Journal of Applied Economic Sciences
Volume XXI, Special Issue 1(91), 2025

Sustainability Signals in Sovereign Risk Pricing: Panel Evidence from Emerging Economies[1]

Huriye Gonca DİLER
https://orcid.org/0000-0002-9937-1324
Department of Economics, Faculty of Economics and Administrative Sciences
Afyon Kocatepe University, Turkey
hgdiler@aku.edu.tr

Article's history:
Received 23rd of November, 2025; *Revised* 9th of February, 2026; *Accepted* 1st of March, 2026; *Available online*: 15th of March, 2026. *Published* as article in the Volume XXI, Special Issue, 1(91), 2026.

Suggested citation:
Diler, H. G. (2026). Sustainability Signals in Sovereign Risk Pricing: Panel Evidence from Emerging Economies. *Journal of Applied Economic Sciences*, Volume XXI, Special Issue, 1(91), 49 – 73. https://doi.org/10.57017/jaes.v21.si.1(91).03

Abstract

This paper examines whether variations in environmental responsibility, social development, and governance quality are systematically associated with sovereign borrowing costs in emerging market economies, based on panel data analysis. The analysis is based on an annual panel dataset covering the period 2014–2023 for Brazil, Chile, India, Indonesia, Malaysia, Turkey, South Africa, and Poland. Sovereign borrowing costs are measured by sovereign bond yield spreads, calculated as the difference between each country's 10-year government bond yield and the 10-year US Treasury yield. ESG performance is represented by a composite ESG index as well as its environmental, social, and governance sub-dimensions, constructed using indicators obtained from the World Bank Sovereign ESG Data Portal. The empirical framework employs a two-way fixed effects model to account for unobserved country-specific heterogeneity and common time effects. To ensure robust statistical inference, standard errors are adjusted using the Driscoll–Kraay procedure, which accounts for heteroskedasticity, serial correlation, and cross-sectional dependence.

The results indicate that ESG performance has a statistically significant effect on sovereign bond yield spreads. Disaggregated estimations further indicate that the social dimension plays a particularly prominent role in explaining variations in sovereign borrowing costs. In addition, heterogeneity and robustness analyses confirm that the main findings remain largely stable across alternative model specifications. Overall, the findings suggest that ESG performance serves as a complementary risk indicator in the pricing of sovereign borrowing costs in emerging economies.

Keywords: ESG performance; sovereign borrowing costs; bond yield spreads.

JEL Classification: G12; H63; Q56.

Introduction

Sovereign debt, also referred to as public or national debt, represents the liabilities of a central government incurred to finance economic growth and development. Governments

[1] This paper is an expanded and revised version of the paper presented at *IX International Applied Social Sciences Congress* (C-IASOS), 2025.

frequently issue sovereign debt, often denominated in foreign currency, to support investment and fiscal needs. In this context, the economic and political stability of the issuing government constitutes a critical factor for investors, as sovereign borrowing inherently involves default risk. Governments ultimately decide whether to repay their debt based on an assessment of whether repayment is more advantageous than default. A substantial body of literature suggests that sovereign defaults are driven primarily by unwillingness to pay rather than by an inability to pay.

The theoretical literature highlights two fundamental channels underlying sovereign repayment decisions: concerns over credibility in international markets and constraints related to future financing opportunities. Reputation-based models emphasise the incentive for governments to honour their obligations in order to preserve credibility in international financial markets. In contrast, alternative access arguments contend that when countries can rely on other creditors or asset markets, the reputational costs of default may not be sufficiently strong to prevent strategic default. This debate highlights that sovereign repayment decisions are shaped not only by economic fundamentals but also by institutional and political incentives.

Sovereign bond yield spreads are widely used to capture sovereign borrowing costs and the pricing of sovereign risk. Yield spreads reflect the difference in returns between debt instruments with varying risk profiles, credit ratings, and maturities. As perceived risk increases, investors demand higher compensation in the form of larger yield spreads. Conversely, lower perceived risk is associated with reduced risk premia. In this framework, sovereign bond yield spreads serve as a key market-based indicator of default risk and repayment incentives.

Empirical studies consistently demonstrate that sovereign risk is highly sensitive to country-specific factors, including fiscal space indicators such as debt-to-GDP ratios and budget balances, as well as broader economic and institutional fundamentals such as economic growth and political stability. Moreover, exposure to global financial conditions and contagion effects arising from trade openness or currency crises further influence sovereign risk assessments.

Recent theoretical and empirical contributions suggest that environmental, social, and governance (ESG) performance may exert a material influence on sovereign credit risk. Effective management of natural resources, social cohesion, and strong governance structures enhance governments' capacity to generate revenues and service public debt, thereby shaping market perceptions of default risk. While governance-related factors have received considerable attention in the literature, environmental and social dimensions remain relatively underexplored due to limitations in comparable cross-country data.

Against this background, the primary objective of this study is to empirically examine the impact of ESG performance on sovereign borrowing costs in a sample of emerging economies. Using annual panel data for the period 2014–2023, the analysis measures sovereign risk through sovereign bond yield spreads and represents ESG performance using composite indicators capturing environmental, social, and governance dimensions. By jointly assessing the relative contribution of environmental and social factors alongside governance, the study extends the existing literature. The findings provide evidence that sustainability-oriented policies may play an important role not only in supporting long-term development objectives but also in strengthening macroeconomic stability by reducing sovereign borrowing costs, offering relevant insights for policymakers.

The analytical framework of this study aims to clarify the relative roles of E, S, and G factors in the pricing of sovereign risk. In this context, the study seeks to address the following research questions:

RQ1: Does environmental, social, and governance (ESG) performance have a statistically significant impact on sovereign borrowing costs in emerging economies?

RQ2: Do the environmental, social, and governance dimensions of ESG exert symmetric effects on sovereign bond yield spreads, or do certain dimensions play a more dominant role?

RQ3: To what extent is the relationship between ESG performance and sovereign borrowing costs robust to alternative model specifications and cross-country heterogeneity?

This study contributes to the existing literature in three main ways. First, while prior research on sovereign borrowing costs has predominantly focused on governance indicators and conventional macroeconomic fundamentals, this study explicitly disentangles the relative effects of environmental and social factors alongside governance dimensions. Second, by concentrating on a relatively homogeneous group of emerging economies, the analysis accounts for shared structural characteristics and vulnerabilities, allowing for more consistent and comparable inference on the ESG, sovereign risk nexus. Third, the empirical framework relies on market-based measures of sovereign risk, namely sovereign bond yield spreads, thereby providing direct evidence on how sustainability-related factors are incorporated into financial market pricing. Taken together, the findings indicate that sustainability-oriented policies are relevant not only for long-term development objectives but also for strengthening macroeconomic stability through their potential role in reducing sovereign borrowing costs, offering clear and policy-relevant insights for decision-makers.

1. Literature Review

One of the most widely used indicators for measuring countries' borrowing costs in international capital markets is sovereign bond yield spreads. Yield spreads are generally regarded as a market-based measure reflecting market participants' perceptions of a country's default risk. In this context, the literature commonly argues that the determinants of sovereign bond yield spreads can be grouped into three broad categories. These are credit risk, which reflects a country's fiscal and macroeconomic position and is associated with creditworthiness; liquidity risk, which is related to the size and depth of the government bond market; and international risk appetite, capturing global investors' attitudes toward risk (Ardagna et al., 2004; Codogno et al., 2003; Beber et al., 2008; Attinasi et al., 2009; Barrios et al., 2009; Gómez-González, 2025; Manganelli & Wolswijk, 2009; Afonso et al., 2015).

Among these three determinants, a growing body of research has argued that country-specific factors, namely credit risk, have become increasingly dominant relative to liquidity and global factors, particularly since the mid-2000s. These studies suggest that during periods of intensified sovereign debt stress, investors place greater emphasis on country fundamentals, and that macroeconomic vulnerabilities play a decisive role in shaping bond yield spreads (Codogno et al., 2003; Barrios et al., 2009; Haugh et al., 2009; Mody, 2009). Accordingly, the empirical literature has sought to explain sovereign bond yield spreads by examining macroeconomic variables such as public debt burdens (Bernoth & Erdogan, 2012; Bernoth et al., 2012), trade openness and terms of trade (Maltritz, 2012), fiscal indicators (Gruber & Kamin, 2012).

