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RESEARCH ARTICLE

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Do creditors care about greening in corporations? Do contingencies matter?

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Abstract

This study assesses whether creditors consider ecological practices (i.e., resource usage, emissions, and eco-innovation) when setting interest rates during loan decisions and whether firm-level contingencies play a role in this relationship. Based on a sample of 38,127 firm-year observations of non-financial firms operating worldwide between 2004 and 2019, our evidence indicates that eco-friendly practices have no significant direct effect on the cost of debt. Thus, we consider other theoretically expected channels that moderate this link. Notably, profitability and board gender diversity significantly moderate the relationship between eco-friendly practices and the cost of debt. Further investigation reveals interesting associations between low and high governance systems, low and high financial development environments, code law versus common law systems, and polluting versus non-polluting sectors. We suggest theoretical and practical implications by which firms can reap greater benefits from environmental engagement.

KEYWORDS

board gender diversity, cost of debt, eco-innovation, environmental performance, profitability, international evidence

1 | INTRODUCTION

The existing body of empirical literature has consistently highlighted the significant impact of emissions resulting from corporate operational activities on global climate change. This influence extends to critical outcomes, such as the escalation of sea levels and the emergence of hazardous weather phenomena, including hurricanes, floods, and heatwaves, as outlined by the Intergovernmental Panel on Climate Change (Intergovernmental Panel on Climate Change, 2018). Consequently, a proactive response has emerged from various nations and international entities, exemplified by the United Nations Framework Convention on Climate Change (UNFCCC) of 2015, more commonly known as the Paris Accord. This concerted effort underscores the imperative for corporations to transcend regulatory requisites and embrace ecologically sustainable practices, thus mitigating their adverse environmental and societal consequences. This resolution is underscored in scholarly works by Li et al. (2020), Gerged, Matthews, and Elheddad (2021), and Chen et al. (2022) and is further augmented by a growing global inclination among consumers to allocate higher financial resources for environmentally friendly products

(Eliwa et al., 2021). Consequently, corporations are compelled to elevate their commitment to environmental pursuits, not only as a means of environmental safeguarding but also as a strategy to satisfy the discerning demands of influential stakeholders, including shareholders, creditors, and customers.

Mainstream research has consistently highlighted the importance of eco-friendly practices in shaping corporate value. A significant body of evidence, as discussed in studies by Hart (1995), Hoepner et al. (2016), Baboukardos (2018), Brooks and Oikonomou (2018), Galaz et al. (2018), Tzouvanas et al. (2020), and Scholtens and Witteveen (2021), suggests that corporations adopting eco-friendly initiatives gain a competitive edge through enhanced relationships with key stakeholders, leading to cost-effective financial resources. However, contrasting evidence by Clarkson et al. (2004) and Jung et al. (2018) indicates that carbon-related risks can increase debt costs, as investors use environmental indicators to assess hidden environmental liabilities and risks.

Despite these insights, existing research exhibits notable limitations, primarily in its focus on single-country contexts or small sample sizes, as seen in the works of Ge and Liu (2015), Stellner et al. (2015), Erragragui (2017), Hasan et al. (2017), and Jung et al. (2018). While some studies like those by Erragragui (2017) and Eliwa et al. (2021) have considered a multi-country framework, there remains a lack of comprehensive analysis on how firm-specific variables, institutional settings, and sectoral affiliations moderate the benefits of eco-friendly practices. This gap calls for further exploration to understand the interplay between these factors and the effectiveness of environmental initiatives. This study aims to address this gap by examining the influence of eco-friendly practices, including eco-innovation, resource management, and emissions control, on the cost of debt in an international context. It seeks to answer: To what extent do eco-friendly practices influence corporate debt costs globally, and how is this relationship influenced by contingency factors, such as profitability and the presence of female directors on boards?

Our study extends existing research by exploring the interplay between firm-level contingencies and eco-friendly strategies in relation to debt costs on a global scale. It investigates the moderating roles of profitability and gender diversity in the relationship between environmental performance and debt dynamics. Additionally, we examine whether these interrelationships and effects vary across different governance systems, financial development stages, legal frameworks, and sectors with varying environmental impacts. This comprehensive approach addresses the critical research void in understanding the institutional and sectoral influences on the eco-friendly practices-debt nexus. Employing a wide dataset of 38,127 observations from listed firms globally from 2004 to 2019 and using methodologies like fixed-effects models and other robust methodologies,[1] our findings provide valuable insights. Contrary to expectations, we found no significant direct impact of eco-friendly practices on debt expenditures. However, the roles of profitability and gender diversity on boards in moderating the relationship between eco-friendly efforts and debt profiles were evident. Further analyses revealed that these relationships vary significantly within different governance frameworks, financial development stages, legal traditions, and environmental sectors, highlighting the importance of the institutional and sectoral context in this nexus.

Our study marks a significant advancement in the scholarly field, primarily in two key areas, as evidenced by its alignment with and extension of existing literature. Firstly, it explores the complex relationship between eco-friendly practices, including eco-innovation, resource utilization, and emissions control, and their impact on debt contracts. Our worldwide investigation with an exclusive focus on eco-friendly practices extends the work of Erragragui (2017) and Eliwa et al. (2021), who focused on the influence of corporate social performance on the cost of debt in Europe and the USA. Secondly, we investigate the moderating roles of profitability and gender diversity on corporate boards in the environmental performance-cost of debt nexus. This aspect of our research contributes to the discourse initiated by Qureshi et al. (2020), who examined the impact of board diversity on the association between environmental innovation and the cost of debt in European companies and complements the findings of La Rosa et al. (2018) on the role of profitability in the relationship between corporate social responsibility and the cost of debt in Europe. Thirdly, our study breaks new ground by comprehensively analysing the potential influences of governance systems, financial development stages, legal systems, and sectoral classification on the connection between eco-friendly initiatives and debt costs. This dimension of our investigation provides useful insights into the link between environmental practices and debt contracts, taking into account institutional contexts, which is of critical importance for policymaking. This aspect of our research builds on the foundational work of Gerged et al. (2023), who explored the role of governance systems in promoting corporate environmental disclosure, which, in turn, is expected to enhance the value of corporations in the Gulf Cooperation Council economies (Gerged, Beddewela, & Cowton, 2021). Through these contributions, our research strengthens the academic base in the domain of external debt financing of eco-friendly activities, offering nuanced insights that span across corporate, environmental, and regulatory spheres. This comprehensive approach not only aligns with but also extends the work of Uyar, Gerged, Kuzey, and Karaman (2023), who emphasized the need for integrated research in understanding the moderating mechanism through which corporate social responsibility practices can influence the cost of debt. Thus, our study aims to make a unique contribution to corporate governance, corporate finance, and environmental management domains.

The remainder of this article is organized as follows: Section 2 discusses the theoretical framework and hypothesis development. Section 3 explains the research methodology, while Section 4 explains the empirical findings. Section 5 discusses the main results and concludes.

2 | THEORETICAL FRAMEWORK AND HYPOTHESES

Levitt (1958) argued that creditors and lenders base their decisions on concrete data, including a company's leverage, profitability, and solvency, to assess its ability to pay off debts. However, since the 2000s, there has been an intensive ongoing debate about the financial effects of eco-friendly practices on corporations (Al-Tuwaijri et al., 2004; Hassel et al., 2005; Sharfman & Fernando, 2008). On the other hand, Hemingway and Maclagan (2004) suggested that some companies engage in environmental practices as a form of "greenwashing" to hide their harmful environmental actions. This deceptive strategy could increase the risk for these companies, potentially leading to higher debt (Jensen & Smith, 1985). This situation challenges the notion of using profitability as the sole criterion for lending decisions in the short term, as noted by Birindelli et al. (2015) and Hoepner et al. (2016).

Neu et al. (1998) suggested that financial stakeholders, especially banks, significantly influence eco-friendly initiatives, often aligning them with their own requirements. This alignment can be strategic for companies to meet these demands effectively. It's reasonable to say that companies with poor environmental performance may face challenges in accessing necessary resources for operations in an environment that values eco-friendly practices, leading to increased debt costs (Deegan & Unerman, 2011).

A notable trend is that environmentally underperforming companies often engage in "greenwashing"—a deceptive practice intended to falsely project eco-friendly commitments for benefits such as reduced debt costs (Ashforth & Gibbs, 1990). Current research indicates that companies might use greenwashing to maintain their legitimacy by manipulating stakeholder perceptions (Cho et al., 2015). Specifically, companies with minimal environmental commitment tend to maintain a façade of eco-friendliness, concealing their actual environmental efforts (Michelon et al., 2015). This issue triggers financial institutions' scepticism about companies' involvement in environmental activities (Eliwa et al., 2021).

Despite the recognized value of eco-friendly initiatives in corporations, the effect of these efforts on debt cost is still debated. Previous research indicates that eco-friendly practices are generally associated with lower debt costs globally. For instance, Albarrak et al. (2019) found a significant negative relationship between emissions reduction and debt costs in the USA. Similarly, He et al. (2013) showed that environmental practices could lead to lower debt costs internationally. Relevant to our study, Eliwa et al. (2021) suggested that the market rewards companies for participating in eco-friendly activities, which can reduce their debt costs.

Thus, the first hypothesis interrogated in our study unfurls as follows:

> **Hypothesis 1.** There is a negative relationship between firms' environmental performance and their cost of debt.

