

3 THE RELATIONSHIP BETWEEN ESG AND COST OF CAPITAL: A STRUCTURAL EQUATION MODELLING APPROACH

Cosmin-Dănuț VEZETEU ^{1*}
Raluca-Ioana STĂNCIULESCU ²
Camelia UNGUREANU ³

Abstract

Sustainable finance has become an increasingly popular topic for both researchers and investment professionals. ESG ratings offer a reasonably equitable quantitative evaluation of a company's sustainability, but empirical studies on the relationship between these scores and the cost of capital are rather scarce and show divergent results. This paper aims to address this research gap through a novel structural equation modelling approach, specifically the Random Intercept – Cross Lagged Panel Model (RI-CLPM). This econometric technique is applied on a global dataset, from 2016 to 2023, with the aim to determine the influence of ESG on cost of capital and its components, namely the cost of debt and the cost of equity, before and during the COVID-19 pandemic. The results reveal an inconsistent impact of ESG on capital components: while ESG does not significantly affect the cost of capital or the cost of equity, a significant negative relationship observed regarding the cost of debt when analyzed as the dependent variable during pre-pandemic years at the total sample level. However, a more in-depth analysis reveals that this outcome is regionally dependent. This article contributes to the growing literature on sustainable finance by providing a rigorous econometric framework that investigates the reciprocal effects between financial and ESG performance metrics.

Keywords: Sustainable finance, ESG, Cost of capital, Structural Equation Modelling, RI-CLPM

JEL Classification: C58, G17, Q56

1. Introduction

The integration of Environmental, Social, and Governance factors into corporate finance represents a significant paradigm shift, compelling organisations to consider not only financial performance but also their broader impact on society and on the environment (Pedersen et al., 2021). As sustainability considerations reshape financial markets, companies with strong ESG performance are increasingly viewed as lower-risk investments, potentially benefiting from reduced capital costs. Policymakers, such as those behind the EU Sustainable Finance Action

¹ Bucharest University of Economic Studies, Romania. Email: cosmin.vezeteu@csie.ase.ro. * Corresponding author

² Bucharest University of Economic Studies, Romania. Email: stanciulescuraluca16@stud.ase.ro

³ Transilvania University of Braşov, Romania. Email: camelia.negri@unitbv.ro

Plan, are also steering capital towards greener initiatives, reinforcing the connection between ESG and financial performance.

To this day, more than 2,000 empirical research were undertaken by scholars and investors to explore the connection between ESG criteria and corporate financial performance (Friede et al., 2015). Although most papers focus on the link between ESG and financial performance using accounting-based and market-based indicators of financial performance, this article aims at examining this relationship from a cost-of-financing perspective, through weighted average cost of capital (WACC) and its components, namely cost of equity, and cost of debt. Cost of capital, a critical determinant of investment decisions and firm valuation, is theorised to be influenced by a company's ESG profile (Bartkoski et al., 2010). Moreover, ESG performance can impact differently the WACC and its components, cost of debt and cost of equity, due to the distinct nature of these financing components. As Loffler (2023) points out, higher levels of ESG scores should be linked to a reduced risk level and cost of capital for companies. Same remark is made by Khan et al. (2016), who argue that ESG investments can improve future outcomes in terms of financial performances and limit risk, and thus, it implicitly affects the cost of financing. More precisely, ESG practices can reduce the cost of debt by mitigating credit risk and signaling stronger long-term resilience, making firms more attractive borrowers and potentially reducing their risk premium. Similarly, the cost of equity can be influenced by ESG through its role as a measure of long-term growth prospects, reputational strength, and governance quality, all of which can affect equity investors' perceptions of risk and required returns. The overall WACC captures the combined effects across both debt and equity financing, depending on the overall capital structure.

Empirical evidence on the relationship between ESG performance and cost of capital is rather scarce and inconclusive: while some studies highlight a significant negative relationship, others indicate mixed results. The lack of clear empirical evidence can also be further explained by the fact that ESG, in general, and ESG scores, in particular, have become popular only in recent years, and therefore the availability of data for an extended period was limited.

This study aims to address this research gap using a rigorous framework, with ESG and financial data over a significant period, for a sample encompassing companies around the world. The dataset used in this research is highly representative, with more than 1200 companies worldwide, over a period of 8 years, between 2016 and 2023. Therefore, the conclusions drawn from this study have global applicability, and they also capture the disruption caused by the COVID-19 pandemic.

Moreover, as a novelty of this paper, a structural equation modelling approach is employed, using the Random-Intercept Cross-Lagged Panel Model (RI-CLPM), an improved model compared to the classical Cross-Lagged Panel Model (CLPM), and traditional methods such as fixed-effect regression or time series analysis. The Random Intercept Cross-Lagged Panel Model (RI-CLPM) is a statistical approach for analyzing longitudinal data, particularly useful for investigating causal relationships between variables, while controlling for individual differences and temporal dependencies. This method also allows for the examination of reverse causality between the analysed variables.

The main assumption of this paper is that high ESG performance can negatively influence a company's cost of capital, i.e., companies with strong ESG performance may have lower risk profiles, leading to lower borrowing costs and a lower cost of equity, while companies with poor ESG practices may face higher costs of capital due to increased risk perception by investors, particularly those focused on socially responsible investing (SRI) or sustainable investing, by incorporating ESG considerations into their valuation models.

The rest of the paper is structured as follows: a critical review of the literature is presented next, followed by a comprehensive description of the data used in the empirical analysis, along with the methodological rationale. The final sections present and discuss the results obtained in the

models, separately for each dependent variable employed. The article concludes with managerial and policy implications, main limitations, as well as future study directions.

2. Literature review

The relationship between ESG factors and cost of capital is increasingly recognized as a significant research area within the financial literature, as stakeholders recognize the relevance of sustainable practices in investment decisions. This review of the literature synthesizes findings from various studies that highlight how ESG performance can influence firms' cost of capital while also exploring divergent perspectives in the literature.

Initial studies, such as that of El Ghoul et al. (2011), analysed the link between corporate social responsibility (CSR) and cost of equity for US companies. Their main results emphasize that factors such as investments in improving employee relations or environmental policies substantially contribute to reducing firms' cost of equity, thus supporting arguments in the literature that firms with socially responsible practices have higher valuation and lower risk. Oikonomou et al. (2014) study the impact that various dimensions of corporate social performance (CSP) have on the pricing of corporate debt for US companies. Their results show that firms with good CSP have lower cost of debt, but, at the same time, that companies with low CSP have higher cost of debt. Suto and Takehara (2017) analyze the impact of CSR on cost of capital for Japanese companies and explain that higher CSP lowers the cost of equity and WACC but increases the cost of debt. Yeh et al. (2020) study whether CSR performance can impact cost of capital for a sample of Chinese companies and conclude that higher CSR performance significantly lowers cost of debt. Furthermore, they also highlight that higher CSR performance significantly increases the cost of equity, however the authors associate this finding with Chinese policy. Bhuiyan and Nguyen (2019), in a study of Australian companies between 2004 and 2016, argue that CSR has a significant and negative relationship with both cost of equity and cost of debt. On the other hand, there are papers suggesting the opposite. The authors Magnanelli and Izzo (2017) emphasize a positive relation between CSP and cost of debt using a dataset comprised of over 300 companies, while Chava (2014) highlights that exclusionary socially responsible investing and environmentally sensitive lending influence both the cost of equity and cost of debt. While early CSR studies laid the groundwork for understanding corporate responsibility and its qualitative benefits, more recent ESG-focused literature has built upon this foundation by introducing quantitative metrics and highlighting financial implications across different markets. These ESG studies expand the scope beyond CSR by addressing how environmental, social, and governance practices relate to cost of capital metrics. One distinguishing factor between CSR and ESG is their origin and intended application. CSR is rooted in ethical considerations, whereby companies voluntarily adopt practices that extend beyond profit generation to benefit society. In contrast, the ESG framework emerged primarily from investment criteria aimed at assessing risk management capabilities pertaining to sustainability. Thus, while CSR can be seen as a voluntary set of practices enhancing community welfare, ESG presents a more formalized set of standards and metrics influencing corporate governance and financial decisions.

