)$$

Additionally, the resulting partial adjustment model is defined in Eq.(7):

$$d_{i,t} = \beta_0 + \beta_1 d_{i,t-1} + B'\boldsymbol{X}_{i,t-1} + \Theta_i + \gamma_t + \nu_{i,t} \quad (7)$$

The main results remain valid, as a significant decrease in firms' optimal leverage ratios after becoming ESG-rated is observed for the entire period, as shown in Table 17. Similar to the benchmark estimations, a decreasing trend for the public debt ratio is observed, while no significant impact on firms' bank debt ratios is noted. This is due to a reverting trend for the bank debt ratio when comparing pre-and post-crisis periods. Moreover, the main findings regarding crisis effects remain valid as well, as shown in Table A.6.

Table 17
T-test of optimal leverage and debt ratios before and after being rated for the entire period (redefined optimal leverage).

	Before rated	After rated	T-test
Book leverage	0.236	0.231	-2.500**
Market leverage	0.168	0.141	-17.149***
Bank debt ratio	0.530	0.524	-1.187
Public debt ratio	0.383	0.325	-11.647***

Note: This table presents the t-statistics for companies' target leverage ratios before and after obtaining ESG ratings. The optimal leverage ratio refers to the forecasted value (residuals) obtained from regressing leverage ratios on firm characteristics. For each regression, control variables, firm- and year-fixed effects are included. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

The estimated coefficients of regressing leverage ratios on the ESGC rating and lagged control characteristics using Eq. (7) are shown in Table 18. Obtaining an ESG rating leads to a significantly decreasing market leverage and public debt ratio, while the coefficient for the book leverage ratio is negative but not significant. Moreover, obtaining an ESG rating negatively impacts firms' public debt ratio, while no similar effect is observed regarding the bank debt ratio, as shown in Table 18.

Table 18
Regression of leverage and debt ratios on ESGC scores (redefined optimal leverage).

	(1) Market leverage	(2) Book leverage	(3) Bank debt ratio	(4) Public debt ratio
Ln(ESGC)	-0.0013**	-0.0002	-0.0004	-0.0035**
	(-2.427)	(-0.260)	(-0.248)	(-2.284)
Market leverage (t-1)	0.3693***			
	(81.173)			
Book leverage (t-1)		0.3691***		
		(82.611)		
Bank debt ratio (t-1)			0.6168***	
			(115.240)	
Public debt ratio (t-1)				0.5939***
				(105.999)
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,346	35,346	23,009	23,009
Adjusted R^2	0.751	0.729	0.804	0.828

Notes: This table shows the regressions of market and book leverage ratios on the ESG combined score and various control characteristics under matched samples. The dependent variables are market leverage and book leverage in columns (1) to (2) respectively. For each regression, control variables, firm- and year-fixed effects are included. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

To summarize, robustness checks were conducted to reaffirm the significant impact of ESG ratings on leverage and debt ratios, utilizing alternative regression models, assessing the role of individual ESG components, and evaluating firm heterogeneity characteristics. While a negative but not always significant effect on book leverage ratios is observed, the overall trend of companies adjusting their financial structure in response to ESG ratings remains evident.

5. Main Conclusions

The main objective of this thesis is to analyze the impact of ESG ratings on firms' leverage ratios and debt composition and whether this impact changes depending on the economic environment. Therefore, U.S. companies between 2002 and 2022 are analyzed using a comprehensive dataset from CCM, Capital IQ, and Refinitiv.

Initially, the analysis focuses on how ESG ratings and the crisis affect firms' target (optimal) leverage and debt ratios. The findings indicate that ESG ratings significantly influence firms' optimal leverage ratios, reducing both book and market leverage ratios across different periods. While ESG ratings also tend to have a negative effect on firms' optimal public and bank debt ratios pre-crisis, they seem to cause a shift from public to bank debt in the post-crisis period. Across all periods, companies use ESG ratings as a signaling mechanism to decrease information asymmetries. The results indicate that the crisis has a significant negative effect on optimal market leverage, book leverage, and public debt ratio while also having a positive effect on firms' optimal bank debt ratio, suggesting that firms alter their financing choices during a crisis.