Empirical research highlights that profitable companies are better equipped to finance green initiatives (Boso et al., 2017). Profitability reduces risk exposure and facilitates the accumulation of funds for environmentally friendly projects, thereby lowering borrowing costs (Julian & Ofori-Dankwa, 2013). Therefore, a company's profitability is a key factor in linking its environmental performance to its cost of borrowing. Financially sound companies can more readily invest in environmental improvements, which, in turn, can lower their borrowing expenses (Albarrak et al., 2019; Bui et al., 2020; Gerged, Matthews, & Elheddad, 2021; He et al., 2013). Thus, the influence of environmental performance on borrowing costs is closely tied to a company's profitability. As a result, we formulate the following hypothesis to capture this interaction:

> **Hypothesis 2.** Firms' profitability is likely to moderate the expected negative relationship between firms' environmental performance and their cost of debt.

In line with the United Nations Sustainable Development Goal 5, which aims for gender equality, it is recommended that companies increase women's participation in boardroom decision-making (Kamil & Appiah, 2021). As a result, both developed and developing countries have adopted quotas, either mandatory or voluntary, to ensure gender diversity on the boards of listed companies (Tanaka, 2019; Terjesen et al., 2015). Critics, however, argue that such quotas might lead to the selection of underqualified women, potentially compromising the interests of shareholders (Kamil & Appiah, 2021).

Despite these criticisms, there is a growing push against male-dominated boards, especially those with over 80% male composition, emphasizing the need for increased gender diversity (Hellier & Chasan, 2018). This has sparked research into the role of female directors in enhancing various aspects of corporate performance, such as financial performance (Post & Byron, 2015; Reguera-Alvarado & Bravo-Urquiza, 2020), sustainability reporting (Buallay et al., 2022), and environmental sustainability (Issa & Zaid, 2021).

Agency theory suggests that diverse boards are crucial for effective governance, potentially strengthening the link between environmental and social performance and financial performance (Amin et al., 2022; Kahloul et al., 2022; Li et al., 2022). This is seen as aligning management's goals with stakeholder interests, encouraging actions beneficial to these stakeholders (Nguyen et al., 2021; Qiu et al., 2016; Tanaka, 2019). Recent studies, such as Li et al. (2022), show that female directors positively influence the relationship between a firm's social, environmental, and financial performance. Therefore, we argue that board diversity significantly impacts the relationship between environmental performance and the cost of debt. Hence, our hypothesis takes the form as follows:

> **Hypothesis 3.** Board gender diversity is likely to moderate the expected negative relationship between firms' environmental performance and their cost of debt.

Figure 1 highlights the theoretical framework of the study and the proposed relationships among the variables.

3 | DATA AND METHODS

The research methodology included multiple steps. First, we constructed the study's econometric models and identified the variables. Second, pertinent datasets were identified and compiled. Third, the data were preprocessed, including cleaning, transformation, imputation, and winsorization. The estimation techniques were then identified and run. Lastly, the results are analysed and interpreted. In the following subsections, we briefly describe the variables but define them broadly with their metrics in Table 1.

3.1 | Variables

3.1.1 | Dependent variable

This study investigated the relationship between the cost of debt (*CostofDebt*) and the environmental performance of a firm and how profitability (return on assets [*ROA*]) and board gender diversity (*BoaGnDv*) moderate this relationship. Following prior studies (Bernstein et al., 2019;

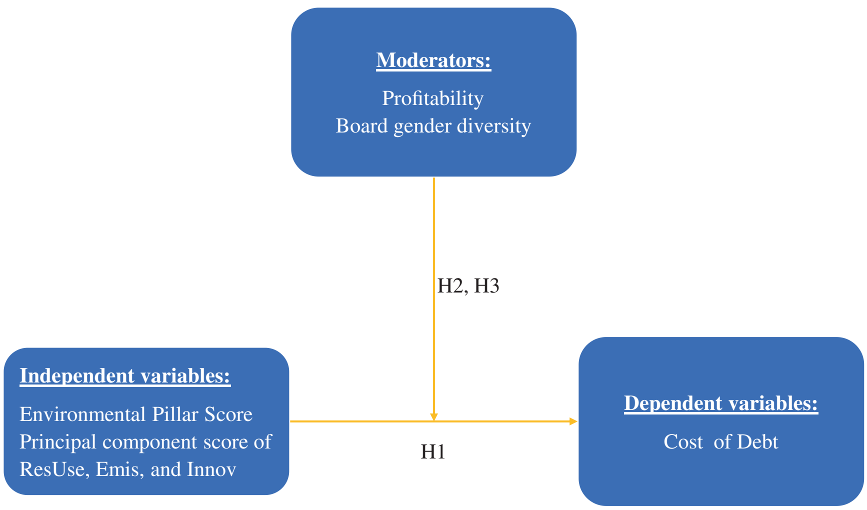

FIGURE 1 The theoretical background of the study and developed hypotheses. [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Variables included in the study.

Variables	Definition	Source
CostofDebt	Interest expense divided by total debt	Eikon database (ED)
CostofDebt_Adj	Industry-adjusted CostofDebt (calculated by subtracting the median CostofDebt of all firms in a given industry from a firm's CostofDebt in a given year.)	ED
EPS	The environmental pillar score assesses a firm's impact on living and non-living natural systems, including the land, air, and water, as well as the whole ecosystem. It measures how well a firm mobilizes best management practices to prevent environmental risks and capitalizes on environmental opportunities in generating long-term stockholder value. The EPS is based on their dimensions, including resource use, emissions, and eco-innovation (please see the definitions below). The score ranges from 0 to 100.	ED
EPS_Adj	Industry-adjusted EPS (calculated similarly as CostofDebt _Adj.)	ED
EPS_PCA	Variable obtained from subjecting ResUse, Emis, and Innov category scores to principal component analysis.	ED
EPS_PCA_Adj	Variable obtained by subjecting ResUse_Adj, Emis_Adj, and Innov_Adj scores to principal component analysis.	ED
ResUse	Resource use score considers a company's achievement and competence in reducing energy, water, and materials consumption and adopting environmentally friendly practices in supply chain operations. It includes 20 metrics, such as the existence of an environmental team, the existence of water, energy efficiency, sustainable supply chain management and packaging policies, the amount of water recycled, water and energy consumption, and e-waste reduction, among others. The score ranges from 0 to 100.	ED
Emis	The emission score measures a company's commitment and ability to reduce manufacturing and operational activities' environmental emissions. It includes 28 metrics, such as CO_2 and CO_2 equivalents emission in tonnes, the total amount of waste produced, the existence of emission reduction policy and target, environmental fines, oil and other hydrocarbon spills, and the total amount of NOx, Sox, and organic compounds emissions, among others. The score ranges from 0 to 100.	ED
Innov	The eco-innovation score assesses a company's innovation capability to create environmentally friendly products, technologies, and processes, thus minimizing the total ecological footprint. Eco-innovation score is built on 20 metrics covering eco-labelled product development, noise-reducing product development, hybrid vehicle development, environmental screening criteria in investments, organic food development, product or technology development for use in the clean, product or technology development for water use efficiency, renewable energy, among others. The score ranges from 0 to 100.	ED
BoaSi	Size of the board of trustees	ED
CEODual	Variable indicating the duality of CEO and board of trustees chairman roles	ED
FiSi	Firm size as proxied by the natural logarithm of total assets	ED
ROA	Earnings before interest and taxes (EBIT) divided by total assets	ED
Tobin_Q	The sum of company market capitalisation and total debt divided by total assets	ED
CapExp	Capital expenditures divided by net sales	ED
Levrg	Total debt divided by total assets	ED
CurRatio	Total current assets divided by total current liabilities	ED
WGI	World governance indicators averaged over the six dimensions of the rule of law, voice and accountability, government effectiveness, control of corruption, regulatory quality, political stability, and absence of violence.	World Bank
BoaGnDv	Women members' percentage of the board of trustees	ED
PolEnrgyEff	Indicator variable for the energy efficiency policy	ED
PolBusEth	Indicator variable for the business ethics policy	ED

Hamrouni et al., 2020; Kling et al., 2021; Swanpitak et al., 2020), *CostofDebt* was proxied by interest expense divided by total debt.[2]

3.1.2 | Independent variables

We measured firms' environmental performance using the widely adopted environmental pillar score (*EPS*) of the environmental, social, and governance taxonomy, as provided by our data source, Thomson Reuters Eikon. The *EPS* included resource use (*ResUse*), emissions (*Emis*), and eco-innovation (*Innov*) category scores ranging from 0 to 100 sticking to the rating system of Thomson Reuters Eikon (Kuzey et al., 2022; Quintana-García et al., 2022; Uyar, Kuzey, Gerged, & Karaman, 2023). We also used principal component analysis (PCA) to construct another environmental performance variable, *EPS_PCA*, based on the variables *ResUse*, *Emis*, and *Innov* (Ferrero-Ferrero et al., 2015).

3.1.3 | Control variables

We used board size (*BoaSi*) and CEO duality (*CEODual*) to control for board characteristics, whereas firm size (*FiSi*; proxied by the natural logarithm of total assets), *ROA*, firm market value (*Tobin_Q*; adopted Tobin's Q ratio as a proxy), capital expenditures (*CapExp*), leverage (*Levrg*), and current ratio (*CurRatio*) were used to control firm financial characteristics (Akbar et al., 2016; Kılıç et al., 2021; Uyar et al., 2021; Uyar, Kuzey, Gerged, & Karaman, 2023). World governance indicators (*WGI*) were used to control governance quality across countries (Jost et al., 2022; Uyar, Kuzey, & Karaman, 2023). The WGI was developed by Kaufmann et al. (2011). Lastly, the energy efficiency policy (*PolEnrgyEff*) and business ethics policy (*PolBusEth*) were used as instrumental variables. Table 1 presents all the variables, their definitions, and data sources.