An early study of Chouaibi et al. (2021) incorporates ESG ratings in the analysis of the relationship between cost of capital and sustainability performance for French firms. The authors show that CSR activities, measured by ESG scores, lower the cost of equity. Moreover, from a regional perspective, Ramirez et al. (2022) provide a foundational examination of the link between overall ESG scores and the cost of capital in firms from Latin America, showcasing evidence of a significant but negative impact of high ESG ratings on the cost of capital. Their findings align with other studies that report similar trends, suggesting that firms recognized for their sustainable practices experience lower capital costs. Possebon et al. (2024) delve into Brazilian companies and report that improved ESG performance correlates with a decrease in the cost of financing,

affirming that an organization's commitment to social responsibility and the promotion of environmental efforts can enhance its financial attractiveness to investors. Similarly, other research points to a constructive dynamic between ESG ratings and the cost of capital, particularly in Europe, as documented by Berk et al. (2023). Their investigation emphasizes that firms exhibiting strong ESG performance can effectively lower their equity cost of capital. They suggest that favorable financial metrics associated with ESG-oriented companies reflect a more stable investment profile, thus attracting lower capital costs. This observation supports the notion that adherence to strong ESG protocols mitigates perceived risk and enhances profitability potential, further justifying a reduced capital cost. Additionally, Hampl and Vágnerová Linnertová (2024), examine the moderating effects of ESG controversies on capital costs. Their research suggests that firms embroiled in negative ESG events may experience heightened capital costs, emphasizing the importance of maintaining a solid reputation and effective crisis management in mitigating financial repercussions. Tanjung (2023) revealed that, on average, non-ESG companies' cost of capital is lower than that of ESG firms, when analyzing publicly listed firms from the 2012 – 2021 timespan. However, the above-mentioned author concludes that ESG firms did not benefit during the pandemic, after controlling for the pandemic effect using dummy variables for 2020 and 2021. These results indicate that "the adoption of green or sustainable finance is still in its infancy and that the sector requires more time to establish an enabling environment".

There are also papers that indicate a more complex relationship between ESG performance and capital costs, where different factors and contexts significantly impact this interconnection. For instance, Nazarova and Lavrova (2022) argue that slight improvements in ESG scores may not substantially alter a firm's cost of capital, arguing that the market may already incorporate these scores into evaluative models. This perspective suggests that while ESG factors can influence capital costs, their effect may diminish over time as market participants adjust to sustainability trends. Priem and Gabellone (2024) suggest that a high ESG score may serve as an important factor in maintaining low capital costs in a less favorable legal environment, highlighting the potential for ESG initiatives to act as protective mechanisms for firms operating under stringent regulations. Their findings underscore the importance of ESG strategies, particularly for companies facing external pressures regarding compliance and regulation, thus serving as a stimulus for firms to enhance their sustainability practices. Emerging market contexts, such as China, further enhance this narrative, as Ruan and Liu (2021) reveal that ESG disclosures can actually become significant burdens that negatively influence overall firm performance. This dynamic indicates that the perceived costs of implementing ESG standards might outweigh the financial benefits in certain situations, suggesting that not all firms uniformly benefit from improved ESG practices, especially in environments where ESG frameworks are still evolving. However, the findings of Eliwa et al. (2021) regarding the EU market context support the view that lending institutions tend to reward firms for strong ESG performance with lower costs of debt. This relationship highlights a growing trend among financial actors to integrate sustainability into their lending criteria, echoing concerns about reputation and risk management in an increasingly ESG-conscious marketplace.

Solely from a correlation perspective, while most studies indicate a negative relationship between ESG performance and cost of capital, others have found disconfirming evidence. For example, Moussa and Elmarzouky (2024) report a positive association between ESG reporting and the cost of capital in the UK, a result that requires a closer examination of the conditions under which ESG disclosures affect capital costs. This discrepancy can be attributed to varying methodologies and contextual factors, underscoring the complexity of assessing ESG's impact across different regions and regulatory frameworks. The impact of specific components of ESG on the cost of capital is another focus area, as highlighted by Ng and Rezaee (2015), who explain that different elements of ESG can uniquely affect capital costs. More precisely, their findings demonstrate that while certain ESG activities can lead to lower equity costs, there are instances where the

substantial costs of sustainability efforts may result in higher capital costs for firms struggling to implement the necessary strategies effectively. Gonçalves et al. (2022) examined the association between ESG performance and cost of capital for the largest European firms between 2002 and 2018. Their findings suggest that better ESG performance correlates with a lower cost of equity; however, at the same time, an increase in ESG performance increases the cost of debt. Furthermore, they indicate that ESG does not influence firm cost of capital in challenging times, such as those of financial and sovereign crises.

From a quantitative and econometric perspective, this relationship has been explored using many different approaches, including, but not limited to regression models or time-series approaches. By reviewing the existing literature, few studies have been found to employ a structural modelling approach, when analyzing the relationship between ESG and cost of capital. A notable example is the study of Piechocka-Kaluzna et al. (2021) in which the authors provide a compelling framework by analyzing the relationship between CSR/ESG reporting and the cost of capital specifically in the U.S. healthcare sector. Their methodology emphasizes how different ESG components interact and consolidate to influence capital costs. Such frameworks illustrate the capacity of structural equation models to elucidate relationships that remain obscured in traditional analyses.

In summary, the link between ESG factors and the cost of capital is multifaceted, characterized by evidence supporting both negative and positive correlations depending on contextual variables such as geographic region and market conditions. Despite the notable findings across various methodologies, studies directly utilizing structural equation modelling in order to analyze the relationship between ESG factors and cost of capital remain few.

Based on the existing literature, the following research hypotheses have been developed:

H1. Higher ESG performance has a negative effect on weighted average cost of capital over time.

H2. Higher ESG performance has a negative effect on cost of debt over time.

H3. Higher ESG performance has a negative effect on cost of equity over time.

3. Data

A novel dataset comprised of ESG and financial data for listed companies worldwide has been gathered at the end of 2024. This has been obtained from Refinitiv Eikon, part of the London Stock Exchange Group (LSEG), one of the largest ESG rating provider. ESG data refers to the Overall ESG Score, aggregated based on 10 category weights, which are determined according to the LSEG magnitude matrix. Financial data refers to the StarMine Weighted Average Cost of Capital (WACC), Cost of Debt (COD) and Cost of Equity (COE), calculated beginning with 2015, representing the average rate a company is expected to pay to its debt, equity, and preferred stockholders to finance its assets, where each component of capital is proportionately weighted in the same fraction as the capital structure, considering the definition presented by Refinitiv.

Below is presented a summary of the variables used in the analysis, along with the codification provided in parentheses.

1. Overall ESG Score (ESG): a measure of a company's sustainability performance across the Environmental, Social and Governance pillars.
2. Weighted Average Cost of Capital (WACC): a financial metric used to measure a company's cost of capital, taking into account the proportional weight of each component of capital.
3. Cost of Debt (COD): the interest rate the company pays on its debt. It can be calculated based on the interest rates of existing debt instruments or estimated based on the company's credit risk profile.

4. Cost of Equity (COE): this represents the return required by equity investors given the risk associated with investing in the company's stock.