Subsequently, the impact of obtaining ESG ratings on actual leverage and debt ratios is evaluated. The results indicate a significant decrease in market leverage, book leverage, and public debt ratios following the acquisition of ESG ratings, without substantial evidence of a shift towards bank capital. The findings from the difference-in-difference regression support previous results, demonstrating that ESG-rated firms significantly reduce both market and book leverage, especially during crises, as a signal of financial stability. Additionally, the crisis causes a deleveraging trend, driven by reduced reliance on bank and public debt. These findings suggest that ESG ratings can be a valuable signaling mechanism by effectively helping to reduce information asymmetries by conveying critical information to financial stakeholders. Moreover, ESG ratings appear to signal financial stability in times of crisis, facilitating access to superior financing terms. The results provide support for the trade-off theory by highlighting the benefits of lower cost of capital for firms with strong ESG credentials. The findings show that while optimal debt ratios support the pecking order theory, indicating a shift towards internal financing during the crisis, the observed actual debt ratios primarily reflect a decrease in public debt. This decrease is influenced by changes in bank lending standards and decreased credit supply, indicating an incomplete alignment with the pecking order theory.

Overall, the analysis highlights the important role of ESG ratings in corporate capital structures even in times of challenging economic conditions. Companies seem to leverage ESG ratings to

mitigate asymmetric information, broaden their investor base, and signal corporate stability, thereby facilitating deleveraging and alleviating capital constraints. Consequently, the research not only impacts corporate decision-making and stakeholder awareness but also lays the groundwork for future studies to explore several aspects in more detail. Future research could delve deeper into the long-term impacts of ESG ratings on investor behavior and capital structure. Additionally, empirical analysis could be conducted in different institutional contexts globally and on a sector-specific basis to examine the persistence of findings in various settings. Moreover, the specific impact of regulatory changes could be investigated, as mandatory disclosure standards might diminish the signaling effect of ESG ratings.

The increasing integration of ESG factors by investors underscores the importance of dynamic ESG ratings and regulatory frameworks to meet growing demand and evolving challenges. This fosters greater transparency, shapes firms' social responsibility efforts, and offers policymakers evidence to incentivize ESG disclosure. This has significant implications for corporate decision-making, prompting firms to engage in socially responsible activities to not only enhance their ESG profiles and reputations but also benefit from lower capital constraints, better growth opportunities, and enhanced resilience during economic instability.

Appendix

Table A.1
Variables description.

Category	Variable	Definition	Data Source
Leverage metrics	Market leverage	Long-term debt/market value of assets, where market value = (assets - common equity) + closing price ∗ common shares outstanding	CCM
	Book leverage	Long-term debt/book value of assets	
Primary debt ratios	Bank debt ratio	(Term loans + revolving credit) / debt	Capital IQ & CCM
	Bond debt ratio	(Senior bonds & notes + subordinated bonds & notes) / debt	
Supplementary debt ratios	Term Loans Ratio	Term loans/debt	Capital IQ & CCM
	Commercial Paper Ratio	Commercial paper/debt	
	Revolving Credit Ratio	Revolving credit/debt	
	Senior Bonds Ratio	Senior bonds & notes/debt	
	Subordinated Bonds Ratio	Subordinated bonds & notes/debt	
	Other Debt Ratio	Other debt/debt	
ESG indicators	Ln(ESGC)	Natural log of the combined ESG score	Refiniv ESG
	Ln(ESG)	Natural log of the ESG score	
	Ln(EP)	Natural log of the environmental pillar score	
	Ln(SP)	Natural log of the social pillar score	
	Ln(GP)	Natural log of the governance pillar score	
Firm control characteristics	Assets	Natural log of assets	CCM
	Market-to-book ratio	Market value of equity/book value of equity	
	Sales	Natural log of sales	
	Sales-to-assets ratio	Sales/assets	
	R&D expense ratio	Research & development expense/sales	
	SGA expense ratio	Selling, general, and administrative expenses/sales	
	Dividend	Dummy variable that equals one if dividend payments = 0	
	Tangibility	Property, plant, and equipment/assets	
	Profitability	Operating income before depreciation/assets	
Asymmetric Information	Asset Size	Natural log of assets	CCM
	Intangible Assets	Intangible assets/assets	
	Sd(EBITDA)	Standard deviation of the ratio of EBITDA to assets over the sample period	
Financing measures	Average debt maturity	Debt scaled by the time to maturity as a proportion of the total debt	CCM
	Retained earnings	Natural log of retained earnings	
	Cash holdings	Cash and cash equivalents as a proportion of total assets	
	Dividend payments	Natural log of dividend payments	
	Share repurchases	Purchase of common and preferred stock minus any reduction in the value of the net number of preferred stocks outstanding scaled by total assets	
	Long-term Debt ratio	Long-term debt as a percentage of total debt	
Crisis indicators	Crisis	Dummy variable that equals one if the year is later than 2019	CCM
	Initial Crisis	Dummy variable that equals one if year is 2020	

