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Sustainability Practices and Capital Costs: Evidence from Banks and Financial Technology Firms in Global Markets

Raminta Vaitiekuniene [1,2,*] and Alfreda Sapkauskiene [1]

[1] Faculty of Economics and Business Administration, Vilnius University, LT-01513 Vilnius, Lithuania; alfreda.sapkauskiene@evaf.vu.lt
[2] School of Economics and Business, Kaunas University of Technology, LT-44239 Kaunas, Lithuania
* Correspondence: raminta.vaitiekuniene@evaf.vu.lt or raminta.vaitiekuniene@ktu.lt

Abstract

This paper examines the impact of environmental, social, and governance (ESG) disclosure on the cost of capital for banks as well as financial technology companies in Europe, America, and Asia from 2010 to 2024. The study investigates how sustainability affects financing conditions in the two institutional settings of conventional and digital financial intermediaries. We estimate the average cost of capital using the traditional WACC (weighted average cost of capital) formula, which calculates the cost and proportions of debt and equity capital. Panel regressions with firm and year fixed effects are used, along with an instrumental variable (IV) approach (2SLS), by way of peer-based ESG instruments to correct for endogeneity. The paper also carries out robustness checks such as the Anderson–Rubin weak IV tests and over identification diagnostics. The findings indicate that more ESG disclosure has a significant negative effect on WACC and debt costs and no robust impact on equity cost. Governance disclosure is revealed to be the dominant dimension and it always correlates with lower financing costs. Environmental disclosure is occasionally associated with a higher cost of equity, owing to investors' expectation of short-term compliance costs. The results shed light on the dynamic relationship between innovation and sustainability in driving banks and financial technology firms financing environment.

Keywords: ESG disclosure; costs of capital; banks; financial technology

1. Introduction

The last 15 years between 2010 and 2024 have seen major change in financial markets attributed to financial technology and sustainability in finance. Financial technology firms (in the field of payments, lending, deposit taking, and neo-banking) have disrupted banking providing new and innovative technology solutions that increase efficiency, decrease transaction costs, and increase financial inclusion. Simultaneously, the banks, which are at the core of worldwide financial intermediation, face the challenge of meeting the accelerating pace of digital and regulatory competition. Concurrently, sustainability has increasingly become a key driver of corporate strategy and capital allocation. There is a growing market for environmental, social, and governance (ESG) indicators from investors, regulators, and stakeholders to assess firm performance, risk management, and long-term resilience. Financial institutions are in a uniquely sensitive position in that sustainability considerations impact their not just reputation but also their ability to access and pay for capital.

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Voluntary Disclosure theory suggests that firms providing more transparent ESG information reduce information asymmetry and uncertainty for investors and creditors, thereby improving their financing conditions (Botosan, 1997). A number of studies suggest that firms with positive ESG performance face lower financing costs, due to lower perceived risk and more transparent performances (Cheng et al., 2014). ESG disclosure improves the stability of banks (Liaqat et al., 2025), which enables the mechanisms for a lower cost of equity and capital by reducing risk and information asymmetry. Previous research on the effect of financial fundamentals such as profitability, leverage, and valuation ratios has not investigated the impact of sustainability disclosure on capital costs among various financial business types. Despite the extensive literature on capital structure and funding costs (Acheampong & Ibeji, 2024; Zhang & Kou, 2025), empirical evidence on how ESG transparency affects banks' cost of capital is still lacking. This is particularly relevant given banks' adoption of financial technologies, which enable additional risks that can lead to expensive cost of capital.

Despite the rapidly growing importance of sustainability and fintech concepts, empirical evidence on how ESG disclosure affects the cost of capital of banks and financial technology firms is still lacking. For example, the authors (Liu et al., 2025) demonstrate that integrating fintech into green supply chain financing improves the efficiency of financing strategies. This, in turn, enables increased transparency and reduced financing constraints. There is a lack of research on how sustainability transparency relates to the cost of capital in traditional and financial technology companies, and their financial business models. This study addresses this issue by examining the relationship between ESG disclosure and the cost of capital in banks and financial technology firms in key regions of the world. In this way, the study adds to the sustainable finance literature by highlighting the dual impact of innovation and sustainability on the future of capital markets.

2. Theoretical Background

Financial technology has become an important tool for expanding the accessibility of payments, savings, and financial transfers. As Asif et al. (2023) have emphasized, a solid background is crucial to explain the technology-related dynamics that drive financial system transformations and to enable meaningful, empirically testable hypotheses. Financial technologies aim to include users in the financial system by providing affordable, convenient, and easy access to digital services. Sun et al. (2025) show that digital inclusive finance is significant in promoting green agricultural development. Their study shows that financial technology accelerates progress, improves agricultural production services, and is beneficial to agriculture and rural industrial integration. Financial technology strengthens rural integration, which has a significant impact in highly environmentally regulated areas. This shows that financial technology not only promotes financial inclusion, but also contributes to broader changes in environmental, social, and governance fields (ESG) and economic development.

Financial technology companies are using a variety of digital technologies that have the potential to reduce the cost of capital, improve the quality of environmental, social, and governance (ESG) disclosures and enhance investor confidence. These technologies include real-time data generated using artificial intelligence, application programming interfaces, and automated reporting tools. Advances in financial technology help companies attract green investors by reducing financing barriers, strengthening environmental governance, and increasing transparency of sustainability-related information (Jiang et al., 2025). As these digital tools together reduce uncertainty and risk award, financial technology companies can obtain more favorable conditions for credit ratings and ultimately reduce the cost of both equity and debt financing.

A more detailed understanding of the association between sustainability disclosure and the cost of capital may arise from different theories.

Based on the Voluntary Disclosure theory, companies offer information outside the mandatory reporting rules as an effort to mitigate the effects of information asymmetry, uncertainty, and the risk premium expected by investors and creditors. Botosan (1997) showed that the cost of equity is decreased when a level of voluntary disclosure is higher, the impact of which is particularly evident for the financial sector where information quality, regulatory oversight, and credit rating requirements are paramount. In this paper, the ESG disclosure is presented as a mechanism to reduce the information asymmetry between financial institutions and capital markets, allowing for more accurate measurement of non-financial risks.

Agency theory posits that any manager–shareholder conflict of interest results in information asymmetry and monitoring costs (Jensen & Meckling, 2019). A firm's disclosure on ESG, particularly in terms of the governance dimension, has an oversight function initiate to provide the firm's information that reducing agency cost because increase appropriateness and accountability. Corporate signaling of good management practices can reduce investor uncertainties which decreases the equity risk premium and, hence, financing costs. This is consistent with previous studies indicating that better governance reduces the cost of equity and fosters investors' trust (Trinh et al., 2020). Signaling theory highlights the role of financial reporting to transmit private information from the management to outside stakeholders. Firms with better ESG performance disclose to signal a credible commitment toward long-term strategic orientation, good quality of risk management, and a high level of resilience. Investors and lenders interpret ESG reporting as a proxy for a lower default risk and better long-term value creation, implying both a lower cost of equity and debt.