3.2 | Methodology

The study adopted the fixed-effects (FE) regression methodology to analyse the link between the cost of debt and EP, among other panel data methods. The FE estimators are unbiased, provided that the strict exogeneity assumption holds—that is, idiosyncratic errors should not correlate with regressors (Wooldridge, 2016). The econometric model is represented by the following equation:

$$Y_{it} = \beta_0 + \beta_1 X_{it-1} + \beta_2 Z_{it} + \lambda_i + \mu_t + \epsilon_{it} \quad (1)$$

In Equation 1, Y_{it} denotes the firm i's cost of debt at year t. X_{it-1} symbolizes the firm's environmental performance at year t − 1, and Z_{it} signifies the board and financial characteristics at year t, respectively. λ_i represents the unobserved firm, μ_t designates the year fixed effects, and ϵ_{it} indicates the idiosyncratic errors. We used the lagged value of the environmental performance variables consistent with Hoepner et al. (2016), Magnanelli and Izzo (2017), and Yeh et al. (2020).

After including the moderating variables in the analysis, the equation was constructed as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it-1} + \beta_2 M_{it} + \beta_3 (X_{it-1} \times M_{it}) + \beta_4 Z_{it} + \lambda_i + \mu_t + \epsilon_{it}, \quad (2)$$

where Y_{it}, X_{it-1}, Z_{it}, λ_i, μ_t, and ϵ_{it} are as described in Equation 1. M_{it} denotes the moderating variables and $X_{it-1} \times M_{it}$ represents the interaction effects of environmental performance and the moderating variables.

3.3 | Data and sample

Following prior studies (Lynch & O'Hagan-Luff, 2023; Uyar, Kuzey, & Karaman, 2023), we downloaded the data from the Refinitiv Eikon (aka Thomson Reuters Eikon; Eikon thereafter) database. The sample included all the publicly traded companies (excluding the financial firms, in line with Sánchez-Ballesta & Garcia-Meca, 2011) maintained in the Eikon database for the years 2004–2019. After preprocessing and cleaning the data, the sample included 38,127 firm-year records that had both company fundamentals and environmental data available. The following records were missing from the sample: 13 firm-year records (corresponding to 0.03% of all records) for *ResUse* and *Emis*, 1114 records (2.92%) for *Innov*, 136 records (0.36%) for *BoaSi*, 110 records (0.29%) for *ROA*, 194 records (0.51%) for *Tobin_Q*, 3331 records (8.74%) for *CapExp*, 390 records (1.02%) for *CurRatio*, and 623 records (1.63%) for *BoaGnDv*. The *p*-value for the Chi-square distance ($\chi^2 = 13{,}729.24$, $p = 0.00$) was significant for the Little's missing completely at random (MCAR) test. The data were multiply imputed since up to 10% of missing data are generally acceptable, and any imputation method is appropriate (Hair Jr et al., 2019). To fill the missing values, we used multivariate imputation techniques, multivariate normal regression using the data augmentation Markov Chain Monte Carlo method (for *ROA*, *Tobin_Q*, and *CurRatio*), and multivariate imputation using chained equations (for *ResUse*, *Emis*, *Innov*, *BoaSi*, *CapExp*, and *BoaGnDv*) based on the type of data (i.e. continuous variables, continuous variables with restricted ranges, count variables). To mitigate the impact of outliers, in line with prior literature, the variables *CostofDebt* and *Levrg* were winsorized at the right tail (at 99% percentile), and the variables *ROA*, *Tobin_Q*, *CapExp*, and *CurRatio* were winsorized at both tails (at 1% and 99% percentile, respectively) (He & Niu, 2018; Zolotoy et al., 2019).

The final unbalanced panel comprised 38,127 firm-year records from 75 countries. Table A1 reports the sample formation (Panel A) and distribution based on sector-wise [Panel B] and year-wise [Panel C] distributions. Table A2 presents the distribution of the sample across countries. Whereas telecommunications services made up the smallest economic sector constituent (3.5% of the firm-year observations), industrials formed the largest constituent (22% of the firm-year records). There were 732 firm-year observations (corresponding to 1.9% of the panel) in 2004, which increased to 5027 observations (corresponding to 13.2% of the panel) in 2019. The firms domiciled in the US constituted the highest share (28.22%) of firm-year records in the sample.

4 | EMPIRICAL RESULTS

4.1 | Descriptive statistics

The univariate analyses included descriptive statistics of the variables used in the study. Table 2 presents the mean, standard deviation, min, and max of the dependent and independent variables. The mean *CostofDebt* was 0.057, with a standard deviation of 0.083, ranging from a minimum value of 0 to a maximum value of 0.695. The lagged value of EPS was averaged at 35.464 (±28.453), the lagged value of EPS_PCA was averaged at 0.002 (±1.478), the lagged value of *ResUse* was averaged at 39.456 (±33.452), the lagged value of *Emis* was averaged at 39.973 (±33.513), and the lagged value of *Innov* was averaged at 23.629 (±30.800). The environmental performance scores ranged from −1.842 to 99.829 during 2004–2019, while the *Innov* score was slightly lower.

4.2 | Correlations

The bivariate analyses, including Pearson's correlations, are reported in Table 3. *CostofDebt* was negatively correlated with *EPS*, *EPS_PCA*, and *Innov* ($p < 0.05$). *CostofDebt* was also negatively correlated with *BoaSi*, *FiSi*, *Levrg*, *CEODual*, and *PolEnrgyEff* ($p < 0.05$), whereas it was positively correlated with *ROA*, *Tobin_Q*, *CapExp*, *CurRatio*, *BoaGnDv*, and *PolBusEth* (with $p < 0.05$). The environmental performance variables were positively correlated with *PolEnrgyEff* and *PolBusEth* ($p < 0.05$).

4.3 | Baseline results

In the baseline analysis, fixed-effects panel data regression was adopted to estimate the coefficients in Equations 1 and 2. We initially ran an ordinary least squares (OLS) regression. We then ran a random effects (RE) regression. Next, we conducted the Lagrange multiplier (LM) test (Breusch-Pagan's), which rejected the null hypothesis. Hence, RE estimates were considered to be more appropriate than OLS estimates. Subsequently, we obtained the FE estimators and compared them with the RE estimators and decided to choose the FE estimators, as they were more appropriate estimators than the RE estimators because of the Hausman test (Greene, 2003). The time-fixed effects were also included in the analysis since the null hypothesis for the time-fixed effects was rejected. Lastly, heteroskedasticity-consistent standard errors (also known as Huber/White sandwich errors) were obtained as a result of the heteroskedasticity of the data (Stock & Watson, 2008).

Table 4 presents the FE estimates for Equation 1 in columns 1 and 2. All the *p*-values for the *F*-test were significant (at the 5% level). The results indicated that the environmental performance variables, including *L.EPS* and *L.EPS_PCA*, were not significant; hence, they had no effect on *CostofDebt*. Further, we executed the GMM estimates to address endogeneity concerns resulting from unobserved heterogeneity, simultaneity, and/or dynamic endogeneity, in line with Wintoki et al. (2012) and Ullah et al. (2018). Table 4 presents the GMM estimates for Equation 1 in columns 3 and 4. The results revealed that the *L.EPS* and *L.EPS_PCA* were not significant; hence, they did not affect *CostofDebt*. Therefore, hypothesis H1 was not statistically supported. This motivated us to further explore the mechanisms through which environmental performance proxies can influence *CostofDebt*.

Table 5 reports the FE estimates for Equation 2 for the moderating variables *ROA* and *BoaGnDv*. All the *p*-values for the *F*-test were significant (at the 5% level). The results showed that the environmental performance variables and their interaction effects, including *L.EPS* ×*ROA* ($p < 0.05$) and *L.EPS_PCA* × *ROA* ($p < 0.01$),

TABLE 2 Descriptive statistics.

Variables	Obs.	Mean	Std. dev.	Min	Max
CostofDebt	38,127	0.057	0.083	0	0.695
CostofDebt _Adj	38,127	0.016	0.083	−0.058	0.653
L.EPS	32,313	35.464	28.453	0	99.058
L.EPS_Adj	32,313	6.497	28.185	−47.201	96.042
L.EPS_PCA	32,313	0.002	1.478	−1.842	3.392
L.EPS_PCA_Adj	32,313	0.005	1.461	−2.880	4.497
L.ResUse	32,313	39.456	33.452	0	99.829
L.Emis	32,313	39.973	33.513	0	99.808
L.Innov	32,313	23.629	30.800	0	99.805
BoaSi	38,127	10.243	3.491	1	37
FiSi	38,127	22.300	1.509	12.412	27.405
ROA	38,127	0.079	0.080	−0.255	0.331
Tobin_Q	38,127	1.497	1.217	0.267	7.506
CapExp	38,127	0.138	0.292	0.002	1.797
Levrg	38,127	0.270	0.172	0.000	0.815
CurRatio	38,127	1.746	1.204	0.272	7.617
WGI	38,127	1.109	0.595	−0.988	1.960
BoaGnDv	38,127	13.757	12.692	0	100

	Category	Frequency	Percentage
CEODual	Not exist	23,221	60.90
	Exist	14,906	39.10
	Total	38,127	100.00
PolEnrgyEff	Not exist	14,979	39.29
	Exist	23,148	60.71
	Total	38,127	100.00
PolBusEth	Not exist	10,579	27.75
	Exist	27,548	72.25
	Total	38,127	100.00

were significant (−) on *CostofDebt*. Further, the environmental performance variables and their interaction effects, including *L.EPS* × *BoaGnDv* ($p < 0.05$) and *L.EPS_PCA* × *BoaGnDv* ($p < 0.01$), were both significant (−) on *CostofDebt*. Hence, H2 and H3 were empirically accepted. Figures 2 and 3 graphically illustrate the interaction effects of *L.EPS* × *ROA* and *L.EPS_PCA* × *ROA*, respectively. Figures 4 and 5 graphically demonstrate the interaction effects of *L.EPS* × *BoaGnDv* and *L.EPS_PCA* × *BoaGnDv*, respectively.