The formulas for calculating the three financial measures are displayed below, according to Refinitiv:

(1) $WACC = K_E * W_E + K_D * W_D + K_P * W_P$

(2) $K_D = (K_{D_SHORT} * W_{D_SHORT} + K_{D_LONG} * W_{D_LONG}) * (1 - tax)$

(3) $K_E = R_f + \beta * ERP$, where:

K_P = WACC Cost of Preferred Stock, (%)

ERP = WACC Equity Risk Premium, (%)

R_f = WACC Inflation Adjusted Risk Free Rate, (%)

W_D = WACC Debt Weight, (%)

W_E = WACC Equity Weight, (%)

W_P = WACC Preferred Weight, (%)

tax = WACC Tax Rate, (%)

K_{D_SHORT} = WACC Short Term Debt Cost, (%)

K_{D_LONG} = WACC Long Term Debt Cost, (%)

β = Stock's Beta

The dataset contains 1206 companies for which complete ESG and financial data in the 2016 – 2023 timeframe was found. The year 2015 was excluded from the analysis due to low coverage for the WACC, COD, and COE variables. The distribution of companies by region and industry can be found in Table 1 and Table 2.

Table 1. Distribution of companies by region

Region	Number of companies
United States and Canada	630
Asia / Pacific	275
Europe	199
Latin America and Caribbean	61
Africa / Middle East	41
Total	1206

Source: Authors' own work in Microsoft Excel, using Refinitiv data

Table 1 illustrates that most companies are from the United States and Canada, but with a rather good distribution in other regions such as Europe or Asia / Pacific. The regions with the least representation consist of Latin America and the Caribbean, as well as Africa/Middle East.

Table 2. Distribution of companies by industry

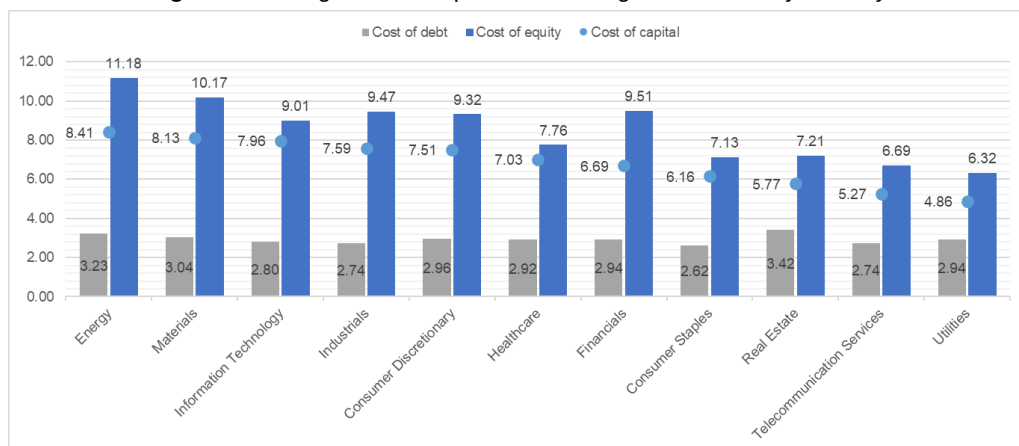
Industry	Number of companies
Financials	210
Industrials	188
Consumer Discretionary	136

Industry	Number of companies
Information Technology	127
Materials	121
Healthcare	93
Real Estate	77
Energy	75
Consumer Staples	70
Utilities	68
Telecommunication Services	41
Total	1206

Source: Authors' own work in Microsoft Excel, using Refinitiv data

Table 2 illustrates that most companies are from financials, industrials and information technology industries, with a rather good overall distribution in other industries, such as materials and consumer discretionary. The industries not so well represented, with a number of companies below 100, are those of healthcare, real estate, energy, consumer staples, utilities and telecommunication services.

Figure 1. Average cost of capital and funding structure, % by industry



Source: Authors' own work in Microsoft Excel, using Refinitiv data

Figure 1 above illustrates that, on average, some industries benefit from a lower cost of debt, e.g. consumer staples, industrials etc., while others from a lower cost of equity, e.g. utilities, telecommunication services. The highest capital costs for the analysed period were in the energy sector, with an average of 8.41%, while the lowest was found in the utilities sector, of 4.86%.

Descriptive statistics are illustrated in Appendix A (Table A1) and show an overall distribution of the data.

4. Methodology

In order to test our above-mentioned hypotheses, a structural equation modelling (SEM) approach is taken, using a Random Intercept - Cross-Lagged Panel Model (RI-CLPM) with an eight-year wave (T1 to T8) from 2016 to 2023. The main advantage of this method, in comparison with other regression techniques, is that the structural equation model enables the development and analysis of path models that better demonstrate the causal links. Furthermore, another advantage of the SEM technique is that it makes it easier and more accurate to model causal pathways, by examining all variables in the model at the same time rather than separately (Chin, 1998).

In general, the cross-lagged panel model (CLPM), is a subtype of the wider structural equation models, appropriate for assessing the lagged effects of one variable on another. However, traditional CLPM cannot control for unobserved firm-specific traits (e.g., industry, corporate culture, financial stability). The RI-CLPM, compared to the general CLPM, adds a layer to the framework by incorporating random intercepts to account for these stable, trait-like individual differences, separating within-entity dynamic processes from between-entity stable differences (Hamaker et al., 2015). This allows for the interpretation of cross-lagged associations as causal effects (Usami, 2020). Given the global sample of companies used in the analysis, this approach is highly suitable to account for differences in particularities and dynamics. This is extremely important for our topic, as firms with consistently high ESG scores might already have a lower WACC due to long-term investor confidence. However, RI-CLPM isolates whether improving ESG performance within a firm leads to subsequent changes in WACC over time.

In this paper, we focus on the lagged effect from the ESG score, the independent variable, in time T to WACC, COD, COE, as the dependent variables, in time T+1, controlling for them in time T. This technique also has the advantage of testing for reverse causality, that is, the impacts of WACC, COE, and COD on ESG scores.

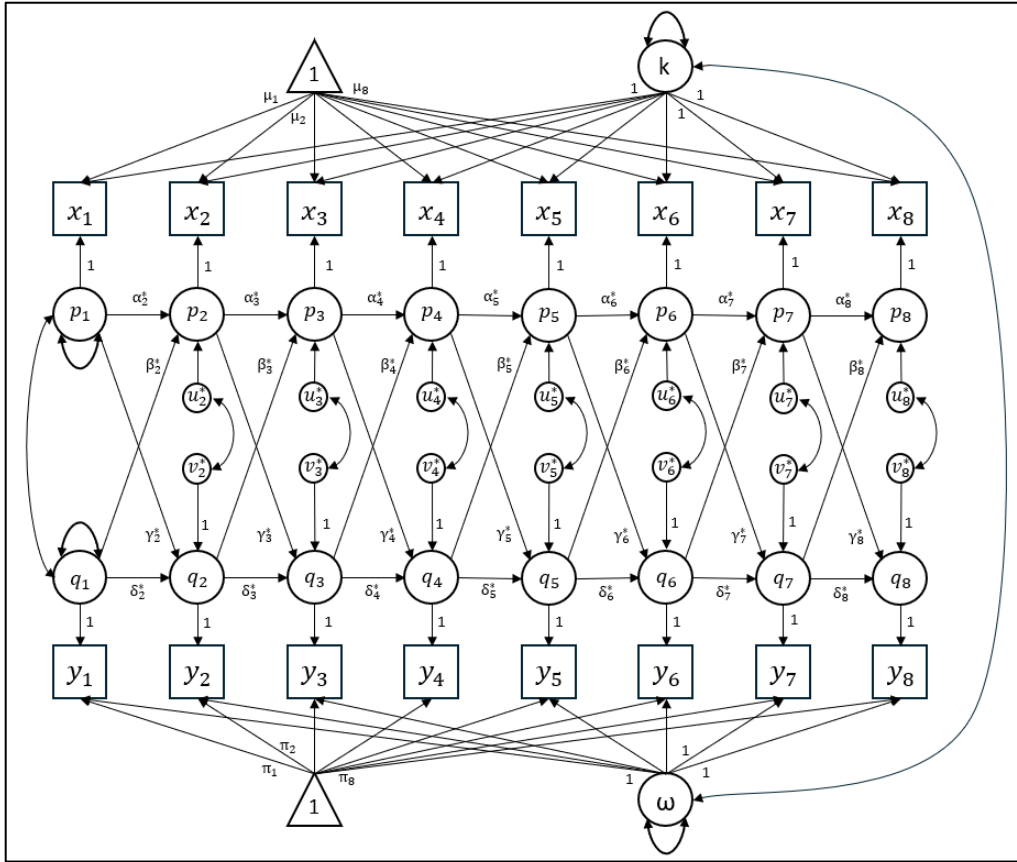
Figure 2 illustrates the conceptual path diagram for the considered model:

In Figure 2 above, the following path diagram and naming conventions were followed: squares illustrate the observed variables (e.g., ESG scores, cost of capital/debt/equity), circles represent the latent variables and triangles are used to emphasize intercepts. Regressions are represented by the single-headed arrows while correlations are illustrated with the help of the double-headed arrows.