Residual income assessment research (Dechow et al., 1999) points out that the perceived informational value of reported earnings and book values directly affects investors' ability to measure valuations, indicating that the quality of the disclosure relates to a firm's cost of capital. This is supported by the seminal work of Botosan (1997), who found empirically that it is true when the extent of discretionary transparency is higher that information asymmetry decreases and costs of equity are lower, which is of paramount interest for all financial institutions whose risk evaluations are subject to sustained disclosure flows. The importance of value relevance theory developed by Srivastava and Muharam (2021) adds to this the idea that the utility and trustworthiness of financial information enhance market efficiency and reduce financing frictions in the markets, especially at a point of regulatory shift. Further, according to accounting conservatism theory (Watts, 2003), by early loss recognition and prudent reporting, agency conflicts have to be lessened to strengthen creditor protection and to reduce the perceived default risk.

Recent literature points to firm-specific parameters (profitability, leverage, valuation ratios, size) as a determinant of the cost of equity and debt (Frank & Goyal, 2009; Gungoraydinoglu & Öztekin, 2011). In the finance sector, capital costs are also affected by regulatory requirements, systemic risk, and funding structures (Allen et al., 2013). A growing body of literature suggests that firms displaying better environmental, social, and governance (ESG) performance also earn lower financing costs as a consequence of lower financial cost, as reflected in lower risk perception and transparency (Friede et al., 2015; Albuquerque et al., 2020; Broadstock et al., 2021). Environmental and social considerations are also positive, but sometimes lead to a raising of short-term financing expense for financial institutions if compliance investment is required (Krüger, 2015; Li et al., 2018). Europe's banks on the higher sustainability rankings reach cheaper wholesale funding (Raimo et al., 2021), similar to the finding of America and Asian research showing that disclosure regulation and investor preferences significantly condition an ESG-WACC relationship. Regional dif-

ferences further confine these relationships. From Europe, stringent regulatory frameworks amplify the positive effect of ESG disclosure on finance costs and firm value (European Central Bank, 2021; Capelle-Blancard & Petit, 2019). Capital costs are still more sensitive to market turbulence and investor sentiment, and investors evaluate those companies that announce emissions (Krueger et al., 2020; Flammer, 2021). The European Union has developed a comprehensive and robust framework that combines digital finance regulation with mandatory ESG disclosure standards, such as the Sustainable Finance Disclosure Regulation (SFDR) and the Corporate Sustainability Reporting Directive (CSRD) (European Commission, 2023). Meanwhile, the United States has adopted a more market-driven and fragmented regulatory approach, with ESG disclosure requirements applied only to a limited and often politically contested extent (Securities and Exchange Commission, 2022). Asian economies show a more heterogeneous pattern: advanced financial hubs such as Singapore and Japan are closer to European practices, while emerging markets such as China and India prioritize digital financial inclusion and state-led financial technology development, while sustainability regulation is still evolving and largely dependent on national strategies (OECD, 2023). In Asia, sustainability is closely associated with macroeconomic development and financial inclusion activities (Bai, 2024).

By assessing banks and financial technology firms across Europe, America, and Asia from 2010 to 2024, and by disaggregating capital costs into cost of equity and cost of debt, we offer new insights into how sustainability disclosure and financial performance interact with each other. We enhance knowledge on how sustainability impacts financing efficiency in the global financial arena. This study yields fresh evidence on the causal effect of sustainability disclosure on the cost of equity, debt, and capital as a whole and enriches the literature in the areas of sustainable finance and financial technology.

In this study, drawing from the theoretical background of Voluntary Disclosure, Agency, and Signaling theories, we argue that ESG disclosure serves as a mechanism whereby financial institutions mitigate information asymmetry, reduce the costs of monitoring and credibly signal long-term resilience to their capital markets.

H_1. *Higher ESG disclosure reduces the overall cost of capital (WACC) by decreasing information asymmetry, improving governance transparency and lowering the risk premium demanded by capital providers.*

H_{1a}. *The reduction in WACC associated with higher ESG disclosure is partly driven by a lower cost of equity, reflecting reduced information asymmetry and improved investor confidence.*

H_{1b}. *The reduction in WACC associated with higher ESG disclosure is partly driven by a lower cost of debt, as greater governance transparency signals lower default risk and enhances lenders' credit risk assessment.*

These hypotheses enable the empirical study by investigating the extent to which sustainability disclosure influences the financing conditions of banks and financial technology companies.

3. Methodology

3.1. Panel Data and Econometric Framework

This study uses a quantitative research design to explore the determinants of capital costs for financial institutions. It comprises banks and financial technology firms involved with payments, lending, deposit-taking, and neo-banking activities across Europe, America, and Asia during the period 2010–2024. The panel data comprises publicly available financial statements, market data, and ESG disclosure scores drawn from the Bloomberg terminal. The dependent variables are calculated as follows: the weighted average cost of capital

(WACC), the cost of equity, and the cost of debt. Figure 1 illustrates the conceptual framework for this study, which links ESG disclosure to the weighted cost of capital for banks and financial technology companies operating in global markets. The model shows that the overall ESG disclosure score is decomposed into environmental, social, and governance components, which are independent variables. The aim is to examine whether these components affect the weighted average cost of capital (WACC) of banks and financial technology companies. The dependent variables are WACC, cost of equity, and cost of debt, which can be affected by changes in sustainability practices. The empirical analysis is based on this framework.

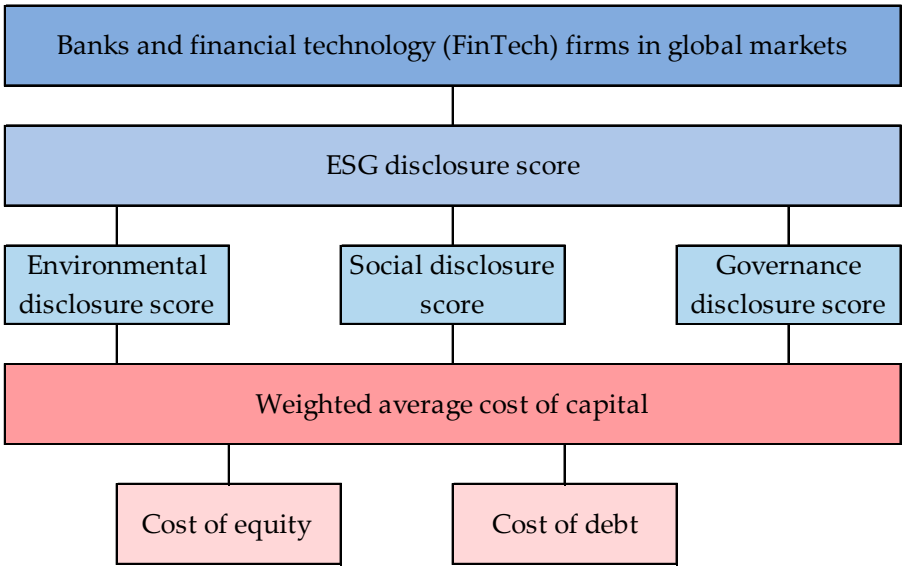

Figure 1. Conceptual framework of the relationship between ESG disclosure and the cost of capital.