4.4 | Robustness checks

The robustness of the results was checked using alternative dependent and test variables (industry-adjusted), an alternative estimation methodology, and an alternative sample. Industry-adjusted cost of debt (*CostofDebt_Adj*) was adopted, following prior studies (Ghosh & Jain, 2000; Le, 2020), and calculated by subtracting the median *CostofDebt* of all firms in a given industry from a firm's *CostofDebt* in a given year. Similarly, following prior studies (Bose et al., 2022; Hubbard et al., 2017), we calculated industry-adjusted EPS scores (*EPS_Adj* and *EPS_PCA_Adj*) and eco-innovation (*Innov_Adj*) scores. Table 6 in Panel A reports the estimates using industry-adjusted variables. All the *p*-values for the *F*-test were significant (at the 5% level). The results corroborated that the environmental performance variables, including *L.EPS_Adj* and *L.EPS_PCA_Adj*, were not significant (FE estimates in columns 1 and 2; GMM estimates in columns 3 and 4).

TABLE 3 Correlation coefficients (Pearson's).

	CostofDebt	L.EPS	L.EPS_PCA	BoaSi	FiSi	ROA	Tobin_Q	CapExp
CostofDebt	1							
L.EPS	−0.1063[a]	1						
L.EPS_PCA	−0.1077[a]	0.9845[a]	1					
BoaSi	−0.1032[a]	0.2967[a]	0.3047[a]	1				
FiSi	−0.2218[a]	0.4931[a]	0.4986[a]	0.4725[a]	1			
ROA	0.0229[a]	0.0323[a]	0.0280[a]	0.0037	0.0396[a]	1		
Tobin_Q	0.1080[a]	−0.1274[a]	−0.1317[a]	−0.1522[a]	−0.3191[a]	0.3582[a]	1	
CapExp	0.0112[a]	−0.0482[a]	−0.0563[a]	−0.0408[a]	−0.0390[a]	−0.0943[a]	0.0394[a]	1
Levrg	−0.2039[a]	−0.0125[a]	−0.0246[a]	0.0558[a]	0.1326[a]	−0.1202[a]	−0.0590[a]	0.0543[a]
CurRatio	0.1140[a]	−0.1461[a]	−0.1449[a]	−0.1510[a]	−0.2828[a]	−0.0411[a]	0.2362[a]	0.0130[a]
WGI	0.0022	0.0396[a]	0.0483[a]	−0.1115[a]	−0.0859[a]	−0.0261[a]	−0.0179[a]	−0.1198[a]
BoaGnDv	0.0101[a]	0.1582[a]	0.1570[a]	−0.0193[a]	0.0087	0.0706[a]	0.0876[a]	−0.0521[a]
CEODual	−0.0338[a]	−0.0086	−0.0028	0.0651[a]	0.1158[a]	0.0250[a]	0.0383[a]	−0.0101[a]
PolEnrgyEff	−0.0968[a]	0.6144[a]	0.6230[a]	0.2165[a]	0.3522[a]	0.0750[a]	−0.1012[a]	−0.0413[a]
PolBusEth	0.0324[a]	0.2029[a]	0.2042[a]	−0.0471[a]	0.0532[a]	−0.0152[a]	0.0377[a]	0.0343[a]

	Levrg	CurRatio	WGI	BoaGnDv	CEODual	PolEnrgyEff	PolBusEth
Levrg	1						
CurRatio	−0.2803[a]	1					
WGI	−0.0485[a]	0.0391[a]	1				
BoaGnDv	0.0549[a]	−0.0607[a]	0.1491[a]	1			
CEODual	0.0183[a]	0.0335[a]	0.0187[a]	−0.0196[a]	1		
PolEnrgyEff	0.0025	−0.1373[a]	−0.0792[a]	0.1348[a]	−0.0418[a]	1	
PolBusEth	0.1009[a]	0.0196[a]	0.1514[a]	0.2269[a]	0.0673[a]	0.1423[a]	1

[a]Correlation is significant at the 0.05 level.

Further, Table 6 in Panel B presents the FE estimates for the moderation analysis again by using industry-adjusted dependent and test variables. All the *p*-values for the *F*-test were significant (at the 5% level). The results verified that the environmental performance variables and their interaction effects *L.EPS_Adj* × *ROA* and *L.EPS_PCA_Adj* × *ROA* ($p < 0.05$) were both significant (−). The interaction effects, including *L.EPS_Adj* × *BoaGnDv* ($p < 0.05$) and *L.EPS_PCA_Adj* × *BoaGnDv* ($p < 0.01$), were also significant (−).

The baseline analysis results were subjected to an alternative methodology. 2SLS regression was used to alleviate endogeneity concerns in the environmental performance variables (including *EPS* and *EPS_PCA*). 2SLS requires choosing an appropriate instrumental variable (IV) that satisfies the exogeneity requirement. That is, the IV and the environmental performance variables should be correlated (IV relevancy condition), and *CostofDebt* should not be affected by the IV (IV exogeneity condition; Wooldridge, 2016). Hence, the lag of the environmental performance variables, energy efficiency policy (*PolEnrgyEff*; Niu et al., 2017) and business ethics policy (*PolBusEth*) were used as the IVs. Due to the difficulty of exploring suitable IVs, the lags of test variables have been widely employed as IVs in the past literature (Murcia et al., 2021; Uyar, Kuzey, Gerged, & Karaman, 2023; Uyar, Kuzey, & Karaman, 2023). Graafland and Smid (2019) posited that corporate policies are appropriate IVs, as they are likely to influence impacts through their effects on corporate practices. Hence, we posit that energy efficiency and business ethics policies are critical policies that spur the environmental performance of firms.

Table 7 discloses the first-stage and second-stage estimates based on the 2SLS. The Kleibergen–Paap statistics were significant, indicating that the IVs were "relevant"; that is, they were correlated with the endogenous regressors. The Hansen *J* statistics (overidentification test of all instruments) were not significant, contributing to the validity of the IVs (i.e. they were not correlated with the

TABLE 4 Model estimation: Cost of debt and environmental performance (FE and GMM estimates).

	(1) CostofDebt	(2) CostofDebt	(3) CostofDebt	(4) CostofDebt
L.CostofDebt			0.3088***	0.3085***
			(9.161)	(9.152)
L.EPS	0.0000		0.0000	
	(0.898)		(1.551)	
L.EPS_PCA		0.0006		0.0004
		(0.842)		(1.029)
BoaSi	−0.0000	−0.0000	−0.0001	−0.0001
	(−0.007)	(−0.015)	(−0.798)	(−0.751)
CEODual	0.0018	0.0018	−0.0010	−0.0011
	(1.019)	(1.017)	(−1.062)	(−1.100)
FiSi	−0.0176***	−0.0176***	−0.0073***	−0.0072***
	(−7.182)	(−7.185)	(−11.748)	(−11.615)
ROA	0.0053	0.0053	−0.0228**	−0.0227**
	(0.308)	(0.310)	(−2.224)	(−2.213)
Tobin_Q	−0.0010	−0.0010	0.0019***	0.0019***
	(−0.679)	(−0.681)	(2.632)	(2.636)
CapExp	−0.0107***	−0.0107***	0.0008	0.0008
	(−3.816)	(−3.817)	(0.359)	(0.350)
Levrg	−0.1426***	−0.1426***	−0.0483***	−0.0484***
	(−13.588)	(−13.588)	(−11.634)	(−11.682)
CurRatio	0.0042***	0.0042***	0.0011*	0.0011*
	(4.168)	(4.167)	(1.765)	(1.751)
WGI	−0.0046	−0.0046	−0.0036***	−0.0035***
	(−0.644)	(−0.642)	(−4.391)	(−4.318)
Constant	0.5007***	0.5018***	0.2301***	0.2290***
	(9.332)	(9.351)	(14.543)	(14.227)
Firm FE/Year FE	**Included**	**Included**	**Included**	**Included**
N	32,313	32,313	32,313	32,313
F-stat	16.49	16.50	34.08	34.19
p-value	0.000	0.000	0.000	0.000
AR(2) p-value			0.068	0.069
Hansen test *p*-value			0.284	0.286

Note: The table presents the results for baseline analysis using lagged independent variables. Columns 1 and 2 are FE estimates, and columns 3 and 4 are GMM estimates. For columns 3 and 4, the Arellano-Bond test for AR(2) is not significant at the 5% level, hence not rejecting the null hypothesis of no higher-order serial correlation in the first differences. Similarly, the Hansen test of overidentifying restrictions is not significant, corroborating that the instruments are valid, that is, uncorrelated with the error term; *t* statistics in parentheses.
$^{*}p < 0.10$. $^{**}p < 0.05$. $^{***}p < 0.01$.

error term). The endogeneity test also specified that endogenous regressors could be treated as exogenous. Again, all the *p*-values for the *F*-test were significant (at the 5% level). The results confirmed that the environmental performance variables, including *L.EPS* and *L.EPS_PCA*, were not significant, which is in line with the base analysis.

A further robustness check was conducted by excluding the countries from the sample with fewer than 10 observations, assuming that a small number of

TABLE 5 Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus.