The same technique has been used in a recent research in the psychology field. Authors Mehrabi, Iskrice and Beshai (2024) studied the link between envy and depressive symptoms for a six months period. The present methodology follows the above-mentioned work as well as the papers of Mund & Nestler (2019) and Falkenström et al. (2022).

The between-entity portion of the RI-CLPM included the latent intercept factors for the ESG (k) and either WACC, COD or COE (ω), corresponding to the time-invariant levels of ESG and these financial variables. The random intercepts were extracted from the observed variables, using black squares ($x_1, \dots, x_8$ and $y_1, \dots, y_8$), with all factor loadings restricted to one. Correlations were observed between random intercepts (between k and ω).

The within-entity portion of the RI-CLPM is emphasized by latent variables, depicted, according to the methodology, with the help of black circles ($p_1, \dots, p_8$ and $q_1, \dots, q_8$). As mentioned above, the factor loadings are constrained to one. Next, two types of within-entity processes based on ESG and cost of capital variables are assessed after accounting for stable between-entity variances.

Figure 2. Conceptual path diagram of the RI-CLPM with eight waves

Source: Authors' own work in Microsoft PowerPoint

First, autoregressive effects ($\alpha_2^*, \dots, \alpha_8^*$ and $\delta_2^*, \dots, \delta_8^*$) are estimated to represent stability effects within an entity or ripple effects in measures over the course of time (i.e., ESG performance for a company at one specific time point may predict the ESG performance at a following period in time, assuming that a company develops and builds on its existing ESG practices each year). Second, cross-lagged effects ($\beta_2^*, \dots, \beta_8^*$ and $\gamma_2^*, \dots, \gamma_8^*$) are estimated to indicate how two key factors impact each other at the within-entity level from one time point to the next, controlling for previous scores (i.e., ESG performance of a company at one-time point predicts the cost of capital at a subsequent time point, controlling for prior ESG performance). Finally, covariances are calculated across variables to show how within-entity differences in two variables are correlated after considering the autoregressive and cross-lagged effects ($u_2^*, \dots, u_8^*$ and $v_2^*, \dots, v_8^*$).

Moreover, specific indicators for the SEM method such as the chi-square statistic, the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardised root mean square residual (SRMR) were used to evaluate the model's goodness of fit.

A brief robustness check is also performed for the top two regions by number of companies in the sample, namely United States & Canada and Asia/Pacific, to validate the hypothesis that the obtained results are robust and can be generalized.

5. Results

In this section, the results are presented depending on the dependent variables, namely weighted average cost of capital, cost of debt, and cost of equity.

5.1. ESG and weighted average cost of capital

Table 3 illustrates the results of the RI-CLPM model of ESG and the weighted average cost of capital over time, focusing on the cross-lagged coefficients. Autoregressive coefficients are reported in Appendix (Table A2), all statistically significant.

Table 3. Random intercept cross-lagged panel model of ESG and weighted average cost of capital over time

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to WACC-2017	0.004	0.003	0.152
From ESG-2017 to WACC-2018	-0.002	0.002	0.164
From ESG-2018 to WACC-2019	-0.014	0.002	0.000
From ESG-2019 to WACC-2020	-0.017	0.003	0.000
From ESG-2020 to WACC-2021	0.013	0.003	0.000
From ESG-2021 to WACC-2022	0.005	0.003	0.097
From ESG-2022 to WACC-2023	-0.007	0.004	0.071
From WACC-2016 to ESG-2017	-0.226	0.092	0.014
From WACC-2017 to ESG-2018	-0.072	0.09	0.426
From WACC-2018 to ESG-2019	-0.223	0.091	0.014
From WACC-2019 to ESG-2020	-0.334	0.121	0.006
From WACC-2020 to ESG-2021	-0.015	0.135	0.912
From WACC-2021 to ESG-2022	-0.093	0.094	0.323
From WACC-2022 to ESG-2023	-0.012	0.072	0.865

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 819.218$, $df=81$, $p\text{-value} = <.001$, CFI = 0.977, TLI = 0.966, RMSEA = 0.087, SRMR = 0.033

Source: Authors' own work in R Studio, using Refinitiv data

As shown in Table 3, there are only 3 significant cross-lagged coefficients from ESG to WACC. From 2018 to 2019 and from 2019 to 2020 the coefficients are negative, while from 2020 to 2021 the coefficient is positive. This leads to the conclusion that there is a mixed influence from ESG to WACC, i.e. higher ESG performance does not significantly negatively or positively affect cost of capital, measured by WACC. However, a deep-dive is required, especially considering the period analyzed: while the expected negative relation between WACC and ESG is found in pre-

pandemic years, the positive coefficient is specific to pandemic years, 2020 and 2021. This can be explained by the surge in ESG popularity at the beginning of 2020 and the record inflows in sustainable funds (US Sustainable Investment Forum, 2020), coinciding with the COVID-19 outbreak, causing cost of capital to rise. For instance, there was a record inflow of \$51.1 billion into US sustainable funds in 2020, a more than tenfold increase compared to 2018, while global sustainable fund assets reached nearly \$1.7 trillion by year-end, highlighting a surge in ESG investing during the pandemic (Morningstar, 2021). Global green, social and sustainability bond issuances also reached approximately \$700 billion in the same year, almost double than in 2019 (Climate Bonds Initiative, 2021).

From a reverse causality perspective, there is some evidence that a high weighted average cost of capital might be associated with a low ESG performance, given by 3 statistically significant coefficients, from WACC-2016 to ESG-2017, WACC-2018 to ESG-2019 and WACC-2019 to ESG-2020. This could be explained by the fact that poorly performing companies do not have the financial resources to invest in ESG initiatives, given their high capital cost, which highlights other structural financial issues. Reciprocally, highly performing companies invest in improving their ESG performance without having certain budgetary constraints, seeking potential long-term gains.

According to the literature, a well-fitted model has CFI and TLI values above or equal to 0.90 as well as RMSEA and SRMR values below or equivalent to 0.05 (Hu & Bentler, 1999). When analyzing the model fit indices, overall, the models fit the data well, apart from the RMSEA value.

As shown in the Appendix (Table A3, Table A4) the results of the same analysis at the regional level are consistent with the results at total sample level.

5.2. ESG and cost of debt

Table 4 illustrates the results of the RI-CLPM model of ESG and cost of debt over time, focusing on the cross-lagged coefficients. Autoregressive coefficients are reported in Appendix (Table A5), all statistically significant.

As shown in Table 4, out of seven cross-lagged coefficients, only two are not statistically significant, from 2020 to 2021 and from 2022 to 2023. As these correspond to COVID-19 pandemic years, the same conclusion as Tanjung (2023) can be partially reached: during these troubled times, ESG performing firms did not actually benefit from lower cost of debt, with the exception of 2021 to 2022. This also relates to the findings of Gonçalves et al. (2022) that ESG could not influence firms' cost of debt in times of crisis.