Variables considered independent are financial performance and sustainability indicators: return on assets, return on equity, net income margin, price-to-earnings ratio, financial leverage, Tobin Q, market capitalization, overall ESG score, and different environmental, social, and governance disclosure scores (see Table 1). We estimated the weighted cost of capital using Formula (1). We estimated the cost of debt and equity capital using Formulas (2) and (3). We set our estimates using fixed effects panel regressions with firm and year effects to account for heterogeneity across institutions and time (see Formulas (4)–(15)). Firm level robust standard errors are added to eliminate any possible heteroskedasticity or serial correlation. Alternative model specifications and sub-sample analyses are used to prove robustness. The methodology provided here enables the disentangling of financial performance and sustainability disclosure from other components of capital costs and emphasizes ESG practices as significant aspects of the financing landscape for all mediums across traditional and digital financial intermediaries. All variables were winsorized at the 1st and 99th percentile to mitigate outlier effects.

$$WACC = \frac{E}{E+D} R_e + \frac{D}{E+D} R_d (1-T) \quad (1)$$

E—equity
D—debt
R_e—cost of equity based on CAPM
R_d—cost of debt (before tax)
T—banks' and financial technology firms' income tax rate

$$R_e = R_f + \beta \left(R_m - R_f \right) \quad (2)$$

R_f—risk-free interest rate (10-year government bond)
B—systematic risk (beta)
$R_m - R_f$—market risk premium

$$R_d = \frac{Interest\ Expense}{Total\ debt} \quad (3)$$

Table 1. List of variables.

Variable	Definitions
Independent variables	
Return on assets (ROA)	(Net income/total assets) × 100
Price-to-earnings ratio (P/E)	Market price per share/earnings per share of the company
Financial leverage (Financial leverage)	Total assets/total common equity
Tobin Q ratio (Tobin Q)	Market value of assets/replacement cost of assets
Market capitalization (Market capitalization)	Price per share × shares outstanding
Logarithm of market capitalization (log_market capitalization)	log(market capitalization)
Return on common equity (ROE)	(Net income/total equity) × 100
Net income margin (Net income margin)	((Interest earned − interest paid)/(average interest-earning assets)) × 100
Sustainability indicators	
ESG disclosure score (ESG)	ESG score (composite)
Environmental disclosure score (Environmental disclosure score)	Environmental score
Social disclosure score (Social disclosure score)	Social score
Governance disclosure score (Governance disclosure score)	Governance score

Data on *WACC* (and debt and equity costs and proportions) of American, European, and Asian banks and financial technology companies for 2010–2014 (see Table 2) show cyclicality. The cost of equity decreased significantly from 17.28% to 12.84%, reflecting reduced risk premiums. The cost of debt increased from 2.33% to 4.77% due to increased interest rates. The weight of equity in the capital structure increased significantly from 22.4% to 63.1% due to increased debt prices and limited financing for financial technology companies. The weight of debt decreased from 77.6% to 36.9%. Due to a significant increase in the proportion of equity, which is significantly more expensive than debt, which was influenced by global inflation and rapid monetary tightening, the cost of capital of banks and financial technology companies reached 9.86%.

$$WACC_{it(M1)} = \beta_0 + \beta_1 ROA_{it} + \beta_2 P/E_{it} + \beta_3 FL_{it} + \beta_4 ESG_{it} + \beta_5 TOBINQ_{it} + \beta_6 LOG\_MCAP_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (4)$$

$$WACC_{it(M2)} = \beta_0 + \beta_1 P/E_{it} + \beta_2 FL_{it} + \beta_3 TOBINQ_{it} + \beta_4 LOG\_MCAP_{it} + \beta_5 ROE_t + \beta_6 SOC_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (5)$$

$$WACC_{it(M3)} = \beta_0 + \beta_1 P/E_{it} + \beta_2 FL_{it} + \beta_3 TOBINQ_{it} + \beta_4 LOG\_MCAP_{it} + \beta_5 NETINCMARG_t + \beta_6 GOV_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (6)$$

$$WACC_{it(M4)} = \beta_0 + \beta_1 ROA_{it} + \beta_2 P/E_{it} + \beta_3 FL_{it} + \beta_4 TOBINQ_{it} + \beta_5 LOG\_MCAP_{it} + \beta_6 ROE_t + \beta_7 NETINCMARG_t + \beta_8 EN_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (7)$$

$$CE_{it(M1)} = \beta_0 + \beta_1 ROA_{it} + \beta_2 P/E_{it} + \beta_3 FL_{it} + \beta_4 ESG_{it} + \beta_5 TOBINQ_{it} + \beta_6 LOG\_MCAP_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (8)$$

$$CE_{it(M2)} = \beta_0 + \beta_1 P/E_{it} + \beta_2 FL_{it} + \beta_3 TOBINQ_{it} + \beta_4 LOG\_MCAP_{it} + \beta_5 ROE_t + \beta_6 SOC_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (9)$$

$$CE_{it(M3)} = \beta_0 + \beta_1 P/E_{it} + \beta_2 FL_{it} + \beta_3 TOBINQ_{it} + \beta_4 LOG\_MCAP_{it} + \beta_5 NETINCMARG_t + \beta_6 GOV_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (10)$$

$$CE_{it(M4)} = \beta_0 + \beta_1 ROA_{it} + \beta_2 P/E_{it} + \beta_3 FL_{it} + \beta_4 TOBINQ_{it} + \beta_5 LOG\_MCAP_{it} + \beta_6 ROE_t + \beta_7 NETINCMARG_t + \beta_8 EN_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (11)$$

$$CD_{it(M1)} = \beta_0 + \beta_1 ROA_{it} + \beta_2 P/E_{it} + \beta_3 FL_{it} + \beta_4 ESG_{it} + \beta_5 TOBINQ_{it} + \beta_6 LOG\_MCAP_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (12)$$

