European Journal of Sustainable Development Research
2026, 10(3), em0402
e-ISSN: 2542-4742
https://www.ejosdr.com/

MODESTUM

Research Article

OPEN ACCESS

Social and environmental trends in ESG financing: New challenges for optimizing the value of capital of companies

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Citation: Sokolenko, L., Petrukha, N., Petrukha, S., Khrystenko, L., & Akimov, O. (2026). Social and environmental trends in ESG financing: New challenges for optimizing the value of capital of companies. *European Journal of Sustainable Development Research, 10*(3), em0402. https://doi.org/10.29333/ejosdr/18523

ARTICLE INFO

Received: 23 Dec 2025

Accepted: 25 Mar 2026

ABSTRACT

The study examines the impact of environmental and social ESG factors on the cost of capital of companies in the context of sustainable development. Its purpose is to assess how the integration of ESG indicators influences financial efficiency, particularly the weighted average cost of capital (WACC), and to identify industry- and region-specific differences in this impact. The methodology is based on a quantitative analysis of panel data from publicly listed companies for the period 2015–2023, using ESG ratings from MSCI and Sustainalytics. The results demonstrate that stronger ESG performance is generally associated with a lower cost of both equity and debt capital, contributing to improved long-term financial sustainability. The most pronounced effects are observed in capital-intensive sectors such as industry, energy, and mining, where environmental standards reduce credit risks. Regionally, the strongest ESG impact is found in the European Union and North America due to advanced regulatory frameworks. The study proposes methodological approaches and practical tools for integrating ESG factors into financial analysis and corporate strategic planning.

Keywords: ESG, sustainable development, cost of capital, financial activities, financing, cost of capital

INTRODUCTION

Capital markets are reacting more and more harshly to companies' non-financial risks. Environmental incidents, social conflicts, and management failures are directly reflected in higher risk premiums, increased debt costs, and restricted access to investment resources. In these conditions, ESG indicators have ceased to perform an exclusively reputational function and have become financially significant determinants of capital cost. Institutional investors, banks, and rating agencies systematically include environmental and social factors in their risk assessment models. Regulatory initiatives in the European Union, North America, and developed Asian markets are tightening ESG disclosure requirements and directly affecting financing terms (Makedon et al., 2025). As a result, a structural shift is taking place, with the financial performance of companies increasingly dependent on the quality of their ESG practices.

Despite a significant amount of empirical research, the impact of ESG factors on the cost of capital remains controversial. Some studies report a decrease in the weighted average cost of capital as ESG ratings increase, while others point to industry or regional heterogeneity in effects. Assessments of the role of individual E and S components in shaping the cost of equity and debt capital, as well as the mechanisms of their transmission through financial risks, remain insufficiently consistent. The problem is exacerbated by differences in the regulatory environment, the maturity of financial markets, and ESG assessment standards. This complicates the universal interpretation of results and reduces the applied value of existing conclusions for strategic financial management of companies (Wong et al., 2024).

Previous studies of the impact of ESG on capital costs have produced a contradictory empirical picture, in which the results depend significantly on the choice of sample, measurement methods, and institutional context. Some studies report positive financial effects, while others find no stable relationships or indicate that they are conditional. This study takes a step forward by moving from general correlations to a clearly identified financial effect, allowing ESG to be interpreted as a systemic element of the cost of capital formation mechanism.

Analysis Recent Research and Publications

The works of Gillan et al. (2021) and Tsang et al. (2023) present the results of a systematic review of studies on the role of ESG and CSR in corporate finance. They show that companies' environmental and social practices are increasingly being integrated into risk assessment models and influencing investment decisions. However, questions remain unresolved regarding the quantitative differentiation of the impact of individual ESG components on the cost of equity and debt capital. This is due to the heterogeneity of methodologies, differences in ESG rating sources, and the heterogeneity of samples across countries and sectors. However, the accumulated results confirm the financial significance of ESG factors and provide a basis for further empirical research.

The studies by Ernst and Woithe (2024) and Wong et al. (2024) present empirical estimates of the impact of ESG ratings on the cost of capital of US companies. It is shown that high ESG scores are associated with a reduction in the cost of equity due to lower systematic risk. At the same time, the authors note ambiguous results regarding WACC. Questions remain unresolved regarding the impact of capital structure and the role of industry differences. This is due to the complexity of separating the ESG effect from macroeconomic and financial factors, as well as limitations in the time horizons of the data. However, these studies demonstrate the need for broader interregional analysis.