All the other five coefficients are negative and statistically significant, which leads to the conclusion that there is a significant negative influence of ESG to cost of debt across most of the analysed period. That is, higher ESG performance negatively affects cost of debt, especially in non-pandemic years. However, the analysis performed at regional level reveals that these results can not be generalized – while for companies in the United States and Canada the results are similar with the total sample level (Appendix, Table A6), none of the coefficients are statistically significant when the analysis was performed for companies in Asia/Pacific (Appendix, Table A6). These results align with Ruan and Liu (2021) who remark that companies in emerging markets, where ESG frameworks are still evolving, do not necessarily benefit from increased ESG practices.

When analyzing the model fit indices, overall, the model fits the data well.

Table 4. Random intercept cross-lagged panel model of ESG and cost of debt over time

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to COD-2017	-0.003	0.001	0.004
From ESG-2017 to COD-2018	-0.002	0.001	0.009
From ESG-2018 to COD-2019	-0.003	0.001	0.005
From ESG-2019 to COD-2020	-0.007	0.002	0.000
From ESG-2020 to COD-2021	-0.003	0.002	0.151
From ESG-2021 to COD-2022	-0.005	0.002	0.009
From ESG-2022 to COD-2023	-0.002	0.001	0.203
From COD-2016 to ESG-2017	0.02	0.23	0.930
From COD-2017 to ESG-2018	-0.021	0.348	0.953
From COD-2018 to ESG-2019	-0.325	0.326	0.319
From COD-2019 to ESG-2020	-0.045	0.379	0.905
From COD-2020 to ESG-2021	-0.155	0.239	0.517
From COD-2021 to ESG-2022	-0.271	0.45	0.547
From COD-2022 to ESG-2023	0.528	0.275	0.055

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 417.793$, $df=81$, $p\text{-value} = <.001$, CFI = 0.988, TLI = 0.983, RMSEA = 0.059, SRMR = 0.037

Source: Authors' own work in R Studio, using Refinitiv data

5.3. ESG and cost of equity

Table 5 illustrates the results of the RI-CLPM model of ESG and cost of equity over time, focusing on the cross-lagged coefficients. Autoregressive coefficients are reported in Appendix (Table A8), all statistically significant.

As shown in Table 5, there are only 4 significant cross-lagged coefficients from ESG to cost of equity. From 2018 to 2019, from 2019 to 2020 and from 2022 to 2023 the coefficients are negative, while from 2020 to 2021 the coefficient is positive. This leads to the conclusion that there is a mixed influence from ESG to cost of equity, i.e. higher ESG performance does not significantly negatively or positively affect cost of equity, which questions the general perception that equity investors are more ESG-conscious. Moreover, the significant coefficient from ESG-2020 to COE-2021 could suggest that, during extraordinary circumstances, ESG initiatives can be perceived by investors as costs that negatively affect financial performance in the short and medium term.

When analyzing the model fit indices, overall, the models fit the data well, considering the same remark as the one made for the ESG and weighted average cost of capital for the RMSEA value.

As shown in the Appendix (Table A9, Table A10), the results of the same analysis at the regional level are consistent with the results at total sample level.

Table 5. Random intercept cross-lagged panel model of ESG and cost of equity over time

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to COE-2017	0.003	0.003	0.346
From ESG-2017 to COE-2018	-0.003	0.002	0.102
From ESG-2018 to COE-2019	-0.016	0.003	0.000
From ESG-2019 to COE-2020	-0.017	0.004	0.000
From ESG-2020 to COE-2021	0.017	0.004	0.000
From ESG-2021 to COE-2022	0.008	0.004	0.052
From ESG-2022 to COE-2023	-0.012	0.004	0.003
From COE-2016 to ESG-2017	-0.109	0.062	0.076
From COE-2017 to ESG-2018	-0.006	0.061	0.926
From COE-2018 to ESG-2019	-0.119	0.062	0.053
From COE-2019 to ESG-2020	-0.262	0.076	0.001
From COE-2020 to ESG-2021	-0.062	0.076	0.415
From COE-2021 to ESG-2022	-0.064	0.058	0.273
From COE-2022 to ESG-2023	-0.07	0.046	0.128

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 1193.86$, $df=81$, $p\text{-value} = <.001$, CFI = 0.966, TLI = 0.949, RMSEA = 0.107, SRMR = 0.028

Source: Authors' own work in R Studio, using Refinitiv data

6. Conclusions

The relationship between ESG performance and cost of capital has become an increasingly popular topic, especially in the context of sustainable finance. ESG scores provide a fair quantitative assessment of the sustainability of a company, but empirical studies on the link between these scores and the cost of capital are rather scarce.

This paper provides significant empirical evidence on this relationship, using a novel approach, structural equation modelling, on a global dataset, over an extensive timeframe. Concretely, the research performed shows that ESG performance does not have a consistent significant impact on cost of capital and cost of equity. Although a significant negative relationship is found in some pre-pandemic years, this is not consistent throughout the entire analysed period. Moreover, in the turbulent pandemic years 2020 and 2021, an interesting positive relationship between ESG performance and cost of capital was found, suggesting that crises can cause significant shifts in investor perception of sustainability, in general. This was evidenced by record inflows in global sustainable funds during the pandemic as investors increasingly looked for more resilient investments.

A significant negative relationship is found between ESG performance and debt cost at the total sample level, explained by the growth of green credit practices, which finance not only 'specific environmentally friendly projects' but also adopt actions to prevent capital from reaching environmentally damaging uses, as mentioned by Tian, Wang and Wu (2023). Even so, a statistically insignificant relationship was found in some years of pandemics, which confirms the

findings of other authors that crises have a disruptive effect on the potential of ESG to positively shape financial performance. Moreover, as shown in the robustness analysis, regional contexts might limit ESG's ability to reduce debt costs.

These dynamics have significant implications for economic and financial resilience. The reduction in cost of debt strengthens firms' ability to access stable financing and maintain liquidity during economic downturns, enhancing their long-term sustainability and adaptability. Despite this, the varied impact on cost of equity suggests that ESG-driven capital structure adjustments must be carefully managed to balance investor expectations and cost efficiency.

From a broader perspective, ESG integration contributes to greater macroeconomic stability by promoting responsible investment practices, reducing systemic financial risks, and promoting long-term sustainability in capital markets. Policymakers and financial institutions should continue to refine ESG-related regulations, credit risk assessments, and investment criteria to ensure that both the debt and equity markets accurately reflect the risk-mitigating benefits of ESG, while acknowledging potential cost variations.

Despite the robustness of the methodology and the significance of the findings, there are certain limitations that must be acknowledged. First, the generalisability of the results may be constrained by the study's focus on a sample comprised mainly of companies in North America. Variations in different national contexts, regulatory frameworks, and market dynamics could influence the relationship between ESG and capital cost. Future research could aim at expanding the scope of the analysis to include a more diverse sample, depending on the availability of the data. Second, the availability and quality of ESG data can be a limiting factor; as highlighted by Berg et al. (2022), there is a divergence in ESG scoring between multiple ESG rating agencies. Third, the study acknowledges the possibility of omitted variable bias, where the exclusion of certain relevant factors could potentially influence the observed relationships. Future research could explore additional moderating factors, such as sector-specific variations, regulatory environments, and investor preferences. Additionally, new variables could be used in the model, such as the growth rate of a company, the profitability, and the size of the company. An approach centred on the impact of the three ESG on these variables could also provide valuable information on the moderating role of ESG on financial resilience.

Acknowledgements

This work was partially supported by the project “Societal and Economic Resilience within multi-hazards environment in Romania” funded by the European Union – NextGenerationEU and the Romanian Government, under the National Recovery and Resilience Plan for Romania, contract no. 760050/23.05.2023, cod PNRR-C9-I8-CF 267/29.11.2022, through the Romanian Ministry of Research, Innovation and Digitalization, within Component C9, Investment I8.

We thank the two anonymous Reviewers for their valuable feedback comments which helped improve the quality of this paper.

