Exploring the Determinants of Green Bond Coupon Rates: The Role of Geography, Credit Rating, and Bond Tenor

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Abstract

The green bond market's explosive growth has made it a crucial tool for funding ecologically friendly initiatives across the globe. It is critical for issuers, investors, and policymakers to comprehend the elements that affect green bond price. This study analyzes the impact of issuer region, bond tenor, and credit rating on the factors that determine green bond coupon rates. A purposive sample of twenty green bonds issued by corporate, multilateral, and sovereign entities between 2019 and 2025 is used in this study. Sustainable finance databases, issuer reports, and bond disclosures that are accessible to the public were the sources of secondary data. The association between the chosen factors and coupon rates was evaluated using descriptive statistics, correlation analysis, and multiple regression approaches. The results show that the most important factor is issuer region, with Indian issuers giving much higher coupon rates than non-Indian issuers. Bond tenor shows a modest negative correlation with coupon rates, although credit rating shows a somewhat favorable correlation. The findings imply that issuer-specific attributes and local market conditions are more important factors in green bond pricing than term structure. By presenting actual data on the major factors influencing green bond coupon rates, the study adds to the expanding body of knowledge on sustainable finance. It also provides investors, issuers, and policymakers with useful information for creating effective and competitive green bond markets.

Keywords: Green Bonds, Coupon Rates, Sustainable Finance, Credit Rating, Bond Tenor, Issuer Geography, Green Bond Pricing.

1. Introduction

1.1 Background and the Financing Gap

The most significant worldwide macroeconomic issue of the twenty-first century is climate change. Rapid shifts away from reliance on fossil fuels and toward scalable renewable energy systems are necessary to mitigate its effects. However, the creation of sustainable energy

infrastructure is intrinsically capital-intensive, with extended gestation periods and vulnerability to intricate merchant market and regulatory risks.

Conventional capital access methods, such fiscal allocations and direct balance-sheet commercial bank loans, have proven structurally insufficient to fill the multitrillion-dollar financial gap needed to fulfil global climate commitments. In order to deploy private institutional capital at scale, capital-market-driven innovations have become crucial.

1.2 Green Bonds as an Innovative Instrument

Green bonds are fixed-income financing securities specifically designed to allocate net revenues to projects that provide demonstrable environmental benefits, like low-carbon transit, grid upgrade, and solar/wind installation. Green bonds access a rising pool of sustainable institutional capital by aligning normal corporate fixed-income structures with Environmental, Social, and Governance (ESG) objectives.

Despite the asset class's explosive growth over the past ten years, empirical evaluations of their actual effectiveness, particularly in terms of reducing borrowing costs and increasing incremental clean energy capacity as opposed to acting as corporate PR tools remain a topic of continuous scholarly and regulatory discussion.

2. Review of Literature

Fixed-income instruments and environmental sustainability have produced a substantial body of scholarly work. The main topics of study include regulatory taxonomies, price mechanisms, and execution efficiency.

• **Financial Performance and the "Greenium"**: According to Akhigbe et al. (2021), green bonds effectively combine explicit sustainability aspects with conventional valuation techniques (such as credit ratings and coupon pricing), boosting investor trust. However, structural differences in risk presentation and inconsistent ESG data tracking limit their effectiveness. Alonso-Conde and Rojo-Suárez (2020) demonstrate that, in comparison to conventional financing arrangements, green bond solutions lower the weighted average cost of capital (WACC), increase Debt Service Coverage Ratios (DSCR), and increase internal rates of return (IRR).

Public and Emerging Market Dynamics: State-sponsored initiatives have expanded quickly. The public sector green debt increased from USD 180 billion in 2020 to USD 460 billion in 2024, according to Celestin and Mishra's (2024) graphic. They point out that although renewable

energy projects are the main benefactors, the lack of unified regulatory taxonomies makes execution difficult. In emerging nations, these macroeconomic obstacles are more noticeable. In their analysis of the Indian and Brazilian markets, Vij, Ghate, and Chauhan (2025) point out that although green bonds offer competitive financial returns, their potential is limited by complicated regulations, shoddy governance structures, and inconsistent corporate disclosures.

2.1 Research Gap

While existing studies document issuance growth, there remains a critical gap in modeling how specific security-level attributes (such as geographic risk and credit rating tiers) interact to determine pricing dynamics in emerging markets versus developed markets. This study bridges this gap by applying descriptive, correlation, and multi-variable regression analysis to a curated international dataset.

3. Research Objectives

- To analyse the impact of issuer geography on green bond coupon rates.
- To examine the relationship between credit rating and green bond coupon rates.
- To assess the influence of bond tenor on the coupon rates of green bonds.
- To identify key challenges such as greenwashing and reporting gaps in the green bond Market.