Recent studies provide robust evidence that sustainability and climate-related risks are systematically priced in sovereign debt markets. Pan et al. (2026) show that countries with higher exposure to climate change risks experience significantly higher sovereign credit risk, highlighting climate vulnerability as a distinct risk factor beyond traditional macroeconomic fundamentals.

Although these studies point to certain empirical regularities, the literature on the determinants of sovereign bond yield spreads has not yet reached a definitive consensus. In particular, evidence suggesting that explanations based solely on financial variables are insufficient to fully account for cross-country differences in borrowing costs has heightened interest in the role of non-financial factors. In this regard, there is growing agreement that ESG factors should be considered complementary elements shaping market perceptions of sovereign risk.

Within the theoretical literature, several approaches have been developed to explain the potential negative relationship between ESG performance and sovereign borrowing costs. The first approach is based on the premise that ESG performance reflects a country's capacity to manage environmental, social, and institutional risks. From this perspective, countries with stronger ESG performance are perceived by investors as less prone to default and are therefore able to borrow at lower risk premia. This view is consistent with reputation-based models of sovereign debt repayment, which emphasise the role of credibility in international financial markets (Eaton & Gersovitz, 1981). By contrast, approaches highlighting access to alternative sources of finance argue that reputational losses may not be sufficient to deter default when countries can redirect borrowing to other markets or creditors (Bulow & Rogoff, 1989). This debate suggests that ESG factors may play an indirect yet important role in shaping sovereign risk perceptions.

A second theoretical explanation of the ESG–borrowing cost relationship draws on the intrinsic motivation literature. This approach posits that some investors are value-oriented and therefore accept lower risk premia when investing in countries with strong ESG orientations (Frey, 1997; Benabou & Tirole, 2003; Besley & Ghatak, 2005). Beyond shared values, this behaviour can also be attributed to lower monitoring and enforcement costs arising from greater alignment between investors' objectives and government policies.

A third theoretical channel is provided by the fiscal fatigue framework. According to this model, investors take into account countries' fiscal space, defined as the distance between the debt limit and the prevailing debt-to-GDP ratio (Ghosh et al., 2013). The extent of fiscal space depends not only on the level of public debt but also on governments' ability to implement fiscal adjustments, such as tax increases, to restore debt sustainability when necessary. This capacity, in turn, is closely related to governance quality and social cohesion. Consequently, countries with stronger ESG performance are argued to possess greater fiscal space, which translates into lower borrowing costs (Crifo et al., 2017).

From an empirical perspective, the literature has examined the relationship between sovereign borrowing costs and various ESG dimensions, including political risk, corruption, and environmental factors. Studies focusing on political risk and governance have shown that political instability and uncertainty increase sovereign bond yield spreads (Ebner, 2009; Eichler, 2013). Research on corruption has similarly demonstrated that countries perceived as more corrupt are required to offer higher yields when issuing sovereign bonds (Ciocchini et al., 2003; Connolly, 2007). These findings confirm the central role of governance quality in sovereign risk pricing.

By comparison, empirical research that explicitly examines the environmental and social dimensions of sustainability remains relatively limited. Margaretic & Pouget (2014) demonstrate that environmental performance indicators contain informative content regarding both the level and volatility of government bond yields. More recent empirical contributions reinforce the view that ESG performance has become an integral component of sovereign risk evaluation. Capelle-Blancard et al. (2019) document a negative association between sustainability indicators and government bond yields, with the effect being more pronounced in countries characterized by stronger institutional frameworks. Along similar lines, Hübel (2022) shows that ESG-related risks are reflected across sovereign yield curves, suggesting that sustainability considerations are relevant not only for equity markets but also for sovereign debt pricing. Taken together, this body of evidence indicates that ESG considerations have moved beyond their traditional ethical framing and now constitute quantifiable elements in the assessment of sovereign risk.

More recent climate-focused studies have further deepened this perspective by explicitly linking climate-related shocks to sovereign risk dynamics. Using evidence from Latin American economies, Damette et al. (2024) show that intense climate events associated with ENSO phenomena significantly increase sovereign risk indicators, particularly during periods of heightened macroeconomic vulnerability. Their findings suggest that climate shocks operate as an independent risk channel in sovereign debt markets, reinforcing the relevance of environmental risks beyond conventional sustainability metrics. Focusing on climate preparedness, Gomez-Gonzalez, Uribe & Valencia (2025) highlight the asymmetric nature of sovereign risk responses to climate change preparedness. Their analysis demonstrates that countries with lower levels of climate adaptation and institutional readiness experience disproportionately larger increases in sovereign risk when exposed to climate-related pressures. This asymmetry underscores the interaction between environmental vulnerability and country-specific fundamentals in shaping sovereign borrowing conditions. Beyond climate shocks and vulnerability, recent studies have examined the role of sovereign green bonds as a policy instrument aimed at improving sustainability outcomes and market perceptions. Owusu-Mante (2025) assesses the effectiveness of sovereign green bond issuance and finds that, while such instruments can enhance environmental credibility, their impact on borrowing costs remains contingent on institutional quality and transparency. This evidence suggests that sustainability-linked debt instruments may generate signalling effects in sovereign debt markets, but their effectiveness depends critically on country-specific governance structures.

Recent empirical contributions emphasize that climate-related and transition-specific risks, as a core component of the environmental dimension, are directly reflected in sovereign bond yields. Collender et al. (2023) document that climate transition risk significantly affects sovereign bond pricing, particularly in countries facing stricter decarbonization pathways.

Recent evidence also highlights, more recent studies highlight the need to explicitly consider heterogeneity across ESG dimensions as well as across different country groups. De Boyrie & Pavlova (2020) find that environmental vulnerabilities can affect sovereign credit risk by interacting with fiscal sustainability and financial stability conditions. Cevik & Jalles (2022) further show that climate-related shocks and environmental exposure have a stronger effect on GBT in emerging economies, underscoring the importance of structural and institutional features. Taken together, these findings suggest that analysing both composite and disaggregated ESG measures within relatively homogeneous samples may offer a more nuanced understanding of ESG-related sovereign risk pricing.

Despite the growing body of evidence supporting the relevance of ESG performance in sovereign risk pricing, the existing literature remains subject to several important limitations. A substantial share of empirical studies focuses on a single ESG dimension, often overlooking potential interaction or offsetting effects among environmental, social, and governance components. Moreover, analyses that pool advanced and emerging economies within the same empirical framework may obscure structural differences that shape the pricing of ESG-related risks across country groups. Finally, empirical evidence on how ESG indicators are incorporated into market-based measures of sovereign risk, particularly government bond yield spreads, remains relatively limited. Against this background, the present study seeks to fill this gap by examining ESG performance using both composite and component-based measures and by analysing the determinants of GBT within the context of emerging economies.

2. Research Hypotheses

Studies in the literature on the determinants of sovereign borrowing costs mainly focus on macroeconomic fundamentals and governance indicators, while suggesting that the role of environmental and social factors in risk pricing has been addressed relatively to a limited extent. However, theoretical approaches and existing empirical evidence indicate that assessing ESG performance as a whole provides a more comprehensive framework for explaining sovereign borrowing costs. Accordingly, the following hypotheses are tested in this study.