Table A.2

Descriptive statistics (matched sample)

	N	Mean	Median	P5	P25	P75	P95	Std. Dev.
Debt Structure variables								
Market leverage	18,036	0.166	0.126	0.002	0.040	0.246	0.494	0.156
Book leverage	18,036	0.237	0.214	0.004	0.087	0.344	0.587	0.184
Bank debt ratio	12,327	0.528	0.516	0.014	0.162	0.926	1.000	0.369
Public debt ratio	12,327	0.359	0.266	0.000	0.000	0.711	0.951	0.364
Commercial paper ratio	12,327	0.007	0.000	0.000	0.000	0.000	0.048	0.030
Revolving credit ratio	12,327	0.172	0.012	0.000	0.000	0.211	0.935	0.288
Term loans ratio	12,327	0.355	0.231	0.000	0.005	0.662	1.000	0.363
Senior bond notes ratio	12,327	0.340	0.202	0.000	0.000	0.688	0.942	0.361
Subordinated bond notes ratio	12,327	0.018	0.000	0.000	0.000	0.000	0.053	0.092
Other debt ratio	12,327	0.017	0.000	0.000	0.000	0.000	0.100	0.064
ESG variables								
Ln (ESGC)	18,036	1.737	0.000	0.000	0.000	3.527	4.142	1.780
Control variables								
Ln (Assets)	18,036	7.515	7.403	4.139	6.054	8.966	11.108	2.092
Market-to-book ratio	18,036	3.598	2.017	0.360	1.205	3.583	10.596	6.512
Ln (Sales)	18,036	6.893	6.979	2.858	5.542	8.490	10.476	2.314
Tangibility	18,036	0.520	0.370	0.046	0.163	0.828	1,277	0.441
Profitability	18,036	0.103	0.097	0.000	0.047	0.146	0,242	0.078
R&D expense	18,036	0.906	0.005	0.000	0.000	0.104	1.327	6.276
SGA cost	18,036	0.395	0.197	0.000	0.072	0.374	0.907	1.361
Dividend	18,036	0.536	1.000	0.000	0.000	1.000	1.000	0.499
Sales-to-assets	18,036	0.752	0.603	0.108	0.348	0.973	1.925	0.593

Notes: This table shows descriptive statistics for the full sample. Data is retrieved from CCM, Capital IQ, and Refinitiv databases between 2002 and 2022. Variables are split into debt structure variables, ESG variables, and control variables. N denotes the number of firm-year observations.