	(1) CostofDebt	(2) CostofDebt	(3) CostofDebt	(4) CostofDebt
L.EPS	0.0001**		0.0001*	
	(2.413)		(1.924)	
ROA	0.0321	−0.0059	0.0048	0.0049
	(1.400)	(−0.366)	(0.283)	(0.283)
L.EPS × ROA	−0.0011**			
	(−2.422)			
L.EPS_PCA		0.0026***		0.0018**
		(2.599)		(2.211)
L.EPS_PCA × ROA		−0.0236***		
		(−2.615)		
BoaGnDv			−0.0001	−0.0002***
			(−0.806)	(−2.636)
L.EPS × BoaGnDv			−0.0000**	
			(−2.024)	
L.EPS_PCA × BoaGnDv				−0.0001***
				(−2.618)
BoaSi	0.0000	0.0000	0.0000	0.0000
	(0.029)	(0.015)	(0.141)	(0.128)
CEODual	0.0017	0.0017	0.0021	0.0021
	(0.971)	(0.968)	(1.192)	(1.207)
FiSi	−0.0175***	−0.0175***	−0.0176***	−0.0177***
	(−7.214)	(−7.218)	(−7.196)	(−7.212)
Tobin_Q	−0.0007	−0.0006	−0.0009	−0.0009
	(−0.452)	(−0.436)	(−0.619)	(−0.602)
CapExp	−0.0106***	−0.0106***	−0.0107***	−0.0107***
	(−3.784)	(−3.785)	(−3.828)	(−3.821)
Levrg	−0.1432***	−0.1432***	−0.1430***	−0.1431***
	(−13.582)	(−13.577)	(−13.643)	(−13.647)
CurRatio	0.0042***	0.0042***	0.0042***	0.0042***
	(4.160)	(4.157)	(4.153)	(4.157)
WGI	−0.0054	−0.0055	−0.0098	−0.0103
	(−0.748)	(−0.766)	(−1.353)	(−1.415)
Constant	0.4973***	0.5011***	0.5060***	0.5097***
	(9.358)	(9.413)	(9.408)	(9.460)
Firm FE/Year FE	**Included**	**Included**	**Included**	**Included**
N	32,313	32,313	32,313	32,313
F-stat	15.93	15.90	16.17	16.13
p-value	0.000	0.000	0.000	0.000

Note: The table presents the results of the moderation analysis using lagged independent variables; *t* statistics in parentheses.
*$p < 0.10$.**$p < 0.05$.***$p < 0.01$.

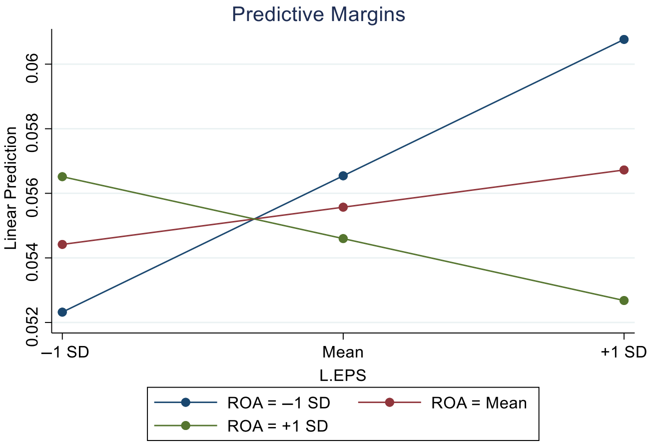

FIGURE 2 Interaction effect of L.EPS × ROA. [Colour figure can be viewed at wileyonlinelibrary.com]

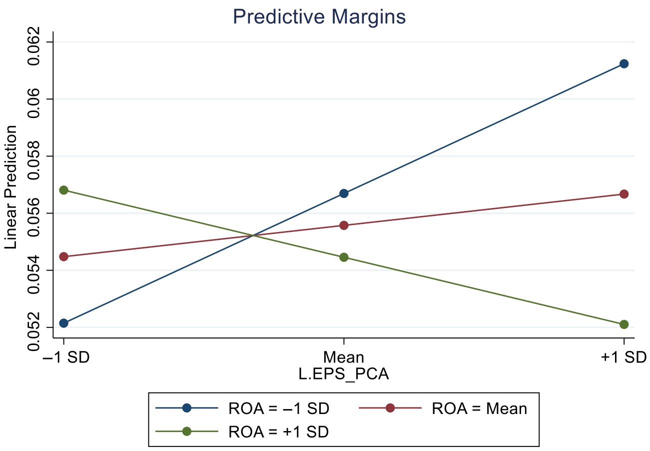

FIGURE 3 Interaction effect of L.EPS_PCA × ROA. [Colour figure can be viewed at wileyonlinelibrary.com]

observations may not yield reliable results. In Table 8, Panel A presents the analysis results with the new sample. The results indicated that the effects of *L.EPS* and *L.EPS_PCA* were not significant on *CostofDebt* (both for the FE (columns 1 and 2) and GMM (columns 3 and 4) estimates). In Table 8, Panel B reports the FE estimates for Equation 2 for the moderating variables *ROA* and *BoaGnDv*. The results showed that *L.EPS* × *ROA* ($p < 0.05$) and *L.EPS_PCA* × *ROA* ($p < 0.01$) were significant (−) on *CostofDebt*. Further, *L.EPS* × *BoaGnDv* ($p < 0.05$) and *L.EPS_PCA* × *BoaGnDv* ($p < 0.01$) were significant (−) on *CostofDebt*. Hence, the results were completely in parallel with the base analysis results.

As a result of both alternative variables and methodology checks, the rejection of hypothesis H1 and the acceptance of H2 and H3 were corroborated. This suggests that our primary results are highly unlikely to be influenced by the possible existence of endogeneity problems.

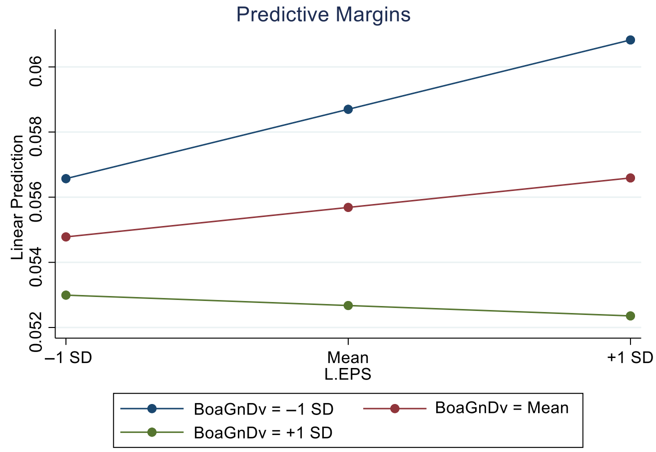

FIGURE 4 Interaction effect of L.EPS × BoaGnDv. [Colour figure can be viewed at wileyonlinelibrary.com]

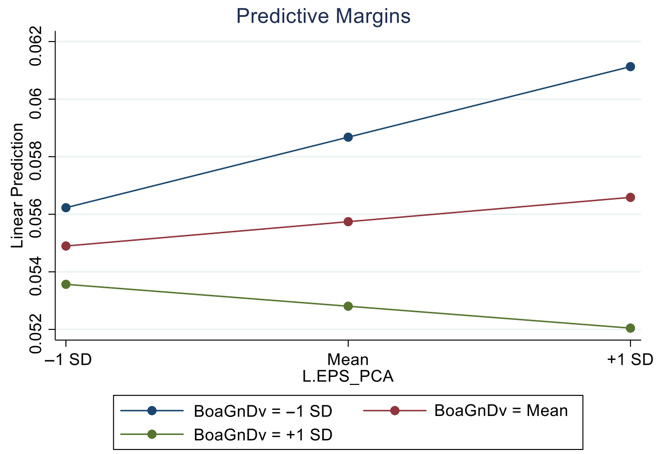

FIGURE 5 Interaction effect of L.EPS_PCA × BoaGnDv. [Colour figure can be viewed at wileyonlinelibrary.com]

4.5 | Further analysis

In addition to the above robustness tests, we executed additional tests to explore whether direct associations and moderating effects vary according to low and high governance systems, low and high financial development environments, code law versus common law systems, and polluting versus non-polluting sectors.

4.5.1 | Governance system

We further analysed the studied relationships in the low and high governance systems. The *WGI* values were used to split the sample into low and high governance quality. In particular, the median *WGI* in 2019 (the latest available year) was used to break up the sample. Table 9 presents the FE estimates for the base analysis

TABLE 6 Robustness analysis (industry-adjusted variables).

Robustness tests

Panel A: Model estimation: Cost of debt and environmental performance (FE and GMM estimates)

	(1)	(2)	(3)	(4)
	CostofDebt_Adj	CostofDebt_Adj	CostofDebt_Adj	CostofDebt_Adj
L.CostofDebt_Adj			0.3129***	0.3128***
			(9.168)	(9.168)
L.EPS_Adj	0.0000		0.0000	
	(0.137)		(1.230)	
L.EPS_PCA_Adj		0.0000		0.0002
		(0.008)		(0.675)
Constant	0.4650***	0.4645***	0.1961***	0.1941***
	(8.665)	(8.663)	(13.569)	(13.387)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included
N	32,313	32,313	32,313	32,313
F-stat	13.86	13.86	35.02	35.07
p-value	0.000	0.000	0.000	0.000
AR(2) p-value			0.062	0.062
Hansen test *p*-value			0.241	0.241

Panel B: Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus

	(1)	(2)	(3)	(4)
	CostofDebt_Adj	CostofDebt_Adj	CostofDebt_Adj	CostofDebt_Adj
L.EPS_Adj	0.0001		0.0001	
	(1.551)		(1.422)	
ROA	0.0061	0.0019	0.0075	0.0075
	(0.371)	(0.115)	(0.446)	(0.443)
L.EPS_Adj × ROA	−0.0009**			
	(−1.977)			
L.EPS_PCA_Adj		0.0016*		0.0013
		(1.673)		(1.574)
L.EPS_PCA_Adj × ROA		−0.0188**		
		(−2.254)		
BoaGnDv			−0.0002**	−0.0002**
			(−2.292)	(−2.472)
L.EPS_Adj × BoaGnDv			−0.0000**	
			(−2.289)	
L.EPS_PCA_Adj × BoaGnDv				−0.0001***
				(−2.843)
Constant	0.4649***	0.4645***	0.4702***	0.4704***
	(8.704)	(8.717)	(8.748)	(8.757)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included

(Continues)

TABLE 6 (Continued)

Panel B: Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus				
	(1)	(2)	(3)	(4)
	CostofDebt_Adj	CostofDebt_Adj	CostofDebt_Adj	CostofDebt_Adj
N	32,313	32,313	32,313	32,313
F-stat	13.27	13.27	13.31	13.32
p-value	0.000	0.000	0.000	0.000

Note: The table presents the results of robustness analysis using lagged independent variables. In Panel A, columns 1 and 2 are FE estimates and columns 3 and 4 are GMM estimates. For columns 3 and 4, the Arellano-Bond test for AR(2) is not significant at the 5% level, hence not rejecting the null hypothesis of no higher-order serial correlation in the first differences. Similarly, the Hansen test of overidentifying restrictions is not significant, corroborating that the instruments are valid, that is, uncorrelated with the error term; *t* statistics in parentheses.
$^{*}p < 0.10$. $^{**}p < 0.05$. $^{***}p < 0.01$.