The works of Bergsagel and Vangberg (2024), Kossentini et al. (2024), and Malich and Husi (2024) examine the European context of ESG financing. They show that for large EU companies, ESG indicators significantly reduce both the cost of debt and the cost of equity. However, questions remain about the stability of this effect across different sectors and under different regulatory regimes. An objective reason for this is the high dependence of the results on the level of regulatory maturity and the quality of non-financial disclosure. Nevertheless, the results confirm the growing role of ESG in shaping financial stability.

Studies by Cheng et al. (2025), Moussa and Elmarzouky (2024), and Mandas et al. (2024) focus on the transmission channels of ESG impact through debt financing and reputational risks. It has been shown that ESG practices act as a signal to creditors and reduce credit spreads. At the same time, questions remain unresolved regarding the interaction of ESG with corporate governance and information asymmetry. The reason for this is the complexity of measuring reputational risk and the cost of collecting detailed ESG data.

The findings of Daoud Ellili (2022), Giannopoulos et al. (2022), and Pirgaip and Rizvić (2023) analyze the role of ESG disclosure and integrated reporting. They show that increased transparency reduces information asymmetry and has a positive impact on investment efficiency. However, the standardization of ESG disclosure and its comparability across countries remain controversial issues. This is due to differences in national requirements and the voluntary nature of many standards.

The works of Korchahina (2023), Lagodiyenko et al. (2024), and Polinkevich et al. (2025) examine the managerial and methodological aspects of integrating ESG into companies' financial strategies. It is shown that ESG management contributes to reducing financial risks but requires adaptation to industry conditions. At the same time, the relationship between environmental and social components and the cost of capital in a comparative international dimension has not been sufficiently researched.

All this gives reason to argue that it is advisable to conduct a study devoted to a comprehensive analysis of the impact of environmental and social ESG factors on the cost of capital, taking into account industry and regional differences.

RESEARCH METHODOLOGY

The study is based on a quantitative analysis of the relationship between ESG indicators and the cost of capital of commercial structures. For this, panel data of public companies from various industries and regions for the period 2015–2023 was used. The sources of information are MSCI and Sustainalytics ESG ratings, as well as financial data from Bloomberg (2024) which provide a comprehensive assessment of the quality of corporate governance and financial metrics of companies.

The study used dependent and independent variables. The dependent variables include cost of equity, cost of debt, and weighted average cost of capital (WACC). The independent variables are ESG indices, including the overall rating and individual components:

1) Environmental
2) Social
3) Governance

To control for the results, variables characterizing the company's size, industry, and region of location were taken into account. To test the research hypotheses and assess the impact of ESG indicators on the cost of capital of companies, an empirical analysis was conducted based on panel data of public companies from different industries and regions for the period 2015–2023. ESG data was obtained from MSCI ESG Ratings and Sustainalytics, and company financial indicators were obtained from Bloomberg (2024).

The dependent variables were cost of capital indicators:

1) Cost of equity
2) Cost of debt
3) Weighted average cost of capital (WACC)

The independent variables were overall ESG ratings and individual components:

1) Environmental
2) Social
3) Governance

The control variables were company size, industry and region of location.

The results of the analysis of 420 companies from 12 countries showed that an increase in ESG rating by 10 points on average reduces the weighted average cost of capital (WACC) by 0.18 percentage points (18 bp) Sustainalytics (2025). At the same time, the effect varies significantly by industry: The greatest impact is observed in capital-intensive

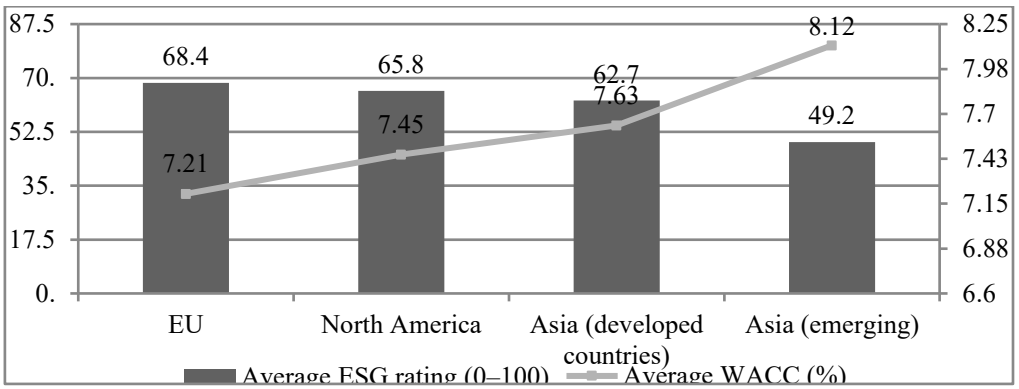

Figure 1. Empirical impact of ESG on cost of capital by region (Adapted from Malich & Husi, 2024; Sustainalytics, 2025)