Appendix

Table A1. Descriptive statistics

	Mean	Median	SD	Minimum	Maximum	Skewness	Kurtosis
WACC_2016	6.96	6.72	2.59	1.80	18.49	0.72	0.86
WACC_2017	6.97	6.66	2.55	2.53	18.92	1.18	2.37
WACC_2018	7.43	7.21	2.54	2.71	18.64	1.10	2.17
WACC_2019	7.00	6.86	2.39	2.02	18.80	0.68	1.09

	Mean	Median	SD	Minimum	Maximum	Skewness	Kurtosis
WACC_2020	6.13	6.01	2.21	1.39	16.71	0.47	0.59
WACC_2021	6.73	6.52	2.60	1.46	19.64	0.62	0.79
WACC_2022	8.03	7.68	2.69	2.79	19.87	1.14	2.18
WACC_2023	7.50	7.13	2.19	2.52	19.03	1.30	2.73
COD_2016	2.66	2.56	1.27	0.00	13.44	1.49	8.73
COD_2017	2.62	2.61	1.11	0.03	10.08	0.40	2.15
COD_2018	3.04	3.08	1.17	0.03	6.84	-0.16	0.75
COD_2019	2.69	2.69	1.17	0.09	6.81	0.09	0.68
COD_2020	2.40	2.18	1.28	0.03	13.54	1.55	7.28
COD_2021	2.02	2.02	1	0.01	7.35	0.56	1.65
COD_2022	3.69	3.78	1.14	0.04	9.70	-0.24	2.09
COD_2023	4.31	4.44	1.25	0.00	17.06	0.92	15.07
COE_2016	8.72	8.48	3.37	0.59	26.05	0.69	1.25
COE_2017	8.64	8.16	3.38	2.01	27.89	1.38	3.53
COE_2018	9.05	8.6	3.34	2.90	28.28	1.49	4.49
COE_2019	8.80	8.51	3.17	2.27	29.21	1.29	4.61
COE_2020	8.05	7.75	3.1	1.13	22.28	0.79	1.36
COE_2021	8.86	8.47	3.72	1.18	29.89	1.24	3.52
COE_2022	9.98	9.38	3.78	2.71	29.97	1.56	3.61
COE_2023	9.13	8.5	3.16	3.20	29.21	1.74	4.70
ESG_2016	49.22	49.59	20.45	2.28	93.50	-0.05	-0.87
ESG_2017	52.09	53.6	19.77	3.16	92.21	-0.17	-0.78
ESG_2018	55.08	57	19.19	3.18	93.86	-0.27	-0.70
ESG_2019	57.43	59.79	18.51	3.86	94.60	-0.35	-0.62
ESG_2020	60.40	62.59	17.42	4.45	93.90	-0.43	-0.45
ESG_2021	62.93	65.3	16.57	6.89	95.10	-0.57	-0.22
ESG_2022	64.74	67.04	15.38	8.31	95.57	-0.69	0.16
ESG_2023	65.65	68.46	14.70	8.43	95.53	-0.73	0.23

Source: Authors' own work in R Studio, using Refinitiv data

Table A2. Autoregressive coefficients for the Random intercept cross-lagged panel model of ESG and weighted average cost of capital over time

Parameter	Coef.	Std. Err.	p-value
Within entity			
Autoregressive relations			
ESG-2016 to ESG-2017	0.903	0.016	0.000
ESG-2017 to ESG-2018	0.911	0.016	0.000
ESG-2018 to ESG-2019	0.895	0.018	0.000
ESG-2019 to ESG-2020	0.855	0.026	0.000
ESG-2020 to ESG-2021	0.877	0.028	0.000
ESG-2021 to ESG-2022	0.845	0.036	0.000
ESG-2022 to ESG-2023	0.892	0.031	0.000
WACC-2016 to WACC-2017	0.696	0.015	0.000
WACC-2017 to WACC-2018	0.94	0.016	0.000
WACC-2018 to WACC-2019	1.08	0.026	0.000
WACC-2019 to WACC-2020	0.694	0.023	0.000
WACC-2020 to WACC-2021	0.737	0.018	0.000
WACC-2021 to WACC-2022	0.92	0.012	0.000
WACC-2022 to WACC-2023	0.851	0.02	0.000

Source: Authors' own work in R Studio, using Refinitiv data

Table A3. Random intercept cross-lagged panel model of ESG and weighted average cost of capital over time for companies in the United States and Canada region

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to WACC-2017	0.015	0.01	0.133
From ESG-2017 to WACC-2018	0.013	0.008	0.096
From ESG-2018 to WACC-2019	0.059	0.052	0.256
From ESG-2019 to WACC-2020	0.36	1.588	0.821
From ESG-2020 to WACC-2021	-0.089	0.079	0.262
From ESG-2021 to WACC-2022	-0.012	0.006	0.057
From ESG-2022 to WACC-2023	-0.063	0.012	0.000
From WACC-2016 to ESG-2017	0.505	0.271	0.063
From WACC-2017 to ESG-2018	1.1	0.569	0.053
From WACC-2018 to ESG-2019	1.72	1.533	0.262
From WACC-2019 to ESG-2020	15.636	70.582	0.825
From WACC-2020 to ESG-2021	-3.863	3.158	0.221
From WACC-2021 to ESG-2022	-1.639	0.523	0.002

From WACC-2022 to ESG-2023	-0.627	0.187	0.001
----------------------------	---------------	--------------	--------------

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 485.57$, $df=81$, $p\text{-value} = <.001$, $CFI = 0.978$, $TLI = 0.967$, $RMSEA = 0.089$, $SRMR = 0.091$

Source: Authors' own work in R Studio, using Refinitiv data

Table A4. Random intercept cross-lagged panel model of ESG and weighted average cost of capital over time for companies in Asia/Pacific region

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to WACC-2017	0.003	0.003	0.394
From ESG-2017 to WACC-2018	-0.006	0.002	0.005
From ESG-2018 to WACC-2019	-0.016	0.005	0.001
From ESG-2019 to WACC-2020	-0.014	0.006	0.013
From ESG-2020 to WACC-2021	0.034	0.01	0.001
From ESG-2021 to WACC-2022	0.001	0.002	0.659
From ESG-2022 to WACC-2023	-0.013	0.005	0.007
From WACC-2016 to ESG-2017	-0.308	0.192	0.108
From WACC-2017 to ESG-2018	-0.504	0.158	0.001
From WACC-2018 to ESG-2019	-0.355	0.173	0.041
From WACC-2019 to ESG-2020	-0.91	0.412	0.027
From WACC-2020 to ESG-2021	1.373	0.573	0.017
From WACC-2021 to ESG-2022	-0.165	0.21	0.433
From WACC-2022 to ESG-2023	0.267	0.143	0.061

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 307.10$, $df=81$, $p\text{-value} = <.001$, $CFI = 0.967$, $TLI = 0.951$, $RMSEA = 0.101$, $SRMR = 0.189$

Source: Authors' own work in R Studio, using Refinitiv data

Table A5. Autoregressive coefficients for the Random intercept cross-lagged panel model of ESG and cost of debt over time

Parameter	Coef.	Std. Err.	p-value
Within entity			
Autoregressive relations			
ESG-2016 to ESG-2017	0.916	0.019	0.000
ESG-2017 to ESG-2018	0.915	0.02	0.000
ESG-2018 to ESG-2019	0.905	0.023	0.000
ESG-2019 to ESG-2020	0.871	0.033	0.000
ESG-2020 to ESG-2021	0.881	0.034	0.000
ESG-2021 to ESG-2022	0.852	0.045	0.000
ESG-2022 to ESG-2023	0.899	0.038	0.000
COD-2016 to COD-2017	0.487	0.021	0.000
COD-2017 to COD-2018	0.711	0.028	0.000
COD-2018 to COD-2019	0.661	0.026	0.000
COD-2019 to COD-2020	0.527	0.049	0.000
COD-2020 to COD-2021	0.294	0.028	0.000
COD-2021 to COD-2022	0.328	0.061	0.000
COD-2022 to COD-2023	0.904	0.038	0.000