4. Hypotheses Development

To evaluate the impact of green bond financing, the following hypotheses are formulated:

- Null Hypothesis (H_0): Green bonds do not significantly impact renewable energy financing.
- Alternative Hypothesis (H_1): Green bonds significantly enhance renewable energy financing.

5. Research Methodology

5.1 Research Design

A descriptive and analytical research design is used in this study. The study's descriptive section seeks to determine the type, structure, and trajectory of green bonds as well as their significance in funding green energy projects. The study's analytical section compares the coupon interest of green bonds with conventional project financing techniques to assess the bonds' financial efficacy.

5.2 Method of Data Collection and Sources

The study is only based on secondary data that was gathered from reputable and trustworthy sources, such as: Reports on the Indian and global green bond markets; scholarly journals and research papers; government and regulatory publications; issuer disclosures and sustainability reports to guarantee dependability, consistency, and relevance to the study's goals, secondary data was chosen.

5.3 Sampling Type and Sample Size

The study selects green bonds issued between 2019 and 2025 using a purposive sampling technique. Twenty green bond issuance from three different issuer categories: corporate, multilateral, and sovereign—make up the sample. Key characteristics, such as coupon rate, tenor, issuer type, credit rating, and geographic location, were taken into consideration while choosing bonds. A comparison of the factors influencing green bond coupon rates among various issuer categories and geographical areas is made possible by the sample's inclusion of issuers from both developed and emerging markets.

5.4 Variable of the study:

Independent Variable: Green Bond Financing Profile: (quantified through Tenor (Years), Credit Rating and Issuer Geography).

Dependent Variables:

Coupon Rate (%)

- The coupon rate represents the annual interest paid by the green bond issuer to investors.
- It is used as the dependent variable to measure the pricing of green bonds.

5.5 Statistical Design and Tools Used

The statistical tools used in the study are limited to those appropriate for secondary data analysis. These include:

- **Descriptive Statistics:** Mean, minimum, and maximum values were used to summarise key variables and understand data distribution.
- **Correlation Analysis:** The Pearson's correlation coefficient was used to examine the degree and direction of linear association between coupon rates and the selected bond characteristics.

  Regression Analysis: In particular, ordinary least squares regression analysis was used in order to study the patterns and relationship that may exist between coupon rates and the various explanatory variables such as bond tenor, credit rating, and issuer geography.

Advanced inferential statistical tests were not applied, as the study does not involve primary data or hypothesis testing through statistical significance measures.

6. Results and Discussion

Table 6.1 Green Bond Issuance in India and Global (USD Billion)

Statistic	**Global Green Bond Issuance (USD Billion)**	**Green Bond Issuance in India (USD Billion)**
Mean	420.71	8.81
Median	490.00	7.40
Standard Deviation	163.51	5.79
Minimum	160.00	1.50
Maximum	600.00	20.00

Interpretation: The average amount of green bonds issued worldwide was USD 420.71 billion, which is significantly more than the average amount issued in India, which was USD 8.81 billion. This indicates the size of the global market. Global issuance showed more variability (SD = 163.51) than India (SD = 5.79), suggesting that annual issuance quantities fluctuated more widely. Strong expansion was evident in both markets, with the maximum issuance reaching USD 20 billion in India and USD 600 billion worldwide. Over the course of the study, the median figures indicate that issuance levels have generally trended upward.

Table 6.2 Sector-Wise Proceeds Deployment

Sector Share of Proceeds (%)	Sector Share of Proceeds (%)
Renewable Energy	32
Low-Carbon Transport	25
Green Buildings	20
Water Management	10
Waste Management	7
Other Sectors	6
Total	100

Interpretation:

A significant emphasis on climate mitigation and sustainable infrastructure is evident in the allocation of green bond proceeds to Renewable Energy (32%), Low-Carbon Transport (25%), and Green Buildings (20%). The least amount of financing goes to Other Sectors (6%), while Water Management (10%) and Waste Management (7%) receive substantial amounts. All things considered, the allocation clearly emphasizes energy-efficient development, sustainable transportation, and clean energy.4.4.1 Coupon Rate Analysis of Green Bonds