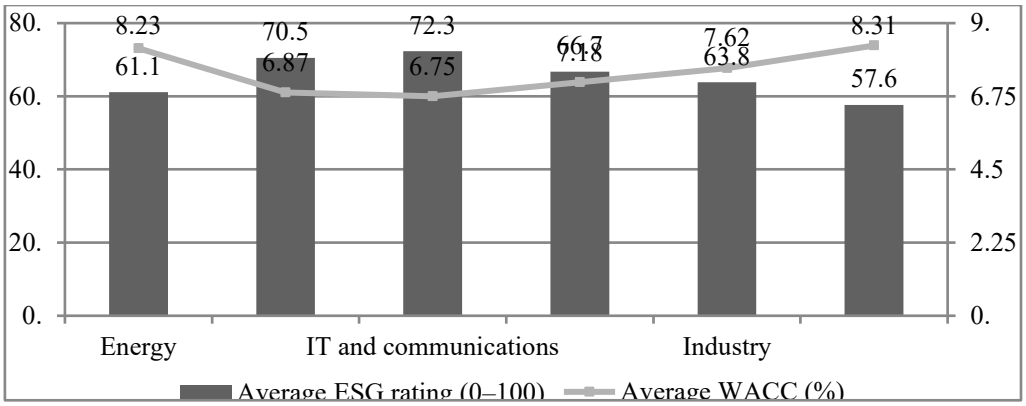

Figure 2. Empirical impact of ESG on the cost of capital by economic sector (Adapted from Malich & Husi, 2024; Sustainalytics, 2025)

sectors with high environmental risks (energy, chemicals, mining). Regional differences are also significant: In EU countries, the ESG effect is 1.5–2 times stronger than in countries with underdeveloped capital markets, which is due to the level of regulation and maturity of institutional investment. The panel is balanced: For each of the 420 companies, there are complete observations for 2015–2023 without gaps in the variables included in the basic specification. The sample was filtered according to the criteria of continuous listing, availability of simultaneous ESG ratings from two providers, and completeness of financial reporting.

The sample of 420 companies was formed based on the principle of financial market representativeness and the availability of comparable ESG and financial data for the period 2015–2023. The sample includes only public companies whose shares or bonds were actively traded throughout the observation period, and ESG ratings were available simultaneously in the MSCI and Sustainalytics databases. This restriction reduced the problem of data gaps and ensured the stability of the panel structure. The geographical composition of the sample covers 12 countries with varying levels of financial market development, which made it possible to assess the regional heterogeneity of ESG effects. The sectoral structure includes manufacturing, energy, finance, IT, and consumer sectors, i.e., areas with varying sensitivity to environmental and social risks. To assess the impact of ESG, a fixed-effects panel regression was used, as the Hausman test confirmed a systematic correlation between individual company characteristics and explanatory variables. The reliability of the results was verified using alternative model specifications, different ESG sources, and robust standard errors adjusted for heteroscedasticity and autocorrelation.

Table 1. Results of panel regressions of the impact of ESG on the cost of capital

Variable	WACC	Cost of equity	Cost of debt
Total ESG	−0.0018***	−0.0024***	−0.0012**
	(0.0006)	(0.0008)	(0.0005)
Environmental (E)	−0.0021***	−0.0028***	−0.0015**
	(0.0007)	(0.0009)	(0.0006)
Social (S)	−0.0014**	−0.0019**	−0.0009*
	(0.0006)	(0.0008)	(0.0005)
Management (G)	−0.0009*	−0.0016**	−0.0004
	(0.0005)	(0.0007)	(0.0004)
Fixed effects	Company, year	Company, year	Company, year
Number of observations	3,780	3,780	3,780
R^2 within	0.27	0.31	0.24

Control variables included company size, industry affiliation, and region, as these factors systematically affect the cost of capital and simultaneously correlate with ESG indicators. This choice allowed us to isolate the net effect of environmental and social ESG components on the cost of equity and debt capital.

The empirical impact of ESG on the cost of capital by region and by economic sector is presented in **Figures 1** and **2**.