$$CD_{it(M2)} = \beta_0 + \beta_1 P/E_{it} + \beta_2 FL_{it} + \beta_3 TOBINQ_{it} + \beta_4 LOG\_MCAP_{it} + \beta_5 ROE_t + \beta_6 SOC_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (13)$$

$$CD_{it(M3)} = \beta_0 + \beta_1 P/E_{it} + \beta_2 FL_{it} + \beta_3 TOBINQ_{it} + \beta_4 LOG\_MCAP_{it} + \beta_5 NETINCMARG_t + \beta_6 GOV_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (14)$$

$$CD_{it(M4)} = \beta_0 + \beta_1 ROA_{it} + \beta_2 P/E_{it} + \beta_3 FL_{it} + \beta_4 TOBINQ_{it} + \beta_5 LOG\_MCAP_{it} + \beta_6 ROE_t + \beta_7 NETINCMARG_t + \beta_8 EN_t + \sum_{k=1}^{T=1} \gamma_k D_{kt} + \varepsilon_{it} \quad (15)$$

$WACC_{it}$—weighted average cost of capital for entity i in
CE_{it}—cost of equity for entity i in
CD_{it}—cost of debt for entity i in
ROA_{it}—return on assets for entity i in
ROE_{it}—return on common equity for entity i in
P/E_{it}—price-to-earnings ratio for entity i in
FL_{it}—financial leverage for entity i in
$TOBINQ_{it}$—Tobin Q for entity i in
$LOG\_MCAP_i t$—logarithm of market capitalization for entity i in year t
ESG_{it}—ESG disclosure score (composite)
EN_{it}—environmental disclosure score
SOC_{it}—social disclosure score
GOV_{it}—governance disclosure score
Dk_t—dummy variable for year k (fixed effects for each year except base year)
γ_k—coefficient for year dummy k

To assess *WACC*, cost of equity, and cost of debt for banks and financial technology companies, the following performance metrics were calculated. R^2 (coefficient of determination), explains the proportion of total variance in the data:

$$WACC^2 = 1 - \frac{\sum\left(\widehat{WACC}_i - WACC_i\right)^2}{\sum\left(\widehat{WACC}_i - WACC_i\right)^2} \quad (16)$$

$$CE^2 = 1 - \frac{\sum\left(\widehat{CE}_i - CE_i\right)^2}{\sum\left(\widehat{CE}_i - CE_i\right)^2} \quad (17)$$

$$CD^2 = 1 - \frac{\sum\left(\widehat{CD}_i - CD_i\right)^2}{\sum\left(\widehat{CD}_i - CD_i\right)^2} \quad (18)$$

We estimate 2SLS models instrumenting ESG with peer and L_1 (industry, region, year leave-one-out), partialling out firm and year fixed effects with cluster standard errors. Given the weak first stage, we report and interpret Anderson–Rubin tests for inference, and Hansen J p-values (0.35–0.51) do not reject over-identifying restrictions. The centered R^2 after partialling out is not directly comparable to the OLS R^2 and may take negative values.

Table 2. Data on WACC (and debt and equity costs and proportions) in 2010–2024.

Year	R_D	R_E	W_E	W_D	WACC
2010	2.33	17.28	0.224	0.776	5.68
2011	1.77	14.34	0.232	0.768	4.69
2012	1.61	12.81	0.268	0.732	4.61
2013	1.83	12.94	0.273	0.727	4.86
2014	1.51	10.29	0.351	0.649	4.59
2015	1.52	11.03	0.362	0.638	4.96
2016	1.77	11.96	0.388	0.612	5.72
2017	2.12	12.94	0.395	0.605	6.39
2018	2.51	12.74	0.463	0.537	7.25
2019	1.83	10.35	0.512	0.488	6.19
2020	1.22	10.82	0.494	0.506	5.96
2021	2.00	12.12	0.423	0.577	6.28
2022	4.23	12.6	0.509	0.491	8.49
2023	4.86	13.39	0.587	0.413	9.87
2024	4.77	12.84	0.631	0.369	9.86

3.2. Endogeneity Concerns and Methodological Approach

One of the challenges in investigating the link between ESG disclosure and the cost of capital is endogeneity generated from reverse causality, omitted variables, or measurement errors (Danisman & Tarazi, 2024). Firms with an already low cost of financing may be more incentivized to invest in broader ESG reporting, thus biasing our estimated effects. To address this issue, we use an instrumental variable (IV) regression approach that enables us to separate the exogenous variation in ESG scores.

The instruments are the industry-region average ESG disclosure score without the focal firm. This instrument is justified in the sense that companies from similar sectors or regions face the same regulatory demands, so that accounts are also influenced by investor demand and stakeholder pressure affects when disclosing ESG information. Meanwhile, the average ESG score of peer firms should have no direct impact on a firm's cost of financing other than its influence on the own firm's ESG practices and meet the exclusion restriction.

The 2SLS estimate is basically defined by the following equation.

First stage

$$ESG_{it} = \pi_0 + \pi_1 Peer\_ESG_{it} + \pi_2 Peer\_ESG_{it-1} + \gamma_1 ROA_{it} + \gamma_2 P/E_{it} + \gamma_3 FL_{it} + \gamma_4 TOBINQ_{it} + \gamma_5 LOG\_MCAP_{it} + \gamma_6 ROE_{it} + \gamma_7 NETINCMARG_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (19)$$

where $Peer\_ESG_{it}$ is industry, region, year leave-one-out average for firm i, μ_i, and λ_t are firm and year fixed effects, standard errors are clustered at the firm level. The instrument vector ($Peer\_ESG_{it}$, $Peer\_ESG_{it-1}$); the control variables are the same in both stages.

Second stage

$$WACC_{it} = \alpha_0 + \alpha_1 \widehat{ESG}_{it} + \delta_1 ROA_{it} + \delta_2 P/E_{it} + \delta_3 FL_{it} + \delta_4 TOBINQ_{it} + \delta_5 LOG\_MCAP_{it} + \delta_6 ROE_{it} + \delta_7 NETINCMARG_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (20)$$

$$\begin{aligned} Cost\ of\ equity_{it} = {} & \alpha_0 + \alpha_1 \widehat{ESG}_{it} + \delta_1 ROA_{it} + \delta_2 P/E_{it} + \delta_3 FL_{it} + \delta_4 TOBINQ_{it} + \delta_5 LOG\_MCAP_{it} + \\ & \delta_6 ROE_{it} + \delta_7 NETINCMARG_{it} + \mu_i + \lambda_t + \varepsilon_{it} \\ Cost\ of\ debt_{it} = {} & \alpha_0 + \alpha_1 \widehat{ESG}_{it} + \delta_1 ROA_{it} + \delta_2 P/E_{it} + \delta_3 FL_{it} + \delta_4 TOBINQ_{it} + \delta_5 LOG\_MCAP_{it} + \\ & \delta_6 ROE_{it} + \delta_7 NETINCMARG_{it} + \mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (21)$$

where $\widehat{ESG}_{it}$ is the fitted value from the first stage.