First, in order to examine the overall effect of ESG performance on sovereign borrowing costs, the following hypothesis is formulated:

H1: There is a negative relationship between countries' ESG performance and sovereign borrowing costs. This hypothesis is based on theoretical and empirical expectations that improvements in ESG performance enhance market perceptions of default risk, thereby reducing sovereign bond yield spreads. Second, considering that ESG performance consists of different dimensions rather than a single structure, the study aims to disentangle the relative effects of ESG components on sovereign borrowing costs. In this context, the following hypothesis is tested:

H2: The effects of the environmental (E), social (S), and governance (G) sub-components of ESG performance on sovereign borrowing costs differ. This hypothesis aims to fill the gap in the literature that, despite the more frequent examination of the governance dimension, does not sufficiently disentangle the roles of environmental and social factors in risk pricing. Finally, given the study's focus on emerging economies, it is assumed that these countries' structural vulnerabilities, differences in institutional capacity, and varying degrees of dependence on external finance may strengthen the relationship between ESG and sovereign borrowing costs. In this framework, the following hypothesis is proposed:

H3: In emerging economies, the effect of ESG performance on sovereign borrowing costs is more pronounced due to macroeconomic and institutional vulnerabilities. This hypothesis is based on the assumption that ESG performance may play a balancing and risk-reducing role not only from a sustainability perspective but also in the pricing of sovereign risk in emerging economies. This hypothesis is tested through sub-sample and interaction analyses that take into account differences in vulnerability among emerging economies.

3. Data Set and Method

3.1. Data Set

In this study, the effect of environmental, social, and governance (ESG) performance on sovereign borrowing costs is examined using panel data methods for a country sample composed of emerging economies. The sample used in the analysis consists of Brazil, Chile, India, Indonesia, Malaysia, Turkey, South Africa, and Poland, representing both geographical diversity and the macroeconomic and institutional heterogeneity specific to emerging economies. The study period covers 2014–2023, taking into account data availability and the comparability of ESG indicators.

The ESG data used in the study were obtained from the WB's Sovereign ESG Data Portal. This dataset includes a wide range of indicators reflecting countries' performance in ESG domains. ESG performance was calculated within a scoring construction approach based on normalising and aggregating these indicators. In measuring ESG performance, the total ESG score, which holistically reflects ESG dimensions, was adopted. The total ESG score was constructed by taking the simple average of the composite scores obtained for each sub-dimension. This method enables ESG performance to be treated not as a single-variable construct but as a multidimensional structure.

Sovereign borrowing costs are measured through sovereign bond yield spreads, which are widely used in the literature. For this purpose, the annual average of 10-year government bond yields was calculated for each country, and yield spreads were obtained by subtracting the US 10-year Treasury yield from these values. This method excludes common movements in the global interest rate level and more accurately reflects the market's perception of country-specific default risk.

In addition to ESG indicators, macroeconomic control variables that may affect GBT were also included in the analysis. In this context, the public debt-to-GDP ratio, economic growth rate, inflation rate, and current account balance-to-GDP ratio were obtained from the World Bank World Development Indicators (WDI) database. To represent global risk appetite, annual average values of the Volatility Index (VIX) published by the Chicago Board Options Exchange (CBOE) were used. The VIX index is widely regarded in the international literature as a standard indicator reflecting global uncertainty and risk aversion.

Due to data gaps observed in the public debt-to-GDP ratio for some countries, no imputation was applied for missing observations; analyses were conducted based on available observations. This approach was preferred to avoid measurement error and bias risks.

3.2. Definition of Variables

The dependent variable used in the study is bond yield spreads calculated to represent sovereign borrowing costs. ESG performance is considered as the independent variable, measured through the total ESG score. To examine component-based effects of ESG performance, scores for the environmental (E), social (S), and governance (G) sub-dimensions were used separately in alternative model specifications. Control variables include the public debt-to-GDP ratio, economic growth, inflation, current account balance-to-GDP ratio, and the VIX index reflecting global risk appetite. All variables are used at annual frequency

Detailed definitions of the variables are provided in Table 1.

Table 1: Variable Definitions

Variable Type	Variable Name	Symbol	Definition	Source
Dependent Variable	Sovereign borrowing cost	GBT	Sovereign bond yield spread obtained by subtracting the U.S. 10-year Treasury yield from the annual average of the country's 10-year government bond yield	Investing.com FRED
Main Independent Variable	ESG performance	ESG-T	Total ESG score that holistically reflects countries' performance in environmental, social, and governance areas	WB – Sovereign ESG Data Portal
Alternative Independent Variables	Environmental performance	E	Composite score obtained by aggregating indicators related to the environmental dimension through the scoring construction approach	WB – Sovereign ESG Data Portal
	Social performance	S	Composite score obtained by aggregating indicators related to the social dimension through the scoring construction approach	WB – Sovereign ESG Data Portal
	Governance performance	G	Composite score obtained by aggregating indicators related to the governance dimension through the scoring construction approach	WB – Sovereign ESG Data Portal
Control Variable	Public debt / GDP	Borç	Ratio of public debt to gross domestic product (%)	WB – WDI
	Economic growth	BÜY	Real GDP growth rate (%)	WB – WDI
	Inflation	ENF	Annual inflation rate based on the consumer price index (%)	WB – WDI

3.3. Econometric Method

In the study, a panel data regression model is applied to examine the relationship between ESG-T and GBT. To control for unobserved structural differences across countries and common time shocks, a two-way fixed effects model is preferred. This approach prevents estimation results from being driven by both time-invariant country-specific characteristics and annual changes in global economic conditions.

The baseline model used in the analysis can be expressed as follows:

$$GBT_{i,t} = \alpha + \beta ESG\text{-}T_{i,t} + \gamma X_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

where: $GBT_{i,t}$ denotes the sovereign bond yield spread for country *i* in year *t*; $ESG\text{-}T_{i,t}$, denotes ESG performance indicators; $X_{i,t}$, denotes the vector of control variables; μ_i denotes country fixed effects; λ_t denotes year fixed effects and $\varepsilon_{i,t}$denotes the error term. To examine component-based effects of ESG performance, E, S, and G sub-indicators were included separately in alternative models.

To account for potential heteroskedasticity, autocorrelation, and cross-sectional dependence in panel data, standard errors were corrected using the D–K method. This method provides reliable results especially in panels with a limited number of countries and a relatively short time dimension.

No panel cointegration or classical causality analyses were applied in this study. The main reason is that the study period is relatively short and the variables used are largely stationary in levels. Rather than long-run equilibrium relationships, the analysis focuses on the medium-term effects of ESG performance on the market pricing of sovereign risk. To limit causality discussions, additional analyses include lagged ESG indicators to control for potential reverse causality.

4. Econometric Analysis

4.1. Descriptive Statistics

In this subsection, basic descriptive statistics for the variables used in the study are presented. The descriptive statistics aim to reveal distributional characteristics of GBT, ESG performance, and macroeconomic indicators across time and countries in the sample. In this context, for each variable, the number of observations, mean, standard deviation, and minimum and maximum values are reported, and preliminary information about the overall structure of the dataset is provided in Table 2.

Table 1: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
GBT	80	5.10	3.62	−0.05	15.97
ESG-T	80	50.30	7.86	36.99	67.22
E	80	47.31	3.79	38.89	56.43
S	80	57.22	13.48	29.37	77.30
G	80	46.38	14.05	22.93	74.07
BÜY	80	3.33	3.73	−6.17	11.81
ENF	80	6.66	9.96	−1.14	72.31
BORC	80	−1.37	2.60	−8.85	4.39
VIX	80	18.12	5.19	11.09	29.25

The descriptive statistics presented in Table 2 indicate that GBT and ESG performance exhibit pronounced heterogeneity across the emerging economies examined over the 2014–2023 period. While the mean value of GBT is approximately 5%, there is considerable variability across observations. The presence of negative yield spreads in a limited number of observations suggests that in some periods, country bonds could offer lower yields than U.S. Treasuries. By contrast, the maximum values reaching double-digit levels indicate that the market demanded a high-risk premium for certain countries and periods.

The mean value of ESG-T is around 50, with a meaningful distribution across countries. This indicates that the countries in the sample do not display a homogeneous structure in terms of sustainability performance. When ESG sub-components are examined, environmental scores appear to fluctuate within a relatively narrower range, whereas higher variance is observed in the social and governance dimensions. In particular, the wide dispersion in governance scores suggests pronounced differences in institutional structure and governance quality across emerging economies.

Regarding macroeconomic indicators, GDP growth rates are positive on average, but display substantial temporal volatility. The high standard deviation and maximum values for inflation indicate that price stability deteriorated significantly in some countries and years. The current account balance exhibits a negative average ratio to GDP, suggesting that the sampled countries generally display dependence on external finance. The distribution of the VIX index, used to represent global risk appetite, confirms that global financial conditions fluctuated markedly over the period examined.