TABLE 7 Model estimation: Cost of debt and environmental performance (2SLS estimates).

Robustness tests				
	(1)	(2)	(3)	(4)
	L.EPS	CostofDebt	L.EPS_PCA	CostofDebt
L2.EPS	0.5583***			
	(72.217)			
L2.EPS_PCA			0.5486***	
			(69.025)	
L.PolEnrgyEff	9.7526***		0.5264***	
	(28.076)		(29.321)	
L.PolBusEth	2.3575***		0.1291***	
	(7.027)		(7.417)	
L.EPS		0.0000		
		(0.565)		
L.EPS_PCA				0.0004
				(0.344)
Constant	−28.9323***	0.5232***	−2.3879***	0.5232***
	(−5.390)	(9.309)	(−8.701)	(9.292)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included
N	27,481	27,481	27,481	27,481
F-stat	810.12	15.62	795.07	15.61
p-value	0.000	0.000	0.000	0.000
Kleibergen-Paap statistics		3282.55***		3370.79***
Hansen J statistics		0.142		0.178
Endogeneity test		1.027		0.536

Note: The Kleibergen-Paap statistics (underidentification test) were significant, meaning that the IVs are "relevant." Moreover, the Hansen J statistics (overidentification test of all instruments) were not significant, contributing to the validity of the IVs. The endogeneity test also specified that endogenous regressors could be treated as exogenous; *t* statistics in parentheses.
$^{*}p < 0.10$. $^{**}p < 0.05$. $^{***}p < 0.01$.

TABLE 8 Robustness analysis (excluding countries with less than 10 observations).

Robustness tests

Panel A: Model estimation: Cost of debt and environmental performance (FE and GMM estimates)

	(1)	(2)	(3)	(4)
	CostofDebt	**CostofDebt**	**CostofDebt**	**CostofDebt**
L.CostofDebt			0.3088***	0.3085***
			(9.161)	(9.152)
L.EPS	0.0000		0.0000	
	(0.898)		(1.551)	
L.EPS_PCA		0.0006		0.0004
		(0.842)		(1.029)
Constant	0.5007***	0.5018***	0.2301***	0.2290***
	(9.332)	(9.351)	(14.543)	(14.227)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included
N	32,313	32,313	32,313	32,313
F-stat	16.49	16.50	34.08	34.19
p-value	0.000	0.000	0.000	0.000
AR(2) *p*-value			0.068	0.069
Hansen test *p*-value			0.284	0.286

Panel B: Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus

	(1)	(2)	(3)	(4)
	CostofDebt	**CostofDebt**	**CostofDebt**	**CostofDebt**
L.EPS	0.0001**		0.0001*	
	(2.413)		(1.924)	
ROA	0.0321	−0.0059	0.0048	0.0049
	(1.400)	(−0.366)	(0.283)	(0.283)
L.EPS × ROA	−0.0011**			
	(−2.422)			
L.EPS_PCA		0.0026***		0.0018**
		(2.599)		(2.211)
L.EPS_PCA × ROA		−0.0236***		
		(−2.615)		
BoaGnDv			−0.0001	−0.0002***
			(−0.806)	(−2.636)
L.EPS × BoaGnDv			−0.0000**	
			(−2.024)	
L.EPS_PCA × BoaGnDv				−0.0001***
				(−2.618)
Constant	0.4973***	0.5011***	0.5060***	0.5097***
	(9.358)	(9.413)	(9.408)	(9.460)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included

(Continues)

TABLE 8 (Continued)

Panel B: Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus				
	(1)	(2)	(3)	(4)
	CostofDebt	CostofDebt	CostofDebt	CostofDebt
N	32,313	32,313	32,313	32,313
F-stat	15.93	15.90	16.17	16.13
p-value	0.000	0.000	0.000	0.000

Note: The table presents the results of the robustness analysis excluding countries with less than ten observations. In Panel A, columns 1 and 2 are FE estimates, and columns 3 and 4 are GMM estimates. For columns 3 and 4, the Arellano-Bond test for AR(2) is not significant at the 5% level, hence not rejecting the null hypothesis of no higher-order serial correlation in the first differences. Similarly, the Hansen test of overidentifying restrictions is not significant, corroborating that the instruments are valid, i.e., uncorrelated with the error term; *t* statistics in parentheses.
p* < 0.10.*p* < 0.05.****p* < 0.01.

TABLE 9 Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus (Low- and High WGI levels).

Further results						
	(1)	(2)	(3)	(4)	(5)	(6)
	CostofDebt	CostofDebt	CostofDebt	CostofDebt	CostofDebt	CostofDebt
	Low WGI			High WGI		
L.EPS	0.0001	0.0001	0.0001	0.0000	0.0001**	0.0001
	(0.880)	(0.791)	(0.720)	(0.407)	(2.089)	(1.572)
ROA	0.0177	0.0289	0.0176	0.0067	0.0366	0.0060
	(0.370)	(0.466)	(0.366)	(0.360)	(1.466)	(0.326)
L.EPS × ROA		−0.0005			−0.0012**	
		(−0.412)			(−2.463)	
BoaGnDv			−0.0000			−0.0001
			(−0.039)			(−0.771)
L.EPS × BoaGnDv			0.0000			−0.0000**
			(0.203)			(−2.116)
Constant	0.3559***	0.3550***	0.3558***	0.5230***	0.5197***	0.5330***
	(3.894)	(3.865)	(3.856)	(8.520)	(8.557)	(8.630)
Controls	Included	Included	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included	Included	Included
N	4827	4827	4827	27,486	27,486	27,486
F-stat	3.77	3.65	3.67	15.06	14.56	14.93
p-value	0.000	0.000	0.000	0.000	0.000	0.000

Note: The table presents the results for moderation analysis using lagged independent variables for low- and high WGI levels; *t* statistics in parentheses.
p* < 0.10.*p* < 0.05.****p* < 0.01.

in columns 1 and 4, and the FE estimates for the moderation analysis are presented in columns 2, 3, 5, and 6. All the *p*-values for the *F*-test were significant (at the 5% level). The results indicated that the effect of *L.EPS* was not significant (columns 1 and 4); hence, it did not affect *CostofDebt*, regardless of the governance systems. Moreover, the moderation effect of *L.EPS* × *ROA* and *L.EPS* × *BoaGnDv* were not significant on *CostofDebt* (columns 2 and 3) for "low" governance quality. However, the interaction effects, including *L.EPS* × *ROA* ($p < 0.05$) and *L.EPS* × *BoaGnDv* ($p < 0.05$), were both significant (−) on *CostofDebt* (columns 5 and 6) for "high" governance quality.

TABLE 10 Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus (Low- and High financial market development (FMD) levels).

Further results	(1)	(2)	(3)	(4)	(5)	(6)
	CostofDebt Low FMD	CostofDebt	CostofDebt	CostofDebt High FMD	CostofDebt	CostofDebt
L.EPS	0.0001	−0.0000	0.0001	0.0000	0.0001**	0.0001
	(1.156)	(−0.128)	(0.845)	(0.406)	(2.372)	(1.610)
ROA	−0.0302	−0.0700	−0.0303	0.0136	0.0477*	0.0129
	(−0.752)	(−1.428)	(−0.753)	(0.727)	(1.904)	(0.691)
L.EPS × ROA		0.0013			−0.0015***	
		(1.271)			(−2.918)	
BoaGnDv			−0.0001			−0.0001
			(−0.556)			(−0.664)
L.EPS × BoaGnDv			0.0000			−0.0000**
			(0.771)			(−2.194)
Constant	0.3773***	0.3876***	0.3799***	0.5179***	0.5153***	0.5280***
	(4.800)	(5.004)	(4.878)	(8.102)	(8.145)	(8.210)
Controls	Included	Included	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included	Included	Included
N	5633	5633	5633	26,680	26,680	26,680
F-stat	3.58	3.51	3.53	14.99	14.47	14.89
p-value	0.000	0.000	0.000	0.000	0.000	0.000

Note: The table presents the results of moderation analysis using lagged independent variables for low- and high financial market development levels; *t* statistics in parentheses.
$^{*}p < 0.10$. $^{**}p < 0.05$. $^{***}p < 0.01$.

4.5.2 | Financial market development

We analysed the studied relationships in the low and high financial market development levels. The World Economic Forum Financial Market Development (FMD) pillar values (World Economic Forum, 2018) were used to split the sample into low and high financial market sophistication. In particular, the median FMD in 2018 (the latest available year) was used to break up the sample.