The results in the IV estimations are overall consistent with those from baseline regressions, which verify that the negative relationship between ESG disclosure and cost of debt is not a result of reverse causality or omitted variables but reflects indeed causal relationships.

4. Results

4.1. Analysis of the Relationship Between Sustainability and Capital Costs

Descriptive statistics indicate (see Table 3) notable variation across capital cost measures. On average, the cost of equity is the highest component (mean 12%), followed by WACC (mean 6%) and the cost of debt (mean 2%). Profitability ratios such as ROA and ROE show moderate dispersion, while valuation measures such as Tobin Q and P/E ratios display higher volatility, reflecting market expectations. The ESG scores range between 26 and 71, with governance disclosure consistently higher than environmental and social disclosure.

Table 3. Descriptive statistics.

Variable	Mean	Median	Standard Deviation	Min	Max
WACC	0.06	0.04	0.04	0.01	0.25
WACC cost of equity	0.12	0.12	0.04	0.01	0.27
WACC cost of debt	0.02	0.02	0.02	0.00	0.15
ROA	0.01	0.01	0.02	−0.04	0.16
ROE	0.10	0.09	0.07	−0.08	0.47
P/E	25.36	11.28	48.70	2.87	371.53
Financial leverage	0.14	0.13	0.08	0.02	0.39
Net income margin	0.21	0.20	0.10	0.01	0.44
ESG Disclosure	50.24	50.46	9.91	26.11	71.17
Social Disclosure	29.35	28.08	12.77	5.35	59.34
Governance disclosure	87.34	89.86	11.80	49.55	100.00
Environmental disclosure	33.98	35.93	13.50	0.33	72.30
Tobin Q	0.01	0.01	0.01	0.01	0.08
Log_Market capitalization	10.92	11.05	1.17	6.76	12.81

The correlation matrix (see Figure 2) shows that WACC, cost of equity, and cost of debt are positively correlated but capture different risk dimensions. Financial leverage is negatively correlated with WACC and cost of debt but positively correlated with cost of equity, consistent with risk–return trade-offs. ESG scores are negatively associated with all capital cost measures, particularly governance, suggesting that transparency and disclosure lower financing costs.

Figure 3 shows how the cost of capital is related with banks and financial technology firms' sustainability performance from 2010 to 2024. As can be seen, the cost of equity has always been a dominant part of WACC, and it is an amount that denotes higher risk premium that is demanded by debtholders. The cost of equity dropped significantly from 2010 to 2014. Running at levels that it remained at for a few years, a rising WACC is expected to materialize. Although the cost of debt remains low during this time, it presents a gradual upward trajectory post-2019, a signal that there is tight credit.

Figure 4 displays similar trends in environmental, social, and governance (ESG) scores. Governance is the dominant one, remaining over 80, and environmental and social are less

strong, struggling mostly above 20–40. The total ESG score depicts a moderate increase until 2022, and then slightly decreases in recent years. On the whole, these results indicate where banks and financial technology firms have been slow to make inroads on ESG performance—particularly where governance is concerned—and they have accomplished little to ease the burden of the higher cost of capital. This suggests that while sustainable strategies are becoming more relevant for corporates financing, they combine with broader market dynamics and risk perceptions in shaping the capital structure of financial institutions.

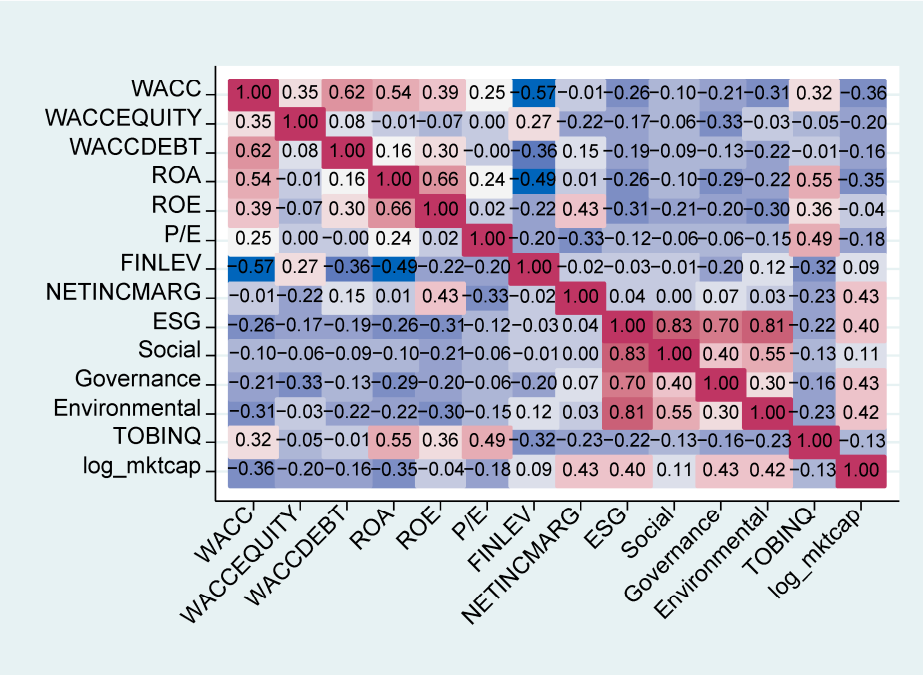

Figure 2. Correlation matrix between variables.