Overall, the descriptive statistics show that there is sufficient variation in both ESG performance and GBT and that the dataset has a panel structure suitable for econometric analysis. These findings provide a solid basis for the econometric analyses conducted in the next stage.

4.2. Correlation Matrix and Multicollinearity Analysis

In this subsection, a correlation matrix and Variance Inflation Factor (VIF) analyses are presented to examine linear relationships among key variables and assess potential multicollinearity problems.

Table 3. Correlation Matrix

Variables	GBT	ESG-T	E	S	G	BÜY	ENF	CD	VIX
GBT	1.00	−0.62	0.24	−0.37	−0.75	−0.06	0.59	−0.26	0.08
ESG-T	−0.62	1.00	−0.35	0.90	0.91	0.01	−0.17	0.07	−0.04
E	0.24	−0.35	1.00	−0.44	−0.44	0.11	0.14	0.15	−0.02
S	−0.37	0.90	−0.44	1.00	0.67	−0.10	−0.01	−0.05	0.01
G	−0.75	0.91	−0.44	0.67	1.00	0.08	−0.31	0.13	−0.08
BÜY	−0.06	0.01	0.11	−0.10	0.08	1.00	0.12	−0.05	−0.35
ENF	0.59	−0.17	0.14	−0.01	−0.31	0.12	1.00	−0.27	0.14
CD	−0.26	0.07	0.15	−0.05	0.13	−0.05	−0.27	1.00	0.14
VIX	0.08	−0.04	−0.02	0.01	−0.08	−0.35	0.14	0.14	1.00

The correlation matrix indicates a pronounced and negative relationship between GBT and ESG performance. In particular, G dimension exhibits a strong negative correlation with yield spreads. By contrast, the relationship between E and yield spreads is weak and positive. This finding suggests that ESG sub-components may operate through different channels in the pricing of sovereign risk.

Among macroeconomic variables, a positive and relatively high correlation is observed between the inflation rate and sovereign bond yield spreads. This indicates that deteriorations in price stability are associated with higher risk premia demanded by the market. Correlations between yield spreads and the remaining control variables appear to be low. High correlations between ESG-T score and the social and governance sub-components are an expected outcome reflecting the composite structure of ESG performance. Therefore, the total ESG score and the E, S, and G components were not used together in the same model specification, and disaggregated analyses were conducted in alternative models.

As reported in Table 4, the variance inflation factor (VIF) results indicate that severe multicollinearity is not a concern in the estimated models. The VIF values for the macroeconomic control variables, economic growth (BÜY), inflation (ENF), and public debt (BORC), are well below commonly accepted thresholds, suggesting a low degree of linear dependence among these regressors.

Table 4. Multicollinearity Analysis (VIF)

Variables	VIF
ESG-T	13.46
BÜY	1.98
ENF	1.72
BORC	1.40
VIX	11.77

Although the total ESG score (ESG-T) and the VIX index exhibit relatively higher VIF values, this pattern likely reflects their limited time variation and co-movement with global financial conditions rather than problematic collinearity. Importantly, these values remain below levels that would necessitate the exclusion of variables from the model. Overall, the evidence in Table 4, together with the correlation analysis, supports the adequacy of the model specification and indicates that the regression estimates are unlikely to be biased by multicollinearity.

4.3. Levin–Lin–Chu and Im–Pesaran–Shin Panel Unit Root Tests

In this subsection, the stationarity properties of the variables used in the study are examined using Levin–Lin–Chu (LLC) and Im–Pesaran–Shin (IPS) panel unit root tests. The LLC test assumes a common unit root process, whereas the IPS test allows for heterogeneous unit root processes. Since the study period is relatively short (2014–2023; T=10), the lag length was set to 1 and results were evaluated jointly across the two tests.

Table 5. Panel Unit Root Test Results

Variables	LLC Stat.	LLC p-value	IPS Stat.	IPS p-value	Result (level)
GBT	−4.478	0.0000	−2.752	0.0030	Stationary
ESG-T	−5.501	0.0000	−4.201	0.0000	Stationary
E	−0.455	0.3245	−0.675	0.2500	Not stationary
S	−1.778	0.0377	−2.070	0.0192	Stationary
G	−2.992	0.0014	−2.078	0.0188	Stationary
BÜY	−5.728	0.0000	−4.403	0.0000	Stationary
ENF	−2.265	0.0118	−0.359	0.3599	Mixed*
CD	−6.048	0.0000	−4.509	0.0000	Stationary
VIX	−0.126	0.4500	0.869	0.8076	Not stationary

Note: * For ENF, the LLC test indicates stationarity, while the IPS test does not, reflecting differences in test power in short panels. The variable is retained as a control, with robustness checks assessing sensitivity under alternative specifications.

The panel unit root tests indicate that many variables, notably GBT and ESG-T, are stationary in levels. By contrast, both tests do not support stationarity for E and VIX. Given the short time dimension, and recognising that panel unit root tests may be sensitive to lag selection, stationarity results were evaluated jointly. Overall, the findings suggest that the risk of spurious regression is limited. For variables with weaker stationarity evidence, robustness checks will additionally test the sensitivity of the findings.

4.4. Model Selection between Fixed Effects and Random Effects: Hausman Test

In panel data analyses, whether unobserved country-specific effects are correlated with explanatory variables is critical for selecting the appropriate model. For this purpose, the Hausman (1978) test was applied when choosing between fixed effects and random effects models. The null hypothesis of the Hausman test states that the random effects model is consistent and efficient; the alternative hypothesis indicates that the fixed effects model should be preferred. The Hausman test results are presented in Table 6.

Table 6. Hausman Test Results

Test	χ^2	sd	p-value	Decision
Hausman (FE vs. RE)	34.742	5	0.0000*	FE is preferred

Note: * p-value = 1.694e−06 ($p < 0.01$).

According to the Hausman test results, the test statistic is $\chi^2(5) = 34.742$ and the corresponding p-value is 0.0000. This finding indicates a strong rejection of the null hypothesis and shows that unobserved country-specific effects are statistically significantly correlated with the explanatory variables. Therefore, the random effects model is concluded to be inconsistent. In the remainder of the study, the fixed effects model is used to examine the determinants of sovereign borrowing costs. This choice is methodologically consistent in the context of emerging economies, where variables such as ESG performance that have institutional and structural characteristics are associated with persistent cross-country differences.

In this study, the determinants of GBT are estimated within the following panel regression model:

$$GBT_{it} = \alpha + \beta_1 ESG_{it} + \beta_2 BÜY_{it} + \beta_3 ENF_{it} + \beta_4 CD_{it} + \beta_5 VIX_t + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

where: μ_i: denotes country-specific fixed effects, λ_t: denotes time-specific common effects, ε_{it}: denotes the error term.

4.5. Baseline Model (H1): The Effect of Total ESG on Sovereign Borrowing Costs

In this section, the effect of ESG-T on GBT is empirically examined within the framework of a two-way fixed effects model including country and year fixed effects.

Model 1

$$GBT_{it} = \alpha + \beta_1 \text{ ESG-T}_{it} + \beta_2 \text{ BORÇ}_{it} + \beta_3 \text{ BÜY}_{it} + \beta_4 \text{ ENF}_{it} + \beta_5 \text{ CD}_{it} + \beta_6 \text{ VIX}_t + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

where: i denotes the country and t denotes the year. μ_i denotes country-specific fixed effects, λ_t denotes common shocks such as global financial conditions and common trends, and ε_{it} denotes the error term.

In line with theoretical approaches and previous empirical studies, an improvement in ESG performance is expected to reduce sovereign borrowing costs and the β_1 coefficient is expected to have a negative sign.

Table 7: Baseline Model (H1): Total ESG and Sovereign Borrowing Costs (Dependent variable: GBT; Model: Two-Way Fixed Effects (country + year); Standard errors: D– K (maxlag = 2).

Variables	Coefficient
ESG-T	−0.353*** (0.021)
BORC	−0.125*** (0.009)
BÜY	0.139*** (0.040)
ENF	0.088*** (0.005)
CD	0.551*** (0.017)
VIX	2.481*** (0.106)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	44
Number of countries	5
R^2	0.921

Note: Values in parentheses indicate D–K SE. *** p<0.01, ** p<0.05, * p<0.10.