Regression coefficients, interpreted as quantitative associations, are presented exclusively in **Table 1**, which allows for a clear distinction between descriptive and econometric levels of analysis. The strongest effect is observed

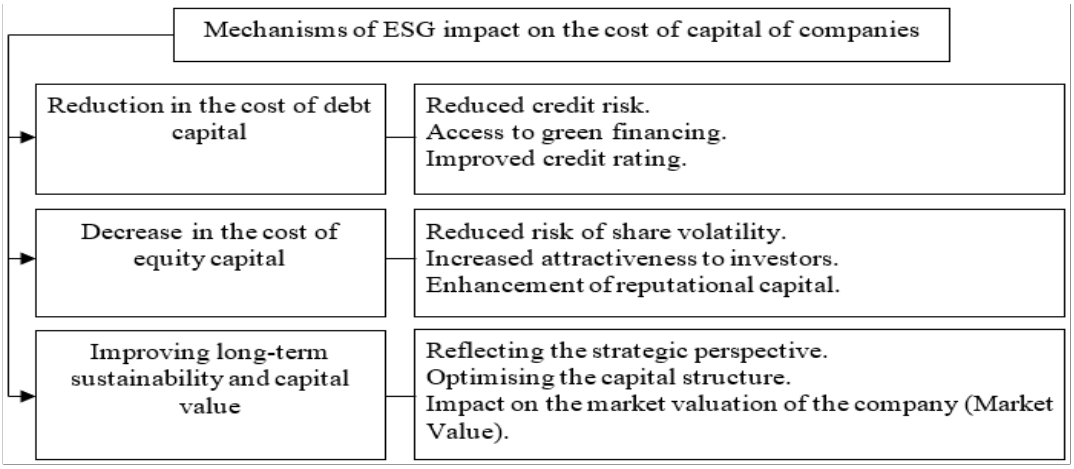

Figure 3. Mechanisms of ESG impact on companies' capital value (Source: Authors' own elaboration)

in energy and mining, where ESG directly impacts reputational and regulatory risks. Regulatory maturity of the market strengthens the link: In the EU, ESG indicators explain up to 29% of the variation in the cost of capital (GSIA, 2021). The IT sector shows the least sensitivity to ESG, reflecting lower environmental risk and higher capital flexibility. The average ESG effect (in the sample) is −0.18% to WACC for every 10 points of ESG improvement, which is consistent with the results of MSCI (Malich & Husi, 2024) and MDPI (Ernst & Woithe, 2024).

The results showed that improving a company's ESG metrics correlated with a decrease in the cost of capital, confirming hypothesis H1. The impact of ESG on WACC was also found to vary by industry and region, confirming hypothesis H2. In particular, environmental and social ESG components were more significant in the industrial and energy sectors, while governance practices had a greater effect on the financial sector. Geographically, the impact of ESG was more pronounced in countries with high levels of regulatory control and corporate governance transparency (Karolyi et al., 2025; Pirgaip & Rizvić, 2023).

Based on the results obtained, practical advice for companies and investors was formulated: integrating ESG into a financial strategy allows reducing the cost of capital, increase the investment attractiveness of companies, and strengthen their financial stability.

RESULTS

The concepts of ESG (Environmental, Social, Governance) and sustainable development are the foundations of the modern model of responsible entrepreneurship and finance. They form a new paradigm of corporate governance, in which economic efficiency is combined with social justice and environmental responsibility (United Nations, n.d.). In the current context of globalization and increasing attention to sustainable development, companies are faced with the need to take into account environmental, social and governance (ESG) factors in their strategy (Makedon et al., 2024, Sytnyk et al., 2022). Investors and regulators are increasingly evaluating companies not only by financial indicators, but also by the level of social responsibility and environmental efficiency. Analysis of these mechanisms allows us to understand how ESG practices can increase the financial sustainability of companies and reduce their cost of capital (**Figure 3**).

Incorporating environmental, social and governance (ESG) factors into companies' financial operations is becoming a key tool for improving economic sustainability and competitiveness in today's capital markets. Current approaches to ESG integration can be divided into several areas. First, corporations are adopting a strategy of transparent ESG reporting, which involves regular disclosure of environmental, social and governance metrics in financial reports and separate ESG documents (Giannopoulos et al., 2022). This allows investors to assess the company's risks and performance from a sustainable perspective and reduces information asymmetry.

Second, ESG risk management systems are being implemented that are integrated into corporate governance and financial planning. Such systems allow for the assessment of potential environmental and social risks, forecasting their impact on financial performance, and adapting investment decisions (Makedon et al., 2020). Third, companies are using sustainable development financial instruments, including green bonds, social and sustainability-linked bonds, which allows raising capital at lower costs for companies with high ESG indicators.

Fourth, integrating ESG into investment decision-making is becoming a priority for large institutional investors and banking institutions. The use of ESG ratings, assessing the impact of ESG components on portfolio risk and return allows organizations to optimize the cost of capital and increase investment attractiveness.

Modern research Wong et al. (2024), Priem and Gabellone (2024), Ganusich and Ganusich, (2025) show that the integration of ESG into the financial activities of companies has a positive impact on the cost of capital, reduces financial and reputational risks, increases investor confidence and promotes sustainable development of companies. At the same time, the effectiveness of ESG integration depends on industry specifics, regional market characteristics and the quality of corporate governance.