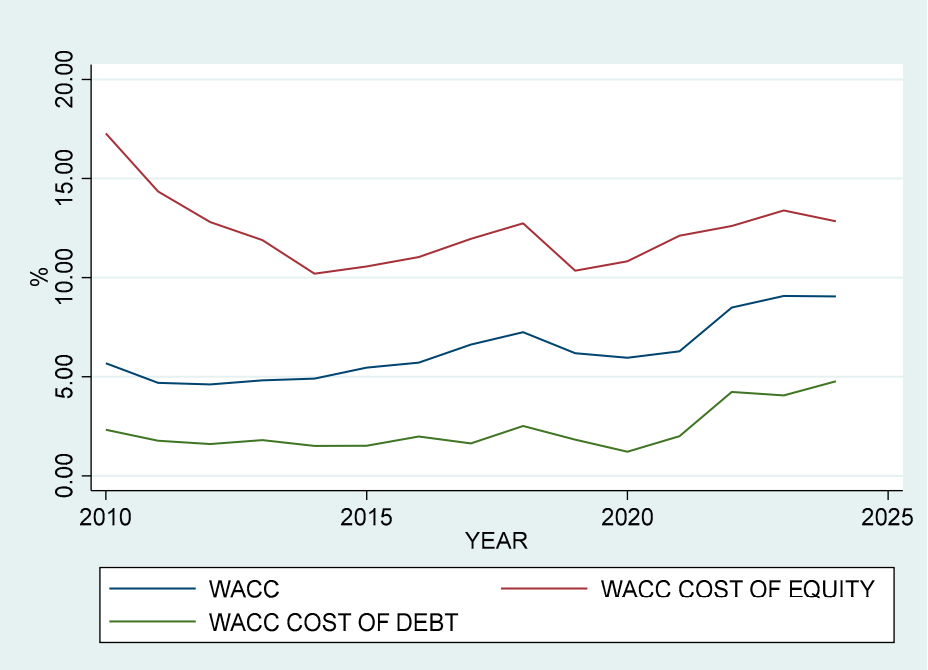

Figure 3. Trend in weighted cost of capital, equity, and debt costs in banks and financial technology companies.

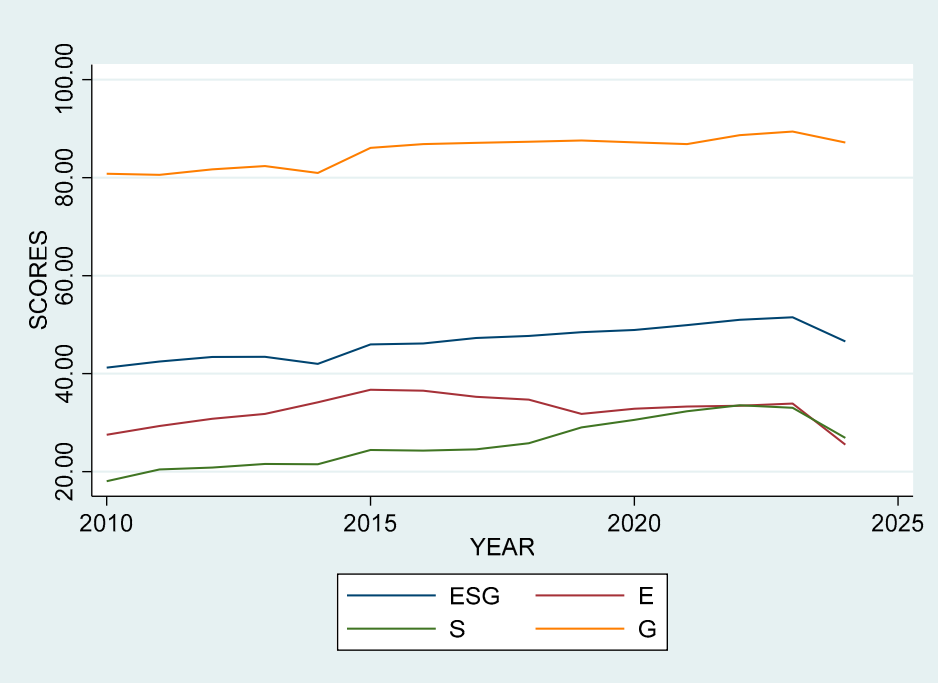

Figure 4. Trend of sustainability scores in banks and financial technology companies.

4.2. Determinants of WACC

The results of the regression analysis reported in Table 4 indicate that financial leverage is a major factor in determining the weighted average cost of capital (WACC). The coefficient is −0.224 to −0.270 across the specifications ($p < 0.01$), implying that for a one unit increase in leverage, WACC decreases by approximately 22–27%. Moving on to the environmental factors, it is interesting to see that sustainability indicators have a negative and significant effect on WACC. The ESG composite score decreases WACC by −0.086 ($p < 0.01$) and governance disclosure reduces WACC by −0.098 ($p < 0.01$). The findings suggest that transparency in governance and extensive ESG disclosure substantially reduce borrowing costs. Strong explanatory power is supported by the adjusted R^2 values (0.56–0.61), and it means that model explains at least more than half of the variance in WACC.

Table 4. Regression results, dependent variable WACC in banks and financial technology firms.

	Model 1	Model 2	Model 3	Model 4
ROA	0.172			0.120
	[0.130]			[0.209]
P/E	0.012 ***	0.014 ***	0.014 ***	0.017 ***
	[0.004]	[0.004]	[0.004]	[0.006]
Financial leverage	−0.224 ***	−0.242 ***	−0.270 ***	−0.262 ***
	[0.029]	[0.028]	[0.024]	[0.036]
ESG	−0.086 ***			
	[0.025]			
Tobin Q	0.257	0.350	0.491 *	−0.016
	[0.330]	[0.328]	[0.274]	[0.385]
log_market capitalization	0.096	−0.406 **	−0.283 *	−0.790 **
	[0.198]	[0.170]	[0.161]	[0.312]
ROE		0.104 ***		0.103 **
		[0.031]		[0.047]
Social disclosure score		−0.004		
		[0.017]		
Net income margin			0.084 ***	0.043
			[0.021]	[0.029]

Table 4. *Cont.*

	Model 1	Model 2	Model 3	Model 4
Governance disclosure score			−0.098 ***	
			[0.023]	
Environmental disclosure score				−0.016
				[0.014]
Constant	11.343 ***	12.813 ***	19.051 ***	17.806 ***
	[2.217]	[2.308]	[2.204]	[3.729]
Adjusted R-squared	0.557	0.568	0.613	0.610
Observations	349.00	345.00	350.00	314.00

Notes: OLS regression results for the determinants of WACC in banks and financial technology firms. Standard errors are reported in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All models are estimated using robust standard errors.

4.3. Determinants of Equity Costs

Table 5 reveals that the determinants of cost of equity are quite different from WACC. Leverage has a positive coefficient and increases equity cost by 7–13% (coefficients varying between 0.073 and 0.130, all $p < 0.01$). Once more, governance disclosure also stands as the most relevant ESG factor in this sample and it decreases the cost of equity by 9–10% (−0.098, $p < 0.01$). Environmental disclosure is positively and significantly related to equity costs (0.027, $p < 0.1$), which indicates that the environmental activities are considered a costly investment commitment by the investors, possibly at the expense of short-term horizon profit reduction. In contrast, profitability decreases equity costs: The coefficient on net income margin is −0.066 ($p < 0.01$). The R^2 changes are between 0.25 and 0.33, meaning that equity costs depend more on the market situation and on investor mood than WACC.

Table 5. Regression results, dependent variable cost of equity in banks and financial technology firms.