The two-way fixed effects estimation results presented in Table 7 indicate that ESG-T has a negative and statistically significant effect on GBT. Accordingly, an increase in ESG performance is associated with a decrease in sovereign bond yield spreads. Regarding the control variables, the positive and strongly significant coefficients of ENF and VIX confirm that the market is sensitive both to domestic macroeconomic instability and to global uncertainty conditions. The CD variable is also statistically significant. The coefficient on BORC is negative and significant. This finding suggests that, in the country-year observations covered by the sample, the relationship between debt dynamics and risk pricing may involve nonlinear or country-specific mechanisms, which will be further evaluated in subsequent robustness analyses. Finally, due to data gaps in BORC variable, H1 estimates were conducted based on available observations and no imputation was applied for missing values.

4.6. Disaggregated Model (H2): The Effects of ESG Subcomponents on Sovereign Borrowing Costs

In the previous subsection, the overall effect of ESG-T on GBT was examined. However, ESG performance is not a one-dimensional construct; rather, it is a multi-component indicator consisting of E, S, and G dimensions. Therefore, to identify more clearly through which channels the findings based on ESG-T score emerge, this section conducts an analysis in which ESG sub-components are included separately in the model.

This approach is particularly important because, although the governance dimension has been examined more extensively in the literature, the roles of environmental and social factors in the pricing of sovereign risk have been addressed in a limited manner. Disaggregating ESG components also enables the identification of potential opposing or asymmetric effects that may be masked in total-effect estimations.

Model 2

$$GBT_{it} = \alpha + \beta_1 E_{it} + \beta_2 S_{it} + \beta_3 G_{it} + \beta_4 BORC_{it} + \beta_5 BÜY_{it} + \beta_6 ENF_{it} + \beta_7 CD_{it} + \beta_8 VIX_t + \mu_i + \lambda_t + \varepsilon_{it} \quad (4)$$

The model was estimated using a two-way fixed effects approach including country and year fixed effects. Thus, both time-invariant structural differences across countries and common global time shocks are controlled for.

In light of the theoretical literature and previous empirical studies, the effects of ESG components on GBT are not expected to be homogeneous. In particular, since the governance component is directly related to institutional quality, policy predictability, and debt sustainability, it is expected to exert a stronger and more stable effect on GBT. The social dimension may affect market perceptions of default risk through channels such as social cohesion, income distribution, and political stability. Environmental performance is expected to display a more indirect and relatively weaker effect, especially in the context of long-term growth expectations and climate-related risks. Within this framework, differences in the magnitude and statistical significance of ESG components' effects on GBT will be considered consistent with Hypothesis H2.

This disaggregated specification more clearly reveals which sub-components drive the effects observed in analyses based on ESG-T score. Thus, the impact of ESG performance on GBT can be evaluated by E, S, and G dimensions beyond a single composite indicator. In addition, potential multicollinearity risk among ESG sub-components in the model was controlled in a manner consistent with the correlation matrix and VIF results presented in the previous section. This approach allows a more detailed examination of how differences in institutional capacity and structural heterogeneity affect the pricing of sovereign risk, particularly in emerging economies.

Table 8: Disaggregated Model (H2): ESG Subcomponents and Sovereign Borrowing Costs (Dep Var: GBT)

Variables	(1) Two-Way FE
E	−0.209* (0.112)
S	−0.320*** (0.095)
G	−0.041 (0.026)
BORC	−0.123*** (0.015)
BÜY	0.138 (0.146)
ENF	0.106** (0.030)
CD	0.657*** (0.031)
VIX	Included
Country fixed effects	Yes
Year fixed effects	Yes
Observations	80
Number of countries	8

Note: Values in parentheses indicate D–K SE. * p<0.10, ** p<0.05, *** p<0.01.

The disaggregated model results presented in Table 8 indicate that the effects of ESG sub-components on GBT are not homogeneous. The findings show that the social component has a negative and statistically significant effect on GBT. This result suggests that factors reflecting social cohesion, income distribution, and social stability improve market perceptions of default risk and reduce the sovereign risk premium.

The coefficient of the environmental performance variable is negative and marginally significant at the 10% significance level. This finding suggests that the effect of E on GBT operates through a weaker and more indirect channel in the current sample. By contrast, the governance component is not statistically significant. This may be because governance indicators in emerging economies largely change slowly over time and represent structural elements captured by country-specific fixed effects.

Regarding control variables, BORC is found to have a negative and strongly significant effect on GBT. This result indicates that, in the sampled countries, debt dynamics may be assessed by the market within a sustainability framework. The ENF is positive and significant, while the coefficient on the current account balance-to-GDP variable is positive and highly significant. This indicates that the current account position plays a role in risk pricing through the financing structure and external vulnerability channel. BÜY is not statistically significant.

H2: The effects of the E, S, and G sub-components of ESG performance on GBT differ. The findings reveal that ESG sub-components differ both in sign and statistical significance. Accordingly, Hypothesis H2 is accepted.

The disaggregated model results suggest that the effects of ESG components on GBT operate through different channels in the context of emerging economies. This strengthens the assumption that the effect may vary depending on countries' macroeconomic and institutional vulnerability levels. Accordingly, the next section aims to examine the relationship between ESG-T and GBT within the framework of vulnerability and heterogeneity.

4.7. Heterogeneity Analysis (H3): ESG Effects under Vulnerability Conditions

In the previous sections, the effects of ESG-T performance and its sub-components on GBT were presented. However, emerging economies may exhibit structural vulnerabilities such as high indebtedness, dependence on external finance, and sensitivity to global financial conditions. Therefore, it is considered that the effect of ESG performance on GBT may differ depending on vulnerability indicators such as debt sustainability and the global risk environment. In this section, heterogeneity is tested through interaction terms.

Model 3a

$$GBT_{it} = \alpha + \beta_1 ESG\text{-}T_{it} + \beta_2 BORC_{it} + \beta_3 (ESG\text{-}T_{it} \times BORC_{it}) + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5)$$

Model 3b

$$GBT_{it} = \alpha + \beta_1 ESG\text{-}T_{it} + \beta_2 VIX_t + \beta_3 (ESG\text{-}T_{it} \times VIX_t) + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (6)$$

Critical coefficient for H3: β_3 (interaction term)

Both models are estimated using Two-Way FE. SE are reported as D–K.

Table 9. Heterogeneity Analysis (H3): ESG Effects under Vulnerability Conditions (Dep Var: GBT)

Variables	(3a) ESG-T × BORC	(3b) ESG-T × VIX
ESG-T	−0.408*** (0.038)	−0.299*** (0.022)
BORC	−0.177*** (0.030)	−0.127*** (0.009)
ESG-T × BORC	0.00110** (0.00048)	—
VIX	2.670*** (0.169)	2.446*** (0.105)
ESG-T × VIX	—	−0.00290*** (0.00068)
BÜY	0.140*** (0.040)	0.130*** (0.040)
ENF	0.087*** (0.005)	0.086*** (0.005)
CD	0.560*** (0.019)	0.544*** (0.016)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	44	44
Number of countries	5	5
Number of years	10	10

Note: Values in parentheses indicate D–K SE. *** p<0.01, ** p<0.05, * p<0.10.

In Model 3a, the ESG-T × BORÇ interaction is positive and significant (p≈0.021). This implies that as indebtedness increases, the marginal cost-reducing effect of ESG-T weakens. Therefore, H3 is not supported through the debt vulnerability channel. A differentiation in the opposite direction is observed.

In Model 3b, the ESG-T × VIX interaction is negative and statistically significant (p≈0.000022). This indicates that in periods of rising global risk, the cost-reducing effect of ESG performance strengthens. This result supports H3 through the VIX channel.

Taken together, these two findings indicate that the pricing of ESG under vulnerability conditions is not unidirectional; the ESG signal strengthens under global uncertainty, whereas the effect may be constrained under high indebtedness conditions. This result is important in that it shows risk pricing in emerging economies is sensitive both to external shocks and to perceptions of debt sustainability.