Thus, modern methods for integrating ESG into companies' financial activities involve a combination of

Table 2. Impact of overall ESG rating and its components on cost of equity and debt capital (WACC)

ESG component	Impact on equity value	Impact on the cost of debt capital	Impact on WACC
Overall ESG rating	Reduces the cost of equity	Reduces the cost of borrowed capital	Overall reduces WACC
Environmental (E)	Significantly reduces the cost of equity	Lowers credit spreads, reducing the cost of borrowed capital	WACC decline, especially in the industrial and energy sectors
Social (S)	Reduces the cost of equity by increasing investor confidence	Reduces the cost of borrowed capital	Positive impact on WACC in socially oriented companies
Management (G)	Mainly reduces the cost of equity	Less pronounced impact on debt capital	Moderate WACC reduction, depending on corporate governance

Table 3. Methodological approaches to assessing the effectiveness of ESG financing

Evaluation block	ESG financing goals	Key performance indicators	Calculation/evaluation methods
Economic (financial)	Ensuring investment profitability while taking into account sustainable development	NPV, IRR, ROI. Payback Period. Green Premium (reduced financing rate)	Classical financial methods (discounted cash flows, cost/benefit analysis)
Environmental	Reducing emissions, increasing energy efficiency, using "green" technologies	CO_2 reduction volume (tons/year). Energy intensity of products. Share of renewable energy in production (%). Waste utilization rate (%)	Life Cycle Assessment (LCA), integrated assessment of environmental impact, comparison with the baseline period
Social	Improving working conditions, developing human capital, inclusiveness	Employee satisfaction index. Share of women in management (%). Number of injuries/incidents. Personnel training costs (% of payroll)	Social Return on Investment (SROI), survey, HR analytics
Governance	Improving transparency, ethics, and quality of corporate governance	Share of independent directors (%). Availability of anti-corruption policies. ESG disclosure (information disclosure). Corporate transparency index	ESG scoring, expert assessment, content analysis of reports
Integral assessment (ESG Index)	Comprehensive measurement of ESG financing effectiveness	Aggregate ESG index (0–1 or 0–100). Integral assessment	Normalization, weighted aggregation (Saati hierarchy analysis method, expert assessments)

transparent reporting, risk management systems, the use of sustainable financial instruments, and the integration of ESG into the process of making strategic financial decisions. This allows companies not only to increase financial performance, but also to form long-term sustainability and attractiveness for investors (Bakarich et al., 2023).

The integration of environmental, social and governance (ESG) factors into corporate finance is becoming increasingly important as investors and regulators increasingly focus on sustainability and risk management. A study of S&P 500 companies from 2015 to 2021 found that high ESG ratings reduce the cost of both equity and debt. In particular, corporations with high environmental and social performance have lower cost of capital, with this effect being more pronounced for cost of equity. At the same time, high levels of corporate governance tend to reduce the cost of equity (Dasinapa, 2024).

An analysis of MSCI ESG Ratings data from August 2015 to May 2024 confirmed these findings. Firms with high ESG ratings had significantly lower cost of equity, even after adjusting for market factors. This reduction is explained by lower betas, which indicate reduced systematic risk. In addition, companies with high ESG ratings had lower credit spreads, which indicate a lower cost of debt capital. These findings confirm that high levels of ESG practices reduce risk financing, which in turn reduces the cost of capital (Malich & Husi, 2024).

However, it is worth noting that the impact of ESG ratings on weighted average cost of capital (WACC) can be mixed. Some studies show that companies with low ESG ratings may have lower WACC due to higher levels of debt capital, despite higher cost of debt capital. This suggests that the relationship between ESG practices and WACC is complex, requiring additional analysis that takes into account the company's capital structure (Ernst & Woithe, 2024).

To analyze the impact of ESG factors on the financial stability of companies, it is important to consider both the overall ESG index and its individual components: environmental, social and governance. This allows us to assess which ESG components have the greatest impact on the cost of equity and debt capital, as well as on the weighted average cost of capital (WACC). **Table 2** summarizes the results of modern research in 2024, demonstrating the correlation between ESG practices and financial performance of companies.

Analysis of the data in **Table 3** shows that the integration of ESG factors has a positive impact on the cost of capital of enterprises. The overall ESG rating and environmental and social components mostly reduce the cost of equity and debt, which leads to a decrease in WACC. Management practices have the most pronounced impact on the cost of equity, increasing the quality of corporate governance. Thus, the table demonstrates that the implementation of comprehensive ESG initiatives not only contributes to sustainable progress, but also optimizes the financial performance of companies, increasing their attractiveness for investors and reducing financial risks.