Source: Authors' own work in R Studio, using Refinitiv data

Table A6. Random intercept cross-lagged panel model of ESG and cost of debt over time for companies in the United States and Canada region

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to COD-2017	-0.004	0.002	0.017
From ESG-2017 to COD-2018	0.000	0.001	0.736
From ESG-2018 to COD-2019	-0.004	0.001	0.015
From ESG-2019 to COD-2020	-0.016	0.003	0.000
From ESG-2020 to COD-2021	-0.003	0.003	0.251
From ESG-2021 to COD-2022	-0.007	0.003	0.013
From ESG-2022 to COD-2023	-0.005	0.004	0.167
From COD-2016 to ESG-2017	-0.566	0.262	0.031
From COD-2017 to ESG-2018	-0.533	0.369	0.148
From COD-2018 to ESG-2019	-0.114	0.435	0.793
From COD-2019 to ESG-2020	-0.394	0.438	0.368
From COD-2020 to ESG-2021	-0.298	0.259	0.249
From COD-2021 to ESG-2022	-0.467	0.559	0.403

From COD-2022 to ESG-2023	0.164	0.311	0.598
---------------------------	-------	-------	-------

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 213.08$, $df=81$, $p\text{-value} = <.001$, $CFI = 0.991$, $TLI = 0.986$, $RMSEA = 0.051$, $SRMR = 0.035$

Source: Authors' own work in R Studio, using Refinitiv data

Table A7. Random intercept cross-lagged panel model of ESG and cost of debt over time for companies in the Asia/Pacific region

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to COD-2017	0.002	0.002	0.332
From ESG-2017 to COD-2018	-0.002	0.002	0.446
From ESG-2018 to COD-2019	0.000	0.002	0.975
From ESG-2019 to COD-2020	0.002	0.003	0.496
From ESG-2020 to COD-2021	0.003	0.003	0.363
From ESG-2021 to COD-2022	0.004	0.004	0.31
From ESG-2022 to COD-2023	-0.009	0.007	0.229
From COD-2016 to ESG-2017	1.094	0.619	0.077
From COD-2017 to ESG-2018	1.011	0.937	0.281
From COD-2018 to ESG-2019	0.446	0.545	0.413
From COD-2019 to ESG-2020	0.732	0.748	0.328
From COD-2020 to ESG-2021	0.232	0.528	0.66
From COD-2021 to ESG-2022	-0.022	0.577	0.97
From COD-2022 to ESG-2023	1.034	0.667	0.121

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 142.17$, $df=81$, $p\text{-value} = <.001$, $CFI = 0.989$, $TLI = 0.983$, $RMSEA = 0.053$, $SRMR = 0.034$

Source: Authors' own work in R Studio, using Refinitiv data

Table A8. Autoregressive coefficients for the Random intercept cross-lagged panel model of ESG and cost of equity over time

Parameter	Coef.	Std. Err.	p-value
Within entity			
Autoregressive relations			
ESG-2016 to ESG-2017	0.914	0.015	0.000
ESG-2017 to ESG-2018	0.918	0.016	0.000
ESG-2018 to ESG-2019	0.903	0.018	0.000
ESG-2019 to ESG-2020	0.865	0.024	0.000
ESG-2020 to ESG-2021	0.884	0.026	0.000
ESG-2021 to ESG-2022	0.858	0.033	0.000
ESG-2022 to ESG-2023	0.902	0.026	0.000
COE-2016 to COE-2017	0.87	0.018	0.000
COE-2017 to COE-2018	0.928	0.011	0.000
COE-2018 to COE-2019	0.793	0.017	0.000
COE-2019 to COE-2020	0.768	0.022	0.000
COE-2020 to COE-2021	1.082	0.02	0.000
COE-2021 to COE-2022	0.926	0.014	0.000
COE-2022 to COE-2023	0.768	0.012	0.000

Source: Authors' own work in R Studio, using Refinitiv data

Table A9. Random intercept cross-lagged panel model of ESG and cost of equity over time for companies in the United States and Canada region

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to COE-2017	-0.006	0.005	0.194
From ESG-2017 to COE-2018	0.004	0.003	0.276
From ESG-2018 to COE-2019	0.022	0.007	0.001
From ESG-2019 to COE-2020	0.018	0.025	0.464
From ESG-2020 to COE-2021	-2.106	3.074	0.493
From ESG-2021 to COE-2022	-0.02	0.003	0.000
From ESG-2022 to COE-2023	-0.006	0.002	0.003
From COE-2016 to ESG-2017	0.091	0.069	0.186
From COE-2017 to ESG-2018	0.251	0.079	0.001
From COE-2018 to ESG-2019	0.08	0.093	0.386
From COE-2019 to ESG-2020	0.514	0.191	0.007
From COE-2020 to ESG-2021	0.728	1.097	0.507
From COE-2021 to ESG-2022	-0.013	0.074	0.855

From COE-2022 to ESG-2023	0.005	0.077	0.95
---------------------------	-------	-------	------

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 716.77$, $df=81$, $p\text{-value} = <.001$, $CFI = 0.968$, $TLI = 0.952$, $RMSEA = 0.112$, $SRMR = 0.193$

Source: Authors' own work in R Studio, using Refinitiv data

Table A10. Random intercept cross-lagged panel model of ESG and cost of equity over time for companies in the Asia/Pacific region

Parameter	Coefficient	Std. Err.	p-value
Within entity			
Cross-lagged relations			
From ESG-2016 to COE-2017	0.007	0.005	0.14
From ESG-2017 to COE-2018	-0.012	0.004	0.006
From ESG-2018 to COE-2019	-0.023	0.006	0.000
From ESG-2019 to COE-2020	-0.012	0.007	0.098
From ESG-2020 to COE-2021	0.061	0.011	0.000
From ESG-2021 to COE-2022	0.011	0.006	0.062
From ESG-2022 to COE-2023	-0.016	0.008	0.058
From COE-2016 to ESG-2017	-0.086	0.134	0.518
From COE-2017 to ESG-2018	-0.122	0.112	0.274
From COE-2018 to ESG-2019	-0.149	0.121	0.22
From COE-2019 to ESG-2020	-0.788	0.311	0.011
From COE-2020 to ESG-2021	0.815	0.332	0.014
From COE-2021 to ESG-2022	0.205	0.188	0.274
From COE-2022 to ESG-2023	0.269	0.146	0.066

Significant coefficients are shown in bold.

Model fit indices: $\chi^2 = 439.46$, $df=81$, $p\text{-value} = <.001$, $CFI = 0.948$, $TLI = 0.923$, $RMSEA = 0.127$, $SRMR = 0.336$