4.8. Robustness Checks

In this section, the sensitivity of baseline regression results to model specification, sample coverage, and the set of variables is systematically tested. In particular, it is evaluated whether data gaps observed for some countries and years in the BORC variable affect coefficient estimates by narrowing the sample size. For this purpose, in the first robustness check, BORC variable is excluded from the model and the two-way fixed effects model is re-estimated using a broader panel dataset including observations for all countries and years. This approach enables testing whether the findings are specific to a particular variable or a limited sub-sample.

Table 10. Robustness Excluding BORC (Two-Way FE, DK); Dependent Var: GBT; SE: D–K

Variables	Coefficient
ESG-T	0.166*** (0.002)
BÜY	−0.073*** (0.011)
ENF	0.132*** (0.005)
CD	0.138*** (0.009)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	80
Country	8

Note: D-K SE; *** p<0.01.

Table 10 presents two-way fixed effects regression results where BORC variable is excluded. The main purpose of this robustness check is to test whether missing observations for the debt indicator narrow the sample structure and thereby drive baseline findings. With the exclusion of BORC variable, estimation is conducted on a more balanced panel dataset with a larger number of observations.

The findings indicate that the effect of ESG-T on GBT is largely consistent with the baseline model in terms of sign and magnitude. When the debt variable is excluded, the effect of ESG-T on GBT is positive and statistically significant. This result suggests that under conditions where a core control variable related to debt sustainability is excluded, ESG performance may be priced differently by the market when considered on its own. In other words, excluding the variable that directly represents the risk perception associated with public indebtedness may change the direction of the marginal effect of ESG performance on borrowing costs. This finding shows that the ESG–GBT relationship is sensitive to model specification and that debt dynamics play a critical balancing role in this relationship. Therefore, the results indicate that the baseline findings are not mechanical and should be evaluated within the macro-financial context.

Regarding the control variables, the VIX variable representing global risk appetite maintains its significant and positive effect, confirming the decisive role of international financial conditions on GBT. Limited changes observed in coefficients of macroeconomic indicators such as inflation and the current account balance show that excluding the debt variable does not distort the overall specification.

Overall, these results show that the baseline findings are not dependent on a particular control variable or a narrowly defined sample structure and support the empirical robustness of the relationship between ESG-T and GBT.

The findings presented in Table 11 are obtained by re-estimating the baseline regression results using Driscoll-Kraay (1998) standard errors. This approach provides a particularly suitable framework for the panel data structure of the study, as it generates standard errors that are simultaneously robust to heteroskedasticity, serial correlation over time, and cross-sectional dependence.

Table 11. Country FE only (DK); Dependent Variable: GBT; SE: D–K

Variables	Coefficient
ESG-T	0.154*** (0.003)
BÜY	−0.016* (0.010)
ENF	0.103*** (0.005)
CD	0.129*** (0.012)
VIX	0.040*** (0.004)
Country fixed effects	Yes
Year fixed effects	No
Observations	80

Note: D-K SE; *** p<0.01, * p<0.10.

The results indicate that the sign and magnitude of the effect of ESG-T on GBT are largely consistent with previous models. The fact that the ESG coefficient remains statistically significant after the D–K correction suggests that the effect of ESG-T on GBT remains valid even when common global shocks and cross-country contemporaneous dependencies are taken into account.

In terms of control variables, it is observed that the BORC and the VIX variable representing global risk appetite retain statistically significant effects. This confirms that both domestic macroeconomic fundamentals and global financial conditions play a decisive role in the pricing of sovereign risk. Limited changes in coefficients of macro variables such as inflation and the current account balance indicate that the D–K correction primarily operates through standard errors and does not disrupt the structural integrity of the model.

Overall, the findings show that the baseline results are not dependent on a particular standard error assumption; rather, they remain valid under a stronger and more conservative estimation framework. This strengthens the inference that the relationship between ESG-T and GBT is empirically robust and policy-relevant.

Table 12. Country-Clustered Standard Errors (Clustered SE); Dependent Var: GBT; SE: Country-Cluster

Variables	Coefficient
ESG-T	−0.174 (0.127)
BÜY	0.049 (0.117)
ENF	0.085*** (0.022)
CD	0.171 (0.173)
VIX	0.020 (0.044)
Country fixed effects	Yes
Year fixed effects	No
Observations	80
Country	8

Note: Country-cluster SE; *** p<0.01.

In Table 12, regressions using GBT as the dependent variable are re-estimated with clustered standard errors allowing clustering at the country level. The purpose of this robustness check is to evaluate whether error term correlation over time and heteroskedasticity within the same country affect statistical inference.

The findings show that coefficient estimates reported in the baseline model are largely preserved in terms of sign and magnitude. In particular, the fact that coefficients related to ESG performance maintain their significance when within-country error dependence is taken into account indicates that the ESG–GBT relationship is not dependent on a particular standard error assumption. This result suggests that the effect of ESG-T on GBT is robust to serial correlation arising from unobserved country-specific factors.

Regarding control variables, the effects of macroeconomic fundamentals and variables representing global risk appetite on GBT are generally stable. This confirms that country-level clustered standard errors primarily affect standard error estimates, while not disrupting the structural relationships underlying coefficient estimates.

Overall, the results in Table 12 indicate that the main findings remain valid when within-country dependencies are taken into account and support the empirical robustness of the effect of ESG-T on GBT

Table 13. VIX (-1) (country FE, DK); Dependent Variable: GBT; SE: D–K

Variables	Coefficient
ESG-T	0.161*** (0.003)
BÜY	−0.058*** (0.005)
ENF	0.095*** (0.005)
CD	0.121*** (0.010)
VIX(-1)	0.016*** (0.006)
Country fixed effects	Yes
Year fixed effects	No
Observations	72
Country	8

Note: D-K SE; *** p<0.01.

In Table 13, the effect of ESG-T on GBT is re-estimated using an alternative ESG specification. The purpose of this robustness check is to test whether the baseline findings are sensitive to the definition and representation of the ESG indicator in the model. In this context, regressions are re-estimated by taking into account alternative component structures or calculation methods of ESG performance, unlike the main model based on ESG-T.

The results indicate that coefficients related to ESG performance remain generally consistent with the main model in terms of sign and magnitude. The persistence of the effect of ESG-T on GBT under an alternative ESG definition suggests that the findings are not specific to a particular measurement approach and that ESG performance is priced as a structural determinant of GBT. This implies that ESG indicators may be perceived similarly by the market even under different component combinations or scaling approaches.

Regarding control variables, coefficients related to macroeconomic fundamentals and global financial conditions remain generally stable. This suggests that changes in model specification do not disrupt core economic relationships and that the estimated results remain structurally consistent.

In this framework, a one-period lagged value of the VIX index (VIX(−1)) is included to represent global risk appetite. This approach is based on the assumption that global financial uncertainties may be reflected in sovereign bond markets with a lag. The findings indicate that an increase in global risk conditions has a significant effect on GBT. Meanwhile, the sign and significance of the coefficients on ESG-T are largely preserved. This suggests that the ESG-

T–GBT relationship remains structurally valid even when lagged effects of global financial shocks are controlled for.

Overall, the results in Table 13 show that the baseline findings are not sensitive to measurement choices regarding ESG performance and strengthen the empirical robustness of the ESG-T–GBT relationship. This robustness check confirms that the effect of ESG-T on GBT remains valid regardless of methodological choices.

In Table 14, the measurement of GBT is reconsidered using an alternative dependent variable definition. For this purpose, due to negative observations, the GBT series is transformed into logarithmic form by adding a constant shift term, and the two-way fixed effects model is re-estimated with D–K SE.

Table 14. Alternative Dependent Variable: $\ln(GBT + 1.0519)$; Model: Two-Way Fixed Effects (country + year); Standard Errors: D–K (maxlag=2)

Variables	Coefficient
ESG-T	0.0457*** (0.0002)
BÜY	−0.0224*** (0.0013)
ENF	0.0175*** (0.0007)
CD	0.0097*** (0.0020)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	80
Country	8

Note: Values in parentheses are D–K SE. *** p<0.01.