Table 10 shows the FE estimates for the base analysis in columns 1 and 4, and the FE estimates for the moderation analysis are displayed in columns 2, 3, 5, and 6. Again, all the *p*-values for the *F*-test were significant (at the 5% level), indicating the goodness of fit of the models. The results specified that *L.EPS* was not significant (columns 1 and 4); hence, it had no effect on *CostofDebt*, regardless of the FMD level. Additionally, the moderation effects of *L.EPS* × *ROA* and *L.EPS* × *BoaGnDv* were not significant on *CostofDebt* (columns 2 and 3) for "low" FMD. However, the moderation effects of *L.EPS* × *ROA* ($p < 0.01$) and *L.EPS* × *BoaGnDv* ($p < 0.05$) were significant (−) on *CostofDebt* (columns 5 and 6) for "high" FMD.

4.5.3 | Law systems

To analyse the relationships in different law systems, we used La Porta et al.'s (1998) legal origin to split the sample into code law and common law countries. Table 11 illustrates the FE estimates for the base analysis (columns 1 and 4) and the estimates for the moderation analysis (columns 2, 3, 5, and 6). Once again, all the *p*-values for the *F*-test were significant (at the 5% level). The results demonstrated that the effect of *L.EPS* was not significant (columns 1 and 4) and had no effect on *CostofDebt*, regardless of the law system. However, the moderation effects of *L.EPS* × *ROA* ($p < 0.05$) were significant (−) on *CostofDebt* (columns 2 and 5) for code law and common

TABLE 11 Model estimation: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus (Code Law vs. Common Law systems).

Further results	(1)	(2)	(3)	(4)	(5)	(6)
	CostofDebt	CostofDebt	CostofDebt	CostofDebt	CostofDebt	CostofDebt
	Code Law			Common Law		
L.EPS	0.0001	0.0002**	0.0001	0.0000	0.0001**	0.0001
	(0.950)	(2.248)	(1.141)	(0.303)	(1.963)	(0.881)
ROA_1	0.0587*	0.1342**	0.0573*	−0.0026	0.0250	−0.0029
	(1.682)	(2.266)	(1.649)	(−0.123)	(0.919)	(−0.137)
L.EPS × ROA		−0.0020**			−0.0014**	
		(−2.251)			(−2.159)	
BoaGnDv			−0.0003			−0.0001
			(−1.639)			(−0.457)
L.EPS × BoaGnDv			−0.0000			−0.0000
			(−0.546)			(−0.949)
Constant	0.3561***	0.3330***	0.3643***	0.6103***	0.6120***	0.6078***
	(4.785)	(4.479)	(4.841)	(7.923)	(8.012)	(7.903)
Controls	Included	Included	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included	Included	Included
N	11,763	11,763	11,763	17,639	17,639	17,639
F-stat	7.70	7.52	7.50	11.47	11.21	10.80
p-value	0.000	0.000	0.000	0.000	0.000	0.000

Note: The table presents the results of moderation analysis using lagged independent variables for code law vs. common law systems; *t* statistics in parentheses. $^{*}p < 0.10$.$^{**}p < 0.05$.$^{***}p < 0.01$.

law countries. By contrast, the moderation effects of *L.EPS* × *BoaGnDv* were not significant on *CostofDebt* (columns 3 and 6) for both law systems.

4.5.4 | Polluting versus non-polluting industries

Regarding the relationship between *CostofDebt* and environmental performance in non-polluting and polluting economic sectors, we grouped non-polluting and polluting sectors based on Clarkson et al. (2011), with the polluting sectors including basic materials, energy, industrials, and Utilities, while the rest were grouped as non-polluting. The motivation for undertaking this additional test is that creditors might react to polluting and non-polluting industries' environmental practices in different ways and the possible differential effects of the moderators.

Table 12 (Panel A and Panel B) presents the FE and GMM estimates for the base analysis. The results indicated that the environmental performance variables, including *L.EPS* and *L.EPS_PCA*, were not significant regardless of the non-polluting (Panel A) or polluting status (Panel B); hence, they had no effect on *CostofDebt*.

Table 12 (Panel C and Panel D) reports the moderating variables' regression estimates for the non-polluting and polluting sectors. The results in Panel C showed that *L.EPS* × *ROA* ($p < 0.05$) and *L.EPS_PCA* × *ROA* ($p < 0.05$) were significant (−) on *CostofDebt*, while *L.EPS* × *BoaGnDv*, *L.EPS_PCA* × *BoaGnDv* were not significant for non-polluting industries. However, the results in Panel D indicate that the reversed interaction effects of *L.EPS* × *ROA* and *L.EPS_PCA* × *ROA* were not significant on *CostofDebt*, while *L.EPS* × *BoaGnDv* ($p < 0.1$), *L.EPS_PCA* × *BoaGnDv* ($p < 0.05$) were significant (−) for polluting industries.

Consequently, the main findings reported for the base analysis still hold for both non-polluting and polluting industries. The moderating effects differed between polluting and non-polluting sectors: whereas ROA was a significant moderator in non-polluting industries, *BoaGnDv* was a significant moderator in polluting industries.

TABLE 12 Model estimation (Polluting vs. non-polluting sectors).

Further results				
Panel A: Cost of debt and environmental performance (non-polluting sectors—FE and GMM estimates)				
	(1)	**(2)**	**(3)**	**(4)**
	CostofDebt	**CostofDebt**	**CostofDebt**	**CostofDebt**
L.CostofDebt			0.3986***	0.3984***
			(8.158)	(8.154)
L.EPS	0.0000		0.0000	
	(0.408)		(0.530)	
L.EPS_PCA		0.0002		0.0001
		(0.148)		(0.253)
Constant	0.3908***	0.3901***	0.1715***	0.1702***
	(5.110)	(5.112)	(9.037)	(8.762)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included
N	15,896	15,896	15,896	15,896
F-stat	7.85	7.85	21.47	21.50
p-value	0.000	0.000	0.000	0.000
AR(2) p-value			0.113	0.113
Hansen test p-value			0.192	0.192
Panel B: Cost of debt and environmental performance (polluting sectors—FE and GMM estimates)				
	(1)	**(2)**	**(3)**	**(4)**
	CostofDebt	**CostofDebt**	**CostofDebt**	**CostofDebt**
L.CostofDebt			0.2106***	0.2100***
			(4.590)	(4.579)
L.EPS	0.0000		0.0000	
	(1.013)		(0.822)	
L.EPS_PCA		0.0011		0.0001
		(1.303)		(0.257)
Constant	0.5939***	0.5964***	0.2764***	0.2742***
	(8.184)	(8.193)	(12.319)	(12.152)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included
N	16,417	16,417	16,417	16,417
F-stat	11.43	11.44	22.16	22.24
p-value	0.000	0.000	0.000	0.000
AR(2) p-value			0.464	0.468
Hansen test p-value			0.380	0.381
Panel C: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus (non-polluting sectors)				
	(1)	**(2)**	**(3)**	**(4)**
	CostofDebt	**CostofDebt**	**CostofDebt**	**CostofDebt**
L.EPS	0.0002*		0.0001	
	(1.818)		(0.810)	

(Continues)

TABLE 12 (Continued)

Panel C: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus (non-polluting sectors)				
	(1)	**(2)**	**(3)**	**(4)**
	CostofDebt	**CostofDebt**	**CostofDebt**	**CostofDebt**
ROA	0.0625*	0.0134	0.0338	0.0337
	(1.877)	(0.519)	(1.271)	(1.264)
L.EPS × ROA	−0.0014**			
	(−2.015)			
L.EPS_PCA		0.0031*		0.0010
		(1.921)		(0.762)
L.EPS_PCA × ROA		−0.0319**		
		(−2.289)		
BoaGnDv			−0.0002*	−0.0003***
			(−1.692)	(−3.026)
L.EPS × BoaGnDv			−0.0000	
			(−0.854)	
L.EPS_PCA × BoaGnDv				−0.0001
				(−1.178)
Constant	0.3875***	0.3910***	0.4007***	0.4022***
	(5.120)	(5.150)	(5.207)	(5.222)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included
N	15,896	15,896	15,896	15,896
F-stat	7.50	7.48	8.02	7.96
p-value	0.000	0.000	0.000	0.000

Panel D: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus (polluting sectors)				
	(1)	**(2)**	**(3)**	**(4)**
	CostofDebt	**CostofDebt**	**CostofDebt**	**CostofDebt**
L.EPS	0.0001		0.0001**	
	(1.350)		(1.999)	
ROA	0.0014	−0.0171	−0.0146	−0.0145
	(0.047)	(−0.829)	(−0.673)	(−0.670)
L.EPS × ROA	−0.0006			
	(−1.026)			
L.EPS_PCA		0.0017		0.0025**
		(1.501)		(2.506)
L.EPS_PCA × ROA		−0.0096		
		(−0.940)		
BoaGnDv			0.0001	−0.0001
			(0.394)	(−0.687)
L.EPS × BoaGnDv			−0.0000*	
			(−1.927)	

TABLE 12 (Continued)

Panel D: Moderating effects of ROA and board gender diversity on cost of debt and environmental performance nexus (polluting sectors)				
	(1)	(2)	(3)	(4)
	CostofDebt	CostofDebt	CostofDebt	CostofDebt
L.EPS_PCA × BoaGnDv				−0.0001**
				(−2.453)
Constant	0.5926***	0.5963***	0.5963***	0.6016***
	(8.173)	(8.204)	(8.221)	(8.268)
Controls	Included	Included	Included	Included
Firm FE/Year FE	Included	Included	Included	Included
N	16,417	16,417	16,417	16,417
F-stat	11.00	10.99	11.32	11.37
p-value	0.000	0.000	0.000	0.000

Note: The table presents the results for base and moderation analysis using lagged independent variables for polluting versus non-polluting sectors. In Panels A and B, columns 1 and 2 are FE estimates, and columns 3 and 4 are GMM estimates. For columns 3 and 4, the Arellano-Bond test for AR(2) is not significant at the 5% significance level, hence not rejecting the null hypothesis of no higher-order serial correlation in the first differences. Similarly, the Hansen test of overidentifying restrictions is not significant, corroborating that the instruments are valid, that is, uncorrelated with the error term; *t* statistics in parentheses. **p* < 0.10.***p* < 0.05.****p* < 0.01.