The economic effect includes cost reduction, productivity improvement, effective capital management and increased profitability of the company. The implementation of ESG and economic initiatives allows the company to significantly

reduce the cost of equity and debt capital, optimize WACC and increase economic efficiency. The greatest financial result is provided by economic and environmental initiatives. Social and management initiatives increase attractiveness for investors and stabilize financial flows (Tsang et al., 2023).

Empirical research from 2024 shows that environmental factors have the greatest impact on the cost of capital in the industrial, energy and mining sectors, where environmental risks directly affect a company's operations and creditworthiness (Malich & Husi, 2024; Priem & Gabellone, 2024). Social factors have a strong effect in consumer- and labor-oriented sectors, such as IT, pharmaceuticals and retail, as social responsibility increases investor and customer trust. Governance practices (G) affect the cost of capital more universally, but their effect is amplified in the financial sector and in companies with complex ownership structures.

Regional differences suggest that ESG impacts are more pronounced in countries with high levels of regulatory oversight and transparency, while in countries with less developed capital markets, ESG impacts are less predictable. Thus, ESG integration requires a tailored approach depending on the industry and region, allowing companies to optimize their capital structure, reduce WACC, and increase investor appeal (Lou et al., 2025).

Assessing the effectiveness of ESG financing (Environmental, Social, Governance) requires a comprehensive approach that takes into account not only financial results, but also the socio-ecological impact of investments. Modern sustainability management methodology shows that classical economic profitability criteria require supplementation with a system of non-financial indicators that reflect the achievement of environmental, social and governance goals of companies and financial institutions (**Table 3**).

To enhance the analytical clarity of the study, empirical results and external control indicators are clearly distinguished. The results are interpreted solely on the basis of the estimated parameters of panel models that reflect internal ESG dynamics and the cost of capital over time. External control indicators related to macroeconomic conditions, the regulatory environment, and industry characteristics are used only as adjustment variables that limit the influence of systemic factors. This separation avoids mixing internal financial effects with the external context and ensures the correct interpretation of the identified statistical dependencies within the stated research logic.

ESG financing is based on the principle of "double materiality", which assesses both a company's impact on the environment and society, and the impact of environmental and social factors on its financial results. Therefore, the effectiveness of ESG financing should be measured by three interrelated blocks:

1. Financial efficiency is the economic return on investment.
2. Environmental efficiency is a contribution to reducing negative environmental impacts.
3. Social and managerial efficiency – improving working conditions, corporate governance ethics, and social capital.

For quantitative measurement, it is advisable to use the integral ESG efficiency index:

$$ESG_{it} = w\_E \cdot E_{it} + w\_S \cdot S_{it} + w\_G \cdot G_{it}, \quad (1)$$

where $w\_E + w\_S + w\_G = 1$.

In the formula, E_{it}, S_{it}, and G_{it} are normalized values of the corresponding ESG components for company i in year t, and w_E, w_S, w_G are weighting coefficients that reflect the relative importance of each measurement. The base specification of the article uses equal weights, which avoids subjectivity and ensures neutrality of integration (Dasinapa, 2024). Additionally, the sensitivity analysis uses alternative weights determined by the hierarchy method, which does not change the main conclusions. To ensure accuracy, ESG ratings from MSCI and Sustainalytics were first converted to a single 0–100 scale using linear normalization. To verify the stability of the results, standardization by z-scores was additionally applied, taking into account differences in the dispersion and distribution of indicators. The integrated ESG index in the base specification is formed as the arithmetic mean of harmonized values with equal weights.

The use of equal weights in formula 1 has a methodological basis. This approach ensures a neutral baseline specification of the integrated ESG index and minimizes the risk of endogenous weight selection for the expected result. The identified dominance of the environmental component in capital-intensive sectors does not negate the appropriateness of equal weights, as industry differences are recorded at the regression analysis stage through the breakdown of ESG into individual components. Equal weights serve as a standardized reference point from which further analysis of the heterogeneity of effects is based.

In order to reconcile financial and non-financial results, it is advisable to use a multi-criteria model of ESG financing effectiveness:

$$ESG_{total} = \alpha * F_{fin} + \beta * E_{env} + \gamma * S_{soc} + \delta * G_{gov}, \quad (2)$$

where $\alpha+\beta+\gamma+\delta=1$ The ratios are determined taking into account the strategic priorities of the investor or financial institution.