Source: Authors' own work in R Studio, using Refinitiv data

References

- Bartkoski, N.N., Sharfman, M.P. and Fernando, C. S., 2010. Environmental Risk Management and Cost of Capital: An International Perspective. *Academy of Management Proceedings*, 2010(1), pp.1-6. <https://doi.org/10.5465/ambpp.2010.54496164>.
- Berg, F., Koelbel, J.F. and Rigobon, R., 2022. Aggregate confusion: The divergence of ESG ratings. *Review of Finance*, 26(6), pp.1315-1344.
- Berk, I., Guidolin, M. and Magnani, M., 2023. New ESG rating drivers in the cross - section of European stock returns. *Journal of Financial Research*, 46(S1). <https://doi.org/10.1111/jfir.12356>.
- Bhuiyan, M.B.U. and Nguyen, T.H.N., 2019. Impact of CSR on cost of debt and cost of capital: Australian evidence. *Social Responsibility Journal*, 16(3), pp.419-430. <https://doi.org/10.1108/srj-08-2018-0208>.
- Chava, S., 2014. Environmental Externalities and Cost of Capital. *Management Science*, 60(9), pp.2223-2247. <https://doi.org/10.1287/mnsc.2013.1863>.
- Chin, W.W., 1998. The partial least squares approach to structural equation modeling. *Modern methods for business research*, 295(2), pp.295-336.
- Chouaibi, Y., Rossi, M. and Zouari, G., 2021. The Effect of Corporate Social Responsibility and the Executive Compensation on Implicit Cost of Equity: Evidence from French ESG Data. *Sustainability*, 13(20). <https://doi.org/10.3390/su132011510>.
- Climate Bonds Initiative., 2021. Sustainable Debt: Global State of the Market 2020. Climate Bonds Initiative. Retrieved from <https://www.climatebonds.net/resources>.
- El Ghouli, S., Guedhami, O., Kwok, C.C.Y. and Mishra, D.R., 2011. Does corporate social responsibility affect the cost of capital? *Journal of Banking & Finance*, 35(9), pp.2388-2406. <https://doi.org/10.1016/j.jbankfin.2011.02.007>.
- Eliwa, Y., Aboud, A. and Saleh, A., 2021. ESG practices and the cost of debt: Evidence from EU countries. *Critical Perspectives on Accounting*, 79. <https://doi.org/10.1016/j.cpa.2019.102097>.
- Falkenström, F., Solomonov, N. and Rubel, J.A., 2022. How to model and interpret cross-lagged effects in psychotherapy mechanisms of change research: A comparison of multilevel and structural equation models. *Journal of consulting and clinical psychology*, 90(5), pp.446–458. <https://doi.org/10.1037/ccp0000727>.
- Friede, G., Busch, T. and Bassen, A., 2015. ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, 5(4), pp.210-233. <https://doi.org/10.1080/20430795.2015.1118917>.
- Gonçalves, T., Dias, J. and Barros, V., 2022. Sustainability Performance and the Cost of Capital. *International Journal of Financial Studies*, 10(3). <https://doi.org/10.3390/ijfs10030063>.
- Hamaker, E.L., Kuiper, R.M. and Grasman, R.P., 2015. A critique of the cross-lagged panel model. *Psychol Methods*, 20(1), pp.102-116. <https://doi.org/10.1037/a0038889>.
- Hampl, F. and Vágnerová Linnertová, D., 2024. How do ESG controversies moderate the nexus between ESG performance and cost of capital? Evidence from European listed companies. *Managerial Finance*, 50(10), pp.1727-1746. <https://doi.org/10.1108/mf-12-2023-0762>.
- Hu, L. t. and Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modeling: a multidisciplinary journal*, 6(1), pp.1-55.

- Khan, M., Serafeim, G. and Yoon, A., 2016. Corporate sustainability: First evidence on materiality. *The accounting review*, 91(6), pp.1697-1724.
- Löffler, M., 2023. The impact of ESG scores on a firm's cost of capital (Doctoral dissertation, ZHAW Zürcher Hochschule für Angewandte Wissenschaften).
- Magnanelli, B.S. and Izzo, M.F., 2017. Corporate social performance and cost of debt: the relationship. *Social Responsibility Journal*, 13(2), pp.250-265. <https://doi.org/10.1108/srj-06-2016-0103>.
- Mehrabi, F., Iskríc, A. and Beshai, S., 2024. The temporal association between envy and depression symptoms over 6 months: A Random-Intercept Cross-Lagged Panel Study. *Current Psychology*, 43(11), pp.10122-10131. <https://doi.org/10.1007/s12144-023-05170-3>.
- Morningstar., 2021. Sustainable Fund Flows and Assets for Q4 and 2020. Morningstar Research Services. Retrieved from <https://www.morningstar.com/lp/sustainable-funds-flow-report>
- Moussa, A.S. and Elmarzouky, M., 2024. Beyond Compliance: How ESG Reporting Influences the Cost of Capital in UK Firms. *Journal of Risk and Financial Management*, 17(8). <https://doi.org/10.3390/jrfm17080326>.
- Mund, M. and Nestler, S., 2019. Beyond the cross-lagged panel model: Next-generation statistical tools for analyzing interdependencies across the life course. *Advances in Life Course Research*, 41, 100249. <https://doi.org/10.1016/j.alcr.2018.10.002>.
- Nazarova, V. and Lavrova, V., 2022. Do ESG Factors Influence Investment Attractiveness of the Public Companies? *Journal of Corporate Finance Research*, 16(1), pp.38-64. <https://doi.org/10.17323/j.jcfr.2073-0438.16.1.2022.38-64>.
- Ng, A.C. and Rezaee, Z., 2015. Business sustainability performance and cost of equity capital. *Journal of Corporate Finance*, 34, pp.128-149. <https://doi.org/10.1016/j.jcorpfin.2015.08.003>.
- Oikonomou, I., Brooks, C. and Pavelin, S., 2014. The Effects of Corporate Social Performance on the Cost of Corporate Debt and Credit Ratings. *Financial Review*, 49(1), pp.49-75. <https://doi.org/10.1111/fire.12025>.
- Pedersen, L.H., Fitzgibbons, S. and Pomorski, L., 2021. Responsible investing: The ESG-efficient frontier. *Journal of Financial Economics*, 142(2), pp.572-597. <https://doi.org/10.1016/j.jfineco.2020.11.001>.
- Piechocka-Kaluzna, A., Tluczak, A. and Lopatka, P., 2021. The Impact of CSR/ESG Reporting on the Cost of Capital: An Example of US Healthcare Entities. *European Research Studies Journal*, XXIV(Special Issue 3), pp.679-690. <https://doi.org/10.35808/ersj/2502>.
- Possebon, E.A.G., Cippiciani, F.A., Savoia, J.R.F. and de Mariz, F., 2024. ESG Scores and Performance in Brazilian Public Companies. *Sustainability*, 16(13). <https://doi.org/10.3390/su16135650>.
- Priem, R. and Gabbellone, A., 2024. The impact of a firm's ESG score on its cost of capital: can a high ESG score serve as a substitute for a weaker legal environment. *Sustainability Accounting, Management and Policy Journal*. <https://doi.org/10.1108/sampj-05-2023-0254>.
- Ramirez, A.G., Monsalve, J., González-Ruiz, J.D., Almonacid, P. and Peña, A., 2022. Relationship between the Cost of Capital and Environmental, Social, and Governance Scores: Evidence from Latin America. *Sustainability*, 14(9). <https://doi.org/10.3390/su14095012>.
- Ruan, L. and Liu, H., 2021. Environmental, Social, Governance Activities and Firm Performance: Evidence from China. *Sustainability*, 13(2). <https://doi.org/10.3390/su13020767>.

- Suto, M. and Takehara, H., 2017. CSR and cost of capital: evidence from Japan. *Social Responsibility Journal*, 13(4), pp.798-816. <https://doi.org/10.1108/srj-10-2016-0170>.
- Tanjung, M., 2023. Cost of capital and firm performance of ESG companies: what can we infer from COVID-19 pandemic? *Sustainability Accounting, Management and Policy Journal*, 14(6), pp.1242-1267. <https://doi.org/10.1108/sampj-07-2022-0396>
- Tian, G., Wang, K.T. and Wu, Y., 2023. Does the market value the green credit performance of banks? Evidence from bank loan announcements. *The British Accounting Review*, 101282.
- US Sustainable Investment Forum., 2020. Report on US sustainable and impact investing trends 2020. The Forum for Sustainable and Responsible Investment.
- Usami, S., 2020. On the Differences between General Cross-Lagged Panel Model and Random-Intercept Cross-Lagged Panel Model: Interpretation of Cross-Lagged Parameters and Model Choice. *Structural equation modeling: a multidisciplinary journal*, 28(3), pp.331-344. <https://doi.org/10.1080/10705511.2020.1821690>.
- Yeh, C.-C., Lin, F., Wang, T.-S. and Wu, C.-M., 2020. Does corporate social responsibility affect cost of capital in China? *Asia Pacific Management Review*, 25(1), pp.1-12. <https://doi.org/10.1016/j.apmr.2019.04.001>.