	Model 1	Model 2	Model 3	Model 4
ROA	0.065			0.325
	[0.138]			[0.203]
P/E	0.006	0.002	0.003	0.005
	[0.004]	[0.004]	[0.004]	[0.005]
Financial leverage	0.130 ***	0.113 ***	0.073 **	0.079 **
	[0.034]	[0.032]	[0.029]	[0.039]
ESG	0.006			
	[0.029]			
Tobin Q	0.111	0.327	−0.192	−0.382
	[0.379]	[0.360]	[0.297]	[0.382]
log_market capitalization	−0.375 *	−0.546 ***	0.165	−0.438
	[0.205]	[0.182]	[0.189]	[0.306]
ROE		−0.009		−0.006
		[0.029]		[0.040]
Social disclosure score		0.021		
		[0.021]		
Net income margin			−0.066 ***	−0.065 **
			[0.024]	[0.030]
Governance disclosure score			−0.098 ***	
			[0.024]	
Environmental disclosure score				0.027 *
				[0.014]
Constant	18.636 ***	20.746 ***	23.969 ***	22.882 ***
	[2.385]	[2.553]	[2.512]	[3.758]
Adjusted R-squared	0.250	0.258	0.312	0.327
Observations	349.00	345.00	350.00	314.00

Notes: OLS regression results for the determinants of cost of equity in financial institutions. Standard errors are reported in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All models are estimated using robust standard errors.

4.4. Determinants of Debt Costs

The cost of debt regressions in Table 6 lend ample support for the reducing effect sustainability has on borrowing costs. The ESG composite score lowers debt costs by 6.9% (−0.069, $p < 0.01$) and governance disclosure reduces debt costs by 4.6% (−0.046, $p < 0.01$). Profitability further strengthens the effect: ROA is inversely correlated with debt costs (β −0.135 to −0.451, $p < 0.01$). Social disclosure is negatively significant (−0.014, $p < 0.1$), which means that lenders are not concerned about social aspects to a very large extent. The adjusted R^2 (0.32–0.41) indicates that these models capture quite a proportion of the variation in debt cost (R^2 values are between 32% and 41%).

Table 6. Regression results, dependent variable cost of debt in banks and financial technology firms.

	Model 1	Model 2	Model 3	Model 4
ROA	−0.135 ***			−0.451 ***
	[0.045]			[0.124]
P/E	−0.002	0.003	0.002	0.001
	[0.002]	[0.002]	[0.002]	[0.003]
Financial leverage	−0.114 ***	−0.095 ***	−0.113 ***	−0.143 ***
	[0.013]	[0.011]	[0.014]	[0.019]
ESG	−0.069 ***			
	[0.013]			
Tobin Q	−0.200 **	−0.396 ***	−0.276 ***	−0.101
	[0.090]	[0.127]	[0.099]	[0.225]
log_market capitalization	0.166 **	0.057	0.029	−0.374 **
	[0.074]	[0.080]	[0.098]	[0.177]
ROE		0.043 ***		0.127 **
		[0.016]		[0.050]
Social disclosure score		−0.014 *		
		[0.008]		
Net income margin			0.037 **	0.019
			[0.017]	[0.029]
Governance disclosure score			−0.046 ***	
			[0.017]	
Environmental disclosure score				−0.006
				[0.011]
Constant	5.517 ***	3.347 ***	7.013 ***	7.963 ***
	[0.981]	[1.016]	[1.432]	[1.779]
Adjusted R-squared	0.358	0.321	0.365	0.405
Observations	344.00	340.00	345.00	310.00

Notes: OLS regression results for the determinants of cost of debt in financial institutions. Standard errors are reported in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All models are estimated using robust standard errors.

The correlation matrix in Figure 1 endorses the results from the regression analysis. WACC, cost of equity, and cost of debt are positively related; however, they measure different risk aspects. Financial leverage is inversely valid with WACC and debt costs but not the holding effect on equity costs due to risk–return trade off. Importantly, ESG scores exhibit negative association with all capital cost proxies, in particular governance, proving their effectiveness in alleviating costs of funding. Dynamic trends for 2010–2024, displayed in Figure 2, demonstrate that the cost of equity was persistently the largest share of WACC (12% versus 6% for WACC and 2% for debt). Equity valuations fell noticeably in the early years (2010–2014), stabilized afterwards and started to rise again after 2019, as credit conditions tightened and risk perceptions increased. The cost of debt was generally low throughout, but rose slightly after 2019, in line with the tightening lending conditions. Parallel trends of sustainability performance are depicted in Figure 3. Governance scores received consistently high marks, averaging above 80, while the environmental and social scoring was significantly lower, ranging mostly between 20 and 40. The ESG score was

slowly increasing until 2022 then showed a little decrease again. This tendency implies that even though firms enhanced the transparency of disclosure, progress was uneven and that lower performance in sustainability (social and environment) did not allow firms to reduce financing costs more widely.

4.5. IV (2SLS) Results with Strengthened Instruments

Table 7 reports the two-stage least squares (2SLS) estimates using peer-based instruments constructed by industry, region, and year leave-one-out means of ESG disclosure to address potential endogeneity in the ESG regressor. Firm and year fixed effects are partialled out, and standard errors are clustered at the firm level. Instrument strength remains limited (Kleibergen-Paap rk Wald F ranges 1.986–2.174), therefore inference relies on weak-IV robust Anderson–Rubin tests.

Table 7. Instrumental variables (2SLS) estimates: ESG disclosure and costs of capital.

	WACC	Cost of Equity	Cost of Debt
ESG	−0.254 * (0.148)	0.014 (0.140)	−0.256 ** (0.117)
ROA	−0.300 (0.296)	−0.122 (0.307)	−0.083 (0.138)
ROE	0.080 (0.085)	0.049 (0.064)	0.020 (0.040)
P/E	0.002 (0.006)	0.001 (0.007)	−0.001 (0.002)
Financial leverage	−0.182 (0.118)	0.229 (0.162)	−0.117 (0.097)
TOBIN Q	−1.322 ** (0.646)	−1.702 *** (0.534)	−0.661 ** (0.323)
Log_Market capitalization	−1.446 (3.831)	−2.080 (5.325)	−0.885 (2.794)
Net interest margin	−0.020 (0.070)	−0.027 (0.072)	−0.018 (0.024)
Obs.	316	316	312
Centered R^2	−0.222	0.105	−1.095
KP rk F (robust)	2.174	2.174	1.986
AR F (p-value)	6.98 (0.0029)	0.51 (0.6044)	36.09 (0.0000)
Hansen J (p-value)	0.368	0.353	0.511

Notes: Two stage least squares (2SLS) with firm and year fixed effects partialled out; standard errors are heteroscedasticity-robust and clustered at the firm level. Instruments: (industry, region, year leave-one-out). KP rk F is the Kleibergen-Paap rk Wald F-statistic; AR denotes the Anderson–Rubin weak-IV-robust test. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The robustness of the results is confirmed through Anderson–Rubin weak-IV tests and over-identification diagnostics.