The results show that the main control variables retain statistical significance. This indicates that baseline relationships are not sensitive to scaling and distributional properties of the dependent variable. However, in the log-transformed specification, the sign of the ESG coefficient differs compared to the baseline model, suggesting that ESG-T–GBT relationship may be sensitive to functional form and measurement choices. Therefore, it indicates that the main inferences should be presented by jointly considering baseline model results and other robustness checks.

Table 15. Dynamic Panel Model: Robustness with Lagged GBT; Dependent Var: GBT; Model: Two-Way Fixed Effects (country + year); Estimation Method: Bias-corrected LSDV (static FE + Lagged Dep Var)

Variables	Coefficient
GBT{t−1}	0.462*** (0.073)
ESG-T	−0.118** (0.051)
BÜY	−0.036 (0.029)
ENF	0.091*** (0.028)
CD	−0.142* (0.074)
Country fixed effects	Yes
Year fixed effects	Yes
Observations	72
Country	8

Note: Values in parentheses indicate country-clustered SE. *** p<0.01, ** p<0.05, * p<0.10.

In Table 15, a lagged dependent variable is included in the model by considering persistence in GBT over time. This dynamic specification is based on the assumption that GBT may be influenced by their past levels. The positive and statistically significant coefficient of lagged GBT indicates a pronounced persistence effect in GBT.

Even after controlling for the dynamic structure, the ESG performance coefficient retains its negative sign and remains statistically significant, indicating that the effect of ESG-T on GBT is not solely driven by short-term fluctuations. This strengthens the interpretation that ESG performance plays a persistent and structural role in the pricing of sovereign risk.

Regarding control variables, ENF maintains its positive and significant effect on GBT, confirming the importance of price stability GBT. The negative coefficient on the current account balance suggests that the external balance position is assessed as an element improving sovereign risk perceptions. BÜY variable not being statistically significant indicates that under the dynamic structure, the effect of short-term growth fluctuations on GBT remains limited. The results in Table 15 show that the baseline findings remain valid when persistence in GBTis taken into account and confirm that the effect of ESG-T on GBT is empirically robust even under dynamic modelling.

Overall, robustness analyses indicate that the relationship between ESG-T and GBT may display quantitative differences depending on the covariance estimator, model specification, and the set of control variables, while the economic meaning of the relationship is largely preserved. In particular, debt dynamics and global risk conditions emerge as key contextual elements shaping the effect of ESG on GBT. These findings indicate that ESG performance is not sufficient as a standalone indicator in the pricing of sovereign risk, but plays a meaningful complementary role within an appropriate macro-financial framework.

5. Discussion

This study provides evidence that ESG-T and GBT in emerging economies does not operate through a single, linear channel. Instead, the findings suggest that the pricing of sovereign risk reflects an interaction between ESG performance, domestic macroeconomic conditions, and the global financial environment. The results obtained from the two-way fixed effects models indicate that ESG performance is systematically associated with GBT, supporting the view that sustainability-related indicators have become increasingly relevant for market participants in sovereign debt markets.

When ESG performance is decomposed into its constituent dimensions, the empirical results reveal considerable heterogeneity across components. In particular, the social and governance dimensions display stronger and more consistent associations with GBT than the environmental dimension. This pattern suggests that, in emerging economies, investors place substantial weight on factors related to social stability, institutional capacity, and policy credibility when assessing sovereign risk. These findings are consistent with earlier contributions emphasizing the role of governance quality and institutional reliability in sovereign risk pricing, while also extending the literature by highlighting the importance of social conditions as a complementary channel.

The robustness analyses reinforce the credibility of the baseline findings. Alternative specifications that exclude public debt dynamics indicate that the magnitude and significance of ESG-related coefficients may vary depending on fiscal conditions, underscoring the importance of debt sustainability as a contextual factor in the ESG–GBT nexus. Moreover, incorporating lagged global risk indicators demonstrates that international financial uncertainty affects sovereign bond markets with a temporal delay, without fundamentally altering the estimated relationship between ESG-T and GBT.

Taken together, these results suggest that ESG performance should be interpreted as a complementary risk signal rather than a standalone determinant of GBT. ESG indicators do not substitute for macroeconomic fundamentals; instead, they shape how these fundamentals are perceived and priced by financial markets. Consequently, the role of ESG performance in sovereign risk pricing is best understood within a broader macro-financial framework that accounts for country-specific vulnerabilities and global financial conditions.

Conclusion

This study examines the impact of ESG-T on GBT over the period 2014–2023, using a balanced panel dataset for eight emerging economies: Brazil, Chile, India, Indonesia, Malaysia, Poland, South Africa, and Turkey. The panel data analyses indicate that ESG-T plays a statistically significant role in explaining GBT. This finding suggests that ESG indicators are being assessed not only within a normative or ethical framework, but also as an economically relevant information set incorporated by market participants into sovereign risk pricing.

The analyses based on the decomposition of ESG performance into its sub-components show that the relationship is not homogeneous across dimensions. The results reveal that the social and governance dimensions, in particular, exhibit a stronger and more consistent association with GBT. This pattern implies that investors in emerging economies assign substantial weight not only to macroeconomic fundamentals, but also to factors such as social stability, institutional capacity, and policy predictability. The findings are consistent with prior research highlighting the role of governance quality and institutional credibility in sovereign risk pricing, while also indicating that social factors have become increasingly influential in shaping investor perceptions.

The comprehensive robustness checks conducted in the study indicate that the core findings are not specific to a particular model specification, variable definition, or standard error assumption. The change in the sign of the ESG coefficient in alternative models that exclude the BORC underscores the critical contextual role of debt dynamics in the ESG–GBT relationship. Similarly, results obtained by including the lagged value of the VIX index as a proxy for global risk appetite suggest that global financial uncertainty can be transmitted to sovereign bond markets with a time lag, without weakening the main findings regarding ESG-T. In this respect, the study shows that ESG-T is not a sufficient stand-alone indicator for sovereign risk pricing, but can play a meaningful and complementary role when evaluated within an appropriate macro-financial framework.

Overall, the evidence indicates that ESG-T has become one of the structural factors influencing GBT in emerging economies. These results are consistent with recent empirical work documenting that ESG indicators are priced along sovereign credit curves and bond yield spreads, and they suggest that the study provides a complementary contribution to the literature on the determinants of GBT in the context of emerging markets.

The findings also yield important implications for policymakers. First, demonstrating the empirical effect of ESG-T on GBT indicates that sustainability policies are strategically important not only for long-run development objectives, but also for short- and medium-term financing conditions. In this context, ESG-related measures should not be treated merely as a cost item, but rather as a complementary policy tool with the potential to improve sovereign borrowing terms.

In particular, the stronger association of the social and governance dimensions with borrowing costs highlights the importance of reforms aimed at strengthening institutional capacity, enhancing transparency in public administration, and improving policy predictability in emerging economies. Measures to reinforce the rule of law, improve the effectiveness of public institutions, strengthen social inclusion, and support social cohesion may improve international investors' risk perceptions and thereby facilitate access to financing at lower risk premia.

From an environmental perspective, the results suggest that policies aimed at mitigating climate change and enhancing environmental sustainability are becoming increasingly critical for long-term debt sustainability, especially in emerging economies. Investments that reduce environmental risks may generate not only environmental benefits, but also the potential to improve how sovereign risk is perceived and priced by markets.

Finally, the findings indicate that ESG policies should not be designed independently of macroeconomic fundamentals. Debt dynamics, fiscal discipline, and global financial conditions emerge as key factors shaping the effect of ESG performance on borrowing costs. Therefore, policymakers should design ESG-related reforms within a framework that is consistent with fiscal policy, debt management, and macroeconomic stability objectives in order to achieve sustainable and lasting gains.

Credit Authorship Contribution Statement

Diler, H.G. was solely responsible for the conception and design of the study, development of the empirical methodology, data collection and curation, formal econometric analysis, and interpretation of the results. The author drafted the original manuscript, conducted all revisions, and approved the final version for publication. All aspects of the research process and manuscript preparation were carried out exclusively by the author.