Table A.3

Regression of market leverage, book leverage, bank debt ratio, and public debt ratio on environmental pillar scores (full sample)

	(1)	(2)	(3)	(4)
	Market leverage	Book leverage	Bank debt Ratio	Public debt Ratio
Ln(E)	-0.0030***	-0.0016**	-0.0015	-0.0000
	(-5.055)	(-1.971)	(-0.857)	(-0.043)
Control Variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,346	35,346	23,009	23,009
Adjusted R^2	0.774	0.739	0.805	0.829

Notes: This table shows the regressions of leverage ratios on the environmental pillar score and various control characteristics under full sample. The dependent variables are market leverage, book leverage, bank debt, and public debt ratios in columns (1) to (4) respectively. For each regression, control variables and firm- and year-fixed effects are incorporated. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Table A.4
Regression of market leverage, book leverage, bank debt ratio and public debt ratio on social pillar scores (full sample)

	(1) Market leverage	(2) Book leverage	(3) Bank debt ratio	(4) Public debt ratio
Ln(S)	-0.0029***	-0.0016**	-0.0013	-0.0023*
	(-5.661)	(-2.338)	(-0.843)	(-1.650)
Control Variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,346	35,346	23,009	23,009
Adjusted R^2	0.774	0.739	0.805	0.829

Notes: This table shows the regressions of leverage ratios on the social pillar score and various control characteristics under full sample. The dependent variables are market leverage, book leverage, bank debt and public debt ratios in columns (1) to (4) respectively. For each regression, control variables and firm- and year-fixed effects are incorporated. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Table A.5
Regression of market leverage, book leverage, bank debt ratio and public debt ratio on governance pillar scores (full sample)

	(1) Market leverage	(2) Book leverage	(3) Bank debt ratio	(4) Public debt ratio
Ln(G)	-0.0029***	-0.0017***	-0.0013	-0.0024*
	(-6.058)	(-2.669)	(-0.935)	(-1.861)
Control Variables	Yes	Yes	Yes	Yes
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Number of observations	35,346	35,346	23,009	23,009
Adjusted R^2	0.774	0.739	0.805	0.829

Notes: This table shows the regressions of leverage ratios on the governance pillar score and various control characteristics under full sample. The dependent variables are market leverage, book leverage, bank debt and public debt ratios in columns (1) to (4) respectively. For each regression, control variables and firm- and year-fixed effects are incorporated. Numbers in parentheses are robust t-statistics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Table A.6
T-test of optimal leverage pre- and post crisis

	Pre-Crisis (2002-2019)	Post-Crisis (2020-2022)	T-test
Bank debt ratio	0.237	0.224	-6.761***
Public debt ratio	0.167	0.146	-13.394***
Bank debt ratio	0.528	0.533	1.114
Public debt ratio	0.387	0.312	-15.058***

Note: This table presents the t-statistics for companies' pre- and post-crisis target market and book leverage ratios. The optimal leverage ratio refers to the forecasted value (residuals) obtained from regressing leverage ratios on firm characteristics. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

Table A.7
Difference-in-difference regression of leverage and debt ratios on ESGC scores and crisis variable (redefined definition).

	(1) Market leverage	(2) Book leverage	(3) Bank Debt Ratio	(4) Public Debt Ratio
ESGC	-0.0040***	-0.0025***	-0.0034	0.0011
	(-4.464)	(-2.562)	(-1.098)	(0.304)
Crisis	-0.0106***	-0.0052***	-0.0117***	-0.0738***
	(-2.431)	(-2.700)	(-3.408)	(-17.664)
ESGC x Crisis	-0.0024***	-0.0026***	0.0005	-0.0051**
	(-3.674)	(-2.742)	(0.289)	(-2.392)
Control variables	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Number of observations	14,86	14,86	9,152	9,152
Adjusted R^2	0.840	0.794	0.822	0.877

Notes: This table shows the difference-in-difference regressions results of market leverage, book leverage, bank debt and public debt ratios on the ESG combined score and the crisis. The Crisis is defined here as the period from 2020 to 2021. For each regression, control variables, firm- and year-fixed effects are included. 1%, 5%, and 10% significance levels are denoted by ***, **, and * respectively.

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