The results indicate that ESG disclosure is negatively associated with the weighted average cost of capital (–0.254) and with the cost of debt (–0.256), while the effect on the cost of equity is not statistically significant (0.014; $p > 0.01$). These findings are confirmed by both the conventional Wald statistics and the Anderson–Rubin test, which shows statistical significance for WACC and debt models ($p < 0.01$). Over-identifying restrictions are not rejected (Hansen J p ranges 0.353–0.511), supporting the validity of the chosen instruments.

Control variables include profitability indicators (ROA, ROE), valuation metrics (P/E, Tobin Q), financial leverage, market capitalization, and net interest margin. Tobin Q shows a negative and statistically significant coefficient in several specifications, suggesting that firms with higher market valuation tend to face lower costs of capital.

This approach mitigates the bias inherent in ordinary least squares estimates by exploiting exogenous variation in peer ESG disclosure. Although instrument strength remains limited, the findings consistently show that enhanced ESG transparency reduces the overall cost of capital and borrowing costs, while having no significant effect on equity investors' required returns. These patterns are consistent with agency and signaling theories, whereby greater ESG disclosure reduces information asymmetry and perceived non-financial risk, thus lowering borrowing and financing costs, even if equity investors remain less sensitive to such disclosures.

5. Discussion

In accordance with the obtained empirical results, ESG disclosure significantly lowered the cost of capital in both WACC and debt drivers; however, the impact on cost of equity remains insignificant in statistical terms. This finding is consistent with previous studies arguing that improved sustainability disclosure is able to alleviate the financing frictions (Friede et al., 2015; Andrieș & Sprincean, 2023; Raimo et al., 2021). The particularly strong complementarity of ESG disclosure with cost of governance reveals the idea that transparency and responsibility continue to be the most reliable signals of corporate quality for debt-holders and investors. The positive relationship between environmental disclosure and equity costs also supports the statement of Li et al. (2018), indicating that there may be short-term costs related to greening actions.

The comparison between banks and financial technology presents a dense interplay in this regard. On the one side, banks enjoy a significantly lower cost of debt through the more considerable reduction in sustainability transparency due to a deposit-taking and wholesale borrowing model that is directly influenced by the credit rating and stakeholder belief. On the other hand, financial technology firms suffer from a higher equity risk premium due to innovation risk and scalability uncertainty. At the same time, they compensate for a slight portion of this cushion by more explicit sustainable reporting that fosters investor trust. Expressed through the lens of theory, these findings are consistent with both agency and signaling theories. ESG acts as a two-fold mechanism by reducing information asymmetry and signaling the company's commitment to responsible governance and long-term value creation. The lack of an effect on equity cost implies that shareholders focus more on growth opportunities and innovation potential than the sustainability implications. Debt holders, in their turn, are more sensitized by transparency and a moderate reduction in default risk. These firm-level dynamics take on even greater meaning when interpreted in the context of a cross-regional regulatory environment. The European Union operates under a robust regulatory framework for sustainability and financial technology. In contrast, the United States follows a market-driven logic, while Asia prioritizes digital financial inclusion. Therefore, expanding the current line of research with the conceptual paper is of critical theoretical and practical importance.

6. Conclusions

In the global banking and financial technology sectors, the role of equity has grown even more as higher risk and limited borrowing options have increased their reliance on equity issuance, confirming the Signaling theory that investors are more sensitive to risk and information transparency factors. Agency and Voluntary disclosure theories have also been confirmed, as greater ESG and governance transparency have reduced information asymmetry and lenders' perceived risk, thereby lowering the cost of debt.

Our study proved and adds to the existing literature new insights that ESG disclosure impacts the cost of capital for banks and financial technology companies in Europe, America, and Asia between 2010 and 2024. Using fixed effects and instrumental variable 2SLS regressions with peer-based instruments, we established that higher ESG transparency, especially governance, significantly reduced borrowed and overall capital costs—the equity cost remained unaffected. It implies that financial institutions with better integration of sustainability strategies and reporting frameworks gain better financing conditions and increased resilience. While governance disclosure becomes a key factor for banking by reducing the cost of debt due to lower perceived default risk, sustainable practices help financial technology firms by increasing reputational capital and investor confidence, which limits the equity risk premium because of fast technological changes.

Such conclusions have various implications for all stakeholders. Managers may use the findings to understand sustainable disclosure's strategic value for optimizing their financing structure. Investors may consider ESG as a sustainable, long-term stabilizer and risk reducing indicator.

The results of this study suggest several important policy implications that can be taken to improve financial inclusion through the services provided by banks and financial technology companies on a broader scale. This is consistent with the findings and suggestions of other studies (Asif et al., 2023) on the importance of financial inclusion. Policymakers should first consider investing in digital financial infrastructure, including mobile networks and low-cost payment systems, as mobile financial technology services significantly increase peoples' ability to transact, save, and increase income. Government support plays an important role in accelerating the integration of financial technology. Regulatory pilot environments, simplified licensing, and public–private partnerships would increase market development and access to digital financial products. Digital financial literacy interventions should be implemented at scale. Responsible oversight of consumer protection systems would strengthen trust in digital financial platforms.

Our findings do support the main hypothesis that higher ESG transparency contributes to a lower weighted cost of capital within the banking sector. We argue that reducing WACC is driven by lower costs of debt financing, in line with our previous assumption that improvement in the transparency of sustainability will mitigate information asymmetry and lender default risk. The influence of the factor on cost of equity is not statistically significant, but its implication is that investors tend to be more willing to chase growth opportunities. More generally, the findings suggest that sustainability transparency is a financial instrument that enables financing conditions, as it acts to exert the greatest influence on financing through the debt market, which helps to reduce the systemic impact of risk on the banking sector (Aifan et al., 2025). This study has limitations. It covers only publicly listed institutions, and regional heterogeneity may bias small estimates. Future research may explore this gap by including disclosed unlisted financial technology companies, adding diverse regulatory and institutional variables, and checking nonlinear ESG impacts on capital costs. Nonetheless, our study contributes to the sustainable finance understanding. It proves that ESG disclosure, and governance in particular, is a strategic tool for strengthening financing conditions, reducing capital costs, and creating a more sustainable and resilient system.

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Abbreviations

The following abbreviations are used in this manuscript:

ESG	Environmental, social, and governance (ESG)
WACC	Weighted average cost of capital

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