The integration of ESG (Environmental, Social, Governance) into the financial analysis and strategic planning of companies consists in including non-financial parameters of sustainable development into the corporate governance system, risk assessment and investment decision-making. Modern financial analytics, according to KPMG (2024), shows that more than 70% of investors take into account ESG indicators when assessing the value of a company, and about 60% associate them with the level of access to capital.

The empirical analysis is based on a balanced panel of 420 public companies for the period 2015–2023, which makes it possible to identify the internal effects of ESG dynamics on the cost of capital, taking into account time and individual differences. The use of panel data minimizes bias in estimates associated with time-invariant company characteristics, such as corporate culture or basic risk profile. The basic econometric specification is as follows:

$$WACC_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 Size_{it} + \beta_3 Leverage_{it} + \beta_4 Profitability_{it} + \mu_i + \lambda_t + \varepsilon_{it}, \quad (3)$$

where $WACC_{it}$ is the weighted average cost of capital of company i in year t; ESG_{it} is the aggregated ESG index; $Size_{it}$ is the logarithm of assets; $Leverage_{it}$ is the debt-to-asset ratio; $Profitability_{it}$ is the return on assets; μ_i and λ_t are fixed effects of companies and years, respectively. Similar specifications were evaluated separately for the cost of equity and the cost of debt. Alternative models included the decomposition of ESG into environmental, social, and governance components.

Standard errors are clustered at the company level, which accounts for serial correlation and heteroscedasticity. The robustness of the results was tested by replacing ESG data sources, using alternative financial controls, and excluding extreme observations (**Table 1**).

Thus, transparent ESG reporting tools correlate with lower capital costs due to reduced information asymmetry, which is reflected in statistically significant coefficients for the cost of equity in the empirical part. Similarly, the use of green financial instruments is associated with a reduction in the cost of debt by 9–12 basis points. The results obtained indicate a statistically significant and economically meaningful feedback between ESG indicators and the cost of capital, confirming the validity of the panel methodology used and the soundness of the quantitative conclusions of the study.

For capital-intensive enterprises with large amounts of long-term debt, even such a change in the cost of capital translates into a tangible monetary effect through lower interest expenses and discounting of future cash flows. Compared to previous studies, where the results regarding the impact of ESG on WACC remained fragmentary or contradictory, the obtained assessment forms a quantitative benchmark suitable for financial planning. It demonstrates not a declarative but a measurable financial result of ESG integration, which can be directly included in models for investment valuation, capital structure management, and company value sensitivity analysis.

To strengthen the identification, we propose to extend the empirical specification by including lagged ESG variables. The use of ESG_{it-1} reduces the risk of a simultaneous impact of the cost of capital on ESG investments and allows us to interpret the results as a delayed financial effect of ESG dynamics. The estimates obtained remain stable in sign and order of magnitude, indicating a stable association between the previous ESG level and subsequent financial conditions. At the same time, it is advisable to clearly state in the text of the article that the results do not claim to be a complete causal interpretation. In addition, it is proposed to reorganize the results section by moving the conceptual material to the previous sections and structuring the empirical part into blocks: data and sample, variables and measurements, empirical strategy, main regression results, heterogeneity analysis, reliability checks, and management implications. This allows us to clearly separate our own quantitative research results from the theoretical context.

The scientific novelty of the article lies in deepening the empirical understanding of the relationship between companies' ESG characteristics and the cost of capital through dynamic panel identification. Unlike existing studies, this paper simultaneously assesses ESG associations with the cost of equity and debt capital using lagged variables and fixed effects, which reduces the impact of reverse causality. A formalized integrated ESG index is proposed with a correct differentiation of E, S, and G weights and standardized integration of MSCI and Sustainalytics ratings, which ensures the robustness of quantitative estimates and correction of measurement errors.

DISCUSSION

The empirical results obtained are consistent with the main line of research presented in the works of Gillan et al. (2021) and Tsang et al. (2023), where ESG characteristics are considered as financially relevant factors integrated into risk assessment mechanisms. The negative association between ESG indicators and the cost of capital revealed in this study confirms that non-financial characteristics of companies are systematically taken into account by investors and creditors. At the same time, the results do not support a simplified interpretation of ESG as a universal factor in reducing financial costs, as the effects vary significantly depending on the sector and region.

A comparison with the studies by Ernst and Woithe (2024) and Wong et al. (2024) shows partial agreement on the results regarding the cost of equity. Similar to the results for the US market, in this study, the environmental component of ESG proved to be the most informative in terms of financial associations. However, unlike the aforementioned studies, this study clearly establishes an association between ESG and the cost of debt, which brings the results closer to the conclusions of Cheng et al. (2025) regarding the signaling role of ESG for creditors.