5 | CONCLUSIONS AND IMPLICATIONS

This study assesses whether creditors consider ecological practices in setting interest rates during loan-granting decisions. We also test whether firm-level contingencies played a role in the highlighted main relationship by taking into account a firm's financial performance and board gender diversity in setting the terms of credit provision. We also executed additional tests to assess whether direct associations and moderating effects vary according to low and high governance systems, low and high financial development environments, code law versus common law systems, and polluting versus non-polluting sectors.

The results indicate that eco-friendly practices have no significant direct effect on the cost of debt. Our empirical evidence suggests that profitability and board gender diversity are mechanisms by which firms can employ eco-friendly practices to reduce their debt costs. The results are robust to industry-adjusted proxies, endogeneity concerns, and alternative samples. Further tests revealed that while profitability and female directors help reduce the cost of debt by leveraging eco-friendly practices in high governance and high financial development countries, they are not influential in low governance and weak financial development environments. Although we could not find differing results between code law and common law systems, we found diverging results for the polluting versus non-polluting sectors. Thus, profitability is the right channel to help reduce the cost of debt by leveraging eco-friendly practices in non-polluting sectors, whereas board gender diversity is the right channel to do so in polluting sectors.

The findings have several important theoretical and practical implications for firms. First, an insignificant finding for the direct association between eco-friendly practices and the cost of debt implies that creditors have no clear idea of whether these practices generate value or are costly practices for firms; this appears to be the conflict of value generation or cost-concerned schools (see Hassel et al., 2005). In this respect, firms may need a better projection of the outcomes of those eco-friendly practices to provide concrete evidence of the benefits of those practices to the firms and to convince creditors that they do not engage in greenwashing.

The moderation analysis of firm financial performance (profitability) implies that as long as the debtors perform financially well, emissions, resource usage, and eco-innovation are attributable to the creditors' motivation to guarantee the collection of interest and principal amount of debt from the firms performing well. Moreover, the moderating effect of board gender diversity for all ecological practices indicates that the female directors' ratio on boards strongly affects creditors' provision of loans with favourable terms (Kamil & Appiah, 2021; Karavitis et al., 2021; Pandey et al., 2020; Usman et al., 2019). This implies that women are considered tough monitors and have a convincing effect on creditors concerning the outcomes of environmental practices. Thus, firms are advised to review and revise their board structures accordingly to reap greater benefits from environmental practices in accessing external debt with favourable terms.

The findings from our additional tests have policy-making and corporate governance implications. Public governance quality and the existence of a well-developed financial market help firms decrease their cost of debt through environmental practices but not the poor institutional environment. However, this finding may encourage firms to engage more with eco-friendly practices in high-quality institutional environments; firms located in poor institutional environments are deprived of this, which might discourage them from undertaking environmental practices. Moreover, the diverging results of the polluting versus non-polluting sectors highlight the importance of female directors, particularly in polluting sectors, which may help them better diversify and design their corporate boards.

Although the generalisability of the findings is enriched by the large sample of this study, which includes firms operating worldwide and in diverse sectors, future studies could focus on specific sectors to suggest specific insights for sectoral audiences. The insignificance of the direct relationship between eco-friendly practices and the cost of debt, on the one hand, and the significant moderation effects on this association, on the other hand, also suggest the need for future studies to incorporate other potential moderating mechanisms by which firms can obtain a low-cost loan through their effective engagement in environmentally responsible activities. For example, future studies could explore whether the asset structure of firms could moderate this relationship, providing additional insights into the possible positive effects of tangible assets on creditors' decisions for environmentally responsible firms. Furthermore, the shareholder- or stakeholder-orientedness of the institutional environment might encourage or discourage incorporating those environmental practices into loan-granting decisions.

CONFLICT OF INTEREST STATEMENT

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] Such as the generalized method of moments (GMM) and the two-stage least squares (2SLS) regression.

[2] Whereas US-based studies such as Ortiz-Molina (2006), Jiang (2008), and Sikochi (2020) used "All-in-Drawn-Spread" to measure the cost of debt, we used interest expense divided by total debt. Unlike these studies, which are based on the US sample, our sample is an international one. The previous used "All-in-Drawn-Spread" data for the cost of debt measure due to data availability for the US firms. However, "All-in-Drawn-Spread" data are not largely available for other countries. We checked the data source and observed that our sample downsizes by 87.5%, so 12.5% of the observations match with the original sample when we adopt "All-in-Drawn-Spread" as an alternative cost of debt proxy. This indicates that using this variable would be unreliable in our study. We follow Bernstein et al. (2019), Hamrouni et al. (2020), Swanpitak et al. (2020), and Kling et al. (2021) to measure the cost of debt as the ratio of interest expense to total debt, a choice justified by Swanpitak et al. (2020), who indicated that the debt market in emerging markets is not developed as in developed countries, especially the US. Thus, in our international sample, which includes developed and emerging countries, measuring the cost of debt as the ratio of interest expense to total debt is more appropriate.

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APPENDIX A

TABLE A1 Sample information.

Panel A: Sample formation[a]		
Firm-year records in the Eikon database for 2004–2019		44,996
Missing values (6757) and negative values (112) for *CostofDebt*		(−) 6869
Final sample size		(=) 38,127
Panel B: Distribution of sample across economic sectors		
Economic Sector	**Frequency**	**Percent**
Basic Materials	5048	13.2%
Consumer Cyclicals	7240	19.0%
Consumer Non-Cyclicals	3557	9.3%
Energy	3393	8.9%
Healthcare	3101	8.1%
Industrials	8378	22.0%
Technology	3789	9.9%
Telecommunications Services	1329	3.5%
Utilities	2292	6.0%
Grand Total	38,127	100%
Panel C: Distribution of sample across years		
Year	**Frequency**	**Percent**
2004	732	1.9%
2005	1027	2.7%
2006	1124	2.9%
2007	1222	3.2%
2008	1395	3.7%
2009	1668	4.4%
2010	1895	5.0%
2011	2151	5.6%
2012	2288	6.0%
2013	2414	6.3%
2014	2570	6.7%
2015	2941	7.7%
2016	3422	9.0%
2017	3880	10.2%
2018	4371	11.5%
2019	5027	13.2%
Grand Total	38,127	100%

[a]Sample is formed where both the company fundamentals and Environmental data were available. All the non-financial firms were included in the sample since the financial firms were subject to different government regulations constraining their board of trustees as well as the financial firms' different accounting practices. The Refinitiv Business Classification (TRBC) was adopted to classify the firms into economic sectors.

TABLE A2 Distribution of sample across countries.

Country	Number of unique firms	Number of records	Percentage	Country	Number of unique firms	Number of records	Percentage
Argentina	41	100	0.26%	Macau	3	29	0.08%
Australia	253	1789	4.69%	Malaysia	44	252	0.66%
Austria	26	182	0.48%	Malta	3	9	0.02%
Bahrain	1	2	0.01%	Mexico	36	253	0.66%
Belgium	37	264	0.69%	Monaco	3	12	0.03%
Bermuda	23	138	0.36%	Morocco	1	11	0.03%
Brazil	78	518	1.36%	Netherlands	51	418	1.10%
Cambodia	1	1	0.00%	New Zealand	40	246	0.65%
Canada	232	1971	5.17%	Norway	40	261	0.68%
Cayman Islands	4	32	0.08%	Oman	3	13	0.03%
Chile	30	201	0.53%	Pakistan	1	3	0.01%
China	460	1690	4.43%	Panama	2	9	0.02%
Colombia	13	58	0.15%	Papua New Guinea	1	10	0.03%
Cyprus	4	12	0.03%	Peru	24	74	0.19%
Czech Republic	3	32	0.08%	Philippines	16	138	0.36%
Denmark	37	305	0.80%	Poland	28	168	0.44%
Egypt	4	22	0.06%	Portugal	14	102	0.27%
Faroe Islands	1	2	0.01%	Puerto Rico	2	8	0.02%
Finland	32	351	0.92%	Qatar	5	21	0.06%
France	127	1054	2.76%	Russia	36	301	0.79%
Germany	142	1050	2.75%	Saudi Arabia	17	29	0.08%
Gibraltar	1	1	0.00%	Singapore	32	297	0.78%
Greece	17	118	0.31%	Slovenia	1	1	0.00%
Guernsey	2	14	0.04%	South Africa	85	589	1.54%
Hong Kong	99	785	2.06%	Spain	51	358	0.94%
Hungary	4	32	0.08%	Sri Lanka	1	8	0.02%
India	104	617	1.62%	Sweden	108	627	1.64%
Indonesia	26	163	0.43%	Switzerland	99	724	1.90%
Ireland	41	342	0.90%	Taiwan	125	974	2.55%
Isle of Man	2	11	0.03%	Thailand	33	226	0.59%
Israel	15	98	0.26%	Turkey	42	173	0.45%
Italy	66	389	1.02%	Uganda	1	1	0.00%
Japan	364	4765	12.50%	Ukraine	1	10	0.03%
Jersey	2	19	0.05%	United Arab Emirates	5	31	0.08%
Kazakhstan	2	4	0.01%	United Kingdom	298	2857	7.49%
Kenya	1	4	0.01%	United States of America	1606	10,761	28.22%
South Korea	117	889	2.33%	Vietnam	1	1	0.00%
Luxembourg	21	97	0.25%	Total	5292	38,127	100%