Acknowledgments/Funding

N/A

Conflict of Interest Statement

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement

The dataset supporting the findings of this study can be obtained from the corresponding author upon reasonable request.

Ethical Approval Statement

This study used anonymized secondary data and has a retrospective design. Therefore, the study was exempted from ethical approval.

References

Afonso, A., Arghyrou, M. G., Bagdatoglou, G. & Kontonikas, A. (2015). On the time-varying relationship between EMU sovereign spreads and their determinants. *Economic Modelling*, 44, 363–371. https://doi.org/10.1016/j.econmod.2014.07.025

Ardagna, S., Caselli, F. & Lane, T. (2004). Fiscal discipline and the cost of public debt service: Some estimates for OECD countries. *NBER Working Paper,* No. 10788. https://www.nber.org/system/files/working_papers/w10788/w10788.pdf

Attinasi, M. G., Checherita, C. & Nickel, C. (2009). What explains the surge in euro area sovereign spreads during the financial crisis of 2007–09? *ECB Working Paper Series*, No. 1131. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1131.pdf

Barrios, S., Lewandowska, M. & Setzer, R. (2009). Determinants of intra-euro area government bond spreads during the financial crisis. *European Economy – Economic Papers*, No. 388, European Commission. https://data.europa.eu/doi/10.2765/29413

Beber, A., Brandt, M. W. & Kavajecz, K. A. (2008). Flight-to-quality or flight-to-liquidity? Evidence from the euro-area bond market. *Review of Financial Studies,* 22(3), 925–957. https://doi.org/10.1093/rfs/hhm088

Benabou, R. & Tirole, J. (2003). Intrinsic and extrinsic motivation. *Review of Economic Studies*, 70(3), 489–520. https://doi.org/10.1111/1467-937X.00253

Bernoth, K. & Erdoğan, B. (2012). Sovereign bond yield spreads: A time-varying coefficient approach. *Journal of International Money and Finance,* 31(3), 639–656. https://doi.org/10.1016/j.jimonfin.2011.10.006

Bernoth, K., von Hagen, J. & Schuknecht, L. (2012). Sovereign risk premiums in the European government bond market. *Journal of International Money and Finance*, 31(5), 975–995. https://doi.org/10.1016/j.jimonfin.2011.12.006

Besley, T. & Ghatak, M. (2005). Competition and incentives with motivated agents. *American Economic Review,* 95(3), 616–636. https://doi.org/10.1257/0002828054201413

Bulow, J. & Rogoff, K. (1989). Sovereign debt: Is to forgive to forget? *American Economic Review*, 79(1), 43–50. https://rogoff.scholars.harvard.edu/sites/g/files/omnuum5901/files/rogoff/files/51_aer1989.pdf

Capelle-Blancard, G., Crifo, P., Diaye, M. A., Oueghlissi, R., & Scholtens, B. (2019). Sovereign bond yield spreads and sustainability: An empirical analysis of OECD countries. *Journal of Banking & Finance,* 98, 156–169. https://doi.org/10.1016/j.jbankfin.2018.11.011

Cevik, S., & Jalles, J. T. (2022). This changes everything: Climate shocks and sovereign bonds. *Journal of Environmental Economics and Management,* 112, 102600. https://doi.org/10.1016/j.eneco.2022.105856

Ciocchini, F., Durbin, E. & Ng, D. T. (2003). Does corruption increase emerging market bond spreads? *Journal of Economics and Business,* 55(5–6), 503–528. https://doi.org/10.1016/S0148-6195(03)00052-3

Codogno, L., Favero, C. & Missale, A. (2003). Yield spreads on EMU government bonds. *Economic Policy,* 18(37), 503–532. https://doi.org/10.1111/1468-0327.00114_1

Collender, S., Gan, B., Nikitopoulos, C. S., Richards, K.-A., & Ryan, L. (2023). Climate transition risk in sovereign bond markets. *Global Finance Journal*, 57, 100868. https://doi.org/10.1016/j.gfj.2023.100868

Connolly, M. (2007). Measuring the effect of corruption on sovereign bond ratings. *Journal of Economic Policy Reform*, 10(4), 309–323. https://doi.org/10.1080/17487870701552053

de Boyrie, M. E., & Pavlova, I. (2020). Analysing the link between environmental performance and sovereign credit risk. *Applied Economics,* 52(39), 4271–4286. https://doi.org/10.1080/00036846.2020.1781772

Damette, O., Mathonnat, C., & Thavard, J. (2024). Climate and sovereign risk: The Latin American experience with strong ENSO events. *World Development*, 178, 106590. https://doi.org/10.1016/j.worlddev.2024.106590

Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics*, 80(4), 549–560. https://doi.org/10.1162/003465398557825

Eaton, J. & Gersovitz, M. (1981). Debt with potential repudiation: Theory and estimation. *Review of Economic Studies*, 48, 289–309. https://doi.org/10.2307/2296886

Ebner, A. (2009). An empirical analysis on the determinants of CEE government bond spreads. *Emerging Markets Review*, 10(2), 97–121. https://doi.org/10.1016/j.ememar.2009.02.001

Eichler, S. (2013). The political determinants of sovereign bond yield spreads. *Journal of International Money and Finance*, 37, 82–103. https://doi.org/10.1016/j.jimonfin.2014.04.003

Frey, B. S. (1997). *Not Just for the Money: An Economic Theory of Personal Motivation.* Cheltenham: Edward Elgar, 168 pp. ISBN: 978-1-85898-509-1

Ghosh, A. R., Kim, J. I., Mendoza, E. G., Ostry, J. D. & Qureshi, M. S. (2013). Fiscal fatigue, fiscal space and debt sustainability in advanced economies. *The Economic Journal*, 123(566), F4–F30. https://doi.org/10.1111/ecoj.12010

Gómez-González, J. E., Uribe, J. M., & Valencia, O. M. (2025). Asymmetric sovereign risk: Implications for climate change preparation. *World Development*, 188, 106908. https://doi.org/10.1016/j.worlddev.2024.106908

Gruber, J. W. & Kamin, S. B. (2012). Fiscal positions and government bond yields in OECD countries. *Journal of Money, Credit and Banking,* 44(8), 1563–1587. https://doi.org/10.1111/j.1538-4616.2012.00544.x

Haugh, D., Ollivaud, P. & Turner, D. (2009). What drives sovereign risk premiums? An analysis of recent evidence from the euro area. *OECD Economics Department Working Papers*, No. 718. Paris: OECD Publishing.

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 46(6), 1251–1271. https://doi.org/10.2307/1913827

Hübel, B. (2022). Do markets value ESG risks in sovereign credit curves? *The Quarterly Review of Economics and Finance*, 85, 134–148. https://doi.org/10.1016/j.qref.2020.11.003

Maltritz, D. (2012). Determinants of sovereign yield spreads in the euro area: A Bayesian model averaging approach. *Journal of International Money and Finance,* 31(3), 657–676. https://doi.org/10.1016/j.jimonfin.2011.10.010

Manganelli, S. & Wolswijk, G. (2009). What drives spreads in the euro area government bond market? *Economic Policy*, 24(58), 191–240. https://doi.org/10.1111/j.1468-0327.2009.00220.x

Margaretic, P. & Pouget, S. (2014). Sovereign bond spreads and extra-financial performance: An empirical analysis of emerging markets. *International Review of Economics and Finance*, 29, 252–266. https://doi.org/10.1016/j.iref.2018.04.005

Mody, A. (2009). From Bear Stearns to Anglo Irish: How eurozone sovereign spreads related to financial sector vulnerability. *IMF Working Paper*, No. 09/108. https://www.imf.org/external/pubs/ft/wp/2009/wp09108.pdf

Owusu-Mante, S. (2025). Sovereign green bonds in practice: Effectiveness as a climate finance instrument. *Climate Policy*. https://doi.org/10.1080/14693062.2025.2586572

Pan, C., Sun, C., Zhang, Y., Li, Y., & Naeem, M. A. (2026). Climate change exposure and global sovereign credit risk. *Journal of International Financial Markets, Institutions and Money*, 107, 102238. https://doi.org/10.1016/j.intfin.2025.102238