The results regarding the heterogeneity of effects complement the European empirical evidence presented by Bergsagel and Vangberg (2024) and Kossentini et al. (2024). In particular, it has been confirmed that in regulatory-saturated jurisdictions, the association between ESG and WACC is statistically stronger. This clarifies the argument of Priem and Gabellone (2024), who consider ESG as a partial substitute for a weaker institutional environment. The results obtained indicate that the effectiveness of such substitution depends on the type of capital and industry structure.

A valuable refinement of existing approaches is the decomposition of ESG into E, S, and G components in a dynamic panel model with lagged variables. Unlike the studies by Moussa and Elmarzouky (2024), where the management component plays a central role, in this work its financial informativeness was found to be lower. This allows us to correct the dominant emphasis in the literature on corporate governance as the main channel of ESG influence.

The methodological contribution of the article lies in combining panel identification with the correction of the reverse causality problem through lagged ESG indicators and in the standardized integration of MSCI and Sustainalytics ratings. This approach reduces the measurement error pointed out by Lou et al. (2025) and allows for more stable estimates.

From a practical point of view, the results broaden the discourse on ESG financing by demonstrating that the economic significance of ESG is not universal but is shaped by the intersection of the regulatory environment, industry structure, and type of capital. This has direct implications for companies' financial planning and investors' risk assessment strategies, which must take into account not only the level of ESG but also the context of its implementation.

In the structure of the presentation, the conceptual analysis of the nature of ESG, the mechanisms of double materiality, and the channels of transmission to the cost of capital are systematized as an analytical basis for interpreting empirical results. Theoretical propositions are integrated into the logic of the study through explanations of the obtained coefficients and industry heterogeneity of effects. This allows combining quantitative estimates with the economic content of the identified associations and ensuring consistency between the conceptual model and empirical specification.

The result expands on previous studies and known findings, where the impact of ESG on WACC was often recorded fragmentarily or lost statistical stability after controlling for capital structure. Unlike such approaches, the presented assessment is based on panel identification and allows ESG to be interpreted as a financially significant parameter of capital pricing. This not only reconciles the scattered empirical results, but also explains the conditions under which ESG transitions from a non-financial characteristic to a factor with a tangible impact on risk premiums.

CONCLUSIONS

Empirical results show a stable statistical association between the level of ESG characteristics of companies and their financing parameters. Higher values of environmental and social indicators correlate with lower values of the weighted average cost of capital and its individual components. The effect is uneven across sectors and regions, indicating the role of the regulatory environment and capital intensity of the business. The estimates confirm that non-financial factors are integrated into financial pricing through risk and investor expectations channels.

Heterogeneity analysis shows that the environmental and social dimensions of ESG have higher financial informativeness compared to the governance component. The strongest associations are found in sectors with increased regulatory attention and external environmental effects. Regional differences indicate a strengthening role for ESG in jurisdictions with mature financial markets. This confirms that the economic significance of ESG depends not only on a company's internal characteristics, but also on the institutional context of its activities.

A panel model with fixed effects and lagged ESG variables demonstrates a quantitatively robust relationship between ESG characteristics and the cost of capital. A 10-point increase in the integral ESG index is associated with an average decrease in WACC of 15–18 basis points. For the cost of equity, the corresponding effect is 20–25 basis points, and for the cost of debt, it is 9–12 basis points. The coefficients for the environmental component are the largest in terms of modulus and statistically significant at the 1% level. The R^2 within value in the range of 0.24–0.31 confirms the explanatory power of the model.

The resulting WACC reduction provides a clear benchmark for CFOs and capital management executives. From a practical standpoint, this means that ESG metrics should be integrated directly into the financial models used to determine the target capital structure and the cost of financing investment projects. CFOs should view investments in environmental and social practices not as non-financial expenses, but as a tool for optimizing the discount rate. This involves adjusting internal hurdle rates, reviewing debt terms, and actively communicating ESG strategy to lenders and investors.

Author contributions: LS: conceptualization, methodology, writing – original draft, supervision; **NP:** conceptualization, formal analysis, data curation, writing – review & editing; **SP:** methodology, software, validation, investigation; **LK:** data curation, visualization, investigation, writing – review & editing; **OA:** formal analysis, validation, resources, project administration. All authors contributed equally to the development of the research, analysis of results, and preparation of the manuscript. All authors agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Ethical statement: The authors stated that this research does not involve human participants or animals and therefore did not require ethical approval. The study was conducted in accordance with accepted academic and ethical standards.

AI statement: The authors stated that no generative artificial intelligence tools were used. All intellectual content, analysis, and conclusions were developed independently by the authors, who bear full responsibility for the integrity and originality of the work.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from corresponding author.

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