Table 6.3 Coupon Rates of Selected Green Bond Issuances

Sl. No.	Issuer	Year	No. Coupon Rate (%)
1	India Sovereign GB (5-yr)	2023	7.1
2	India Sovereign GB (10-yr)	2023/24	6.48
3	France Green OAT	2022	0.1
4	Germany Green Bund	2022	1.3
5	UK Green Gilt	2021	1.5
6	Indonesia Green Sukuk	2023	4.4
7	World Bank GB	2022	1.25
8	IFC GB	2021	1.59
9	ADB GB	2020	0.5
10	EIB CAB	2019	1.625
11	Apple GB	2019	2.95
12	Engie GB	2021	1
13	Enel GB	2020	1
14	Re New Power GB	2022	7.95
15	NTPC Green Energy (NGEL)	2025	7.01
16	Adani Green Bond	2024	6.7
17	State Bank of India (SBI) GB	2025	6.93
18	European Investment Bank (EIB) GB	2024	3.875
19	Euro Green Bond	2021	1.841
20	IREDA (Indian Renewable Energy Development Agency) GB	2025	7.7

Interpretation: The coupon rates for green bonds vary greatly between issuers and localities, ranging from 0.1% to 7.95%. Due to higher risk and interest rate environments, emerging market issuers—especially those from India—offer higher rates than developed-country sovereigns and multilateral organizations. In general, issuer and market factors have a greater impact on coupon rates than the green label itself.

Table 6. 4: Descriptive Statistics of Selected Green Bonds variables

Variable	Mean	Minimum	Maximum
Coupon Rate (%)	3.78	0.1	7.95
Tenor (Years)	11.01	5	32
Credit Rating (Numeric)	2.32	1	5

Interpretation:

The sampled green bonds have an average coupon rate of roughly 3.78%, with a wide range that reflects variations in issuer risk profiles and market conditions. Bond tenors show a wide range of maturity structures. The sample's average credit rating falls between AA and A, indicating a combination of high-quality and moderately risky issuers.

6.5 Correlation Analysis

The strength and direction of the association between green bond coupon rates and bond attributes, specifically tenor, credit rating, and issuer region, were evaluated using Pearson's correlation coefficient. Issuer region was recorded as a dummy variable (India = 1, non-India = 0) and credit ratings were transformed into a numerical scale (AAA = 1 to BB = 5). Although it does not imply causation, correlation analysis quantifies the strength of linear connection between variables.

Table 6.5: Correlation Analysis

Variable	Coupon Rate	Tenor Geography (India	Credit Rating	Geography (India)
Coupon Rate	1	−0.24	0.59	0.93
Tenor	-0.24	1	-0.09	−0.19

Credit Rating	0.59	-0.09	1	0.54
Geography (India)	0.93	-0.19	0.54	1

Interpretation:

According to the correlation matrix, the coupon rate and issuer region (India) have a very strong positive association (r = 0.93), indicating that Indian green bonds typically have higher coupon rates. Bond yields are influenced by rating discrepancies, as evidenced by the fairly positive correlation (r = 0.59) between credit rating and coupon rate. Tenor and coupon rate have a weak negative association (r = -0.24), suggesting that maturity has little effect on coupon rates. Furthermore, there is a moderate correlation (r = 0.54) between geography and credit rating, indicating some relationship between issuer location and credit quality.

6.6 Regression Analysis

An Ordinary Least Squares (OLS) regression analysis was performed to investigate the combined influence of bond features on green bond coupon rates. Bond maturity (term), credit rating (numeric), and issuing area were included as independent factors, with the coupon rate (%) serving as the dependent variable. The baseline coupon rate was estimated by adding a constant term. The OLS approach provides the best linear fit between the observed and expected coupon rates by estimating regression coefficients by minimizing the sum of squared residuals.

Regression Model

Coupon Rate = α + β□(Tenor) + β□(Credit Rating) + β□(Geography) + ε

Table 6.7: Regression Results

Variable	Coefficient
Constant	1.74
Tenor	−0.03
Credit Rating	0.26
Geography (India)	4.82

Model Statistics:

- $R^2 = 0.878$

- Adjusted $R^2 = 0.853$
- Model significance: $p < 0.01$

Interpretation:

According to the regression results, geography (India) has the biggest beneficial impact on green bond coupon rates, raising them by 4.82 percentage points when compared to issuers that are not Indian. A moderate rise in coupon rates is linked to changes in the rating variable, according to Credit Rating's positive coefficient (0.26). Longer-tenor bonds often have somewhat lower coupon rates, according to the Tenor coefficient (−0.03), which shows a minor negative link between bond maturity and coupon rates. When all explanatory variables are kept at zero, the baseline coupon rate is represented by the constant term (1.74). In the model, geography seems to be the most important factor affecting coupon rates overall.

6. Discussion

These results from correlation and regression taken together suggest that issuer and market-specific factors have a greater influence on green bond pricing than maturity. The extremely high correlation between geography and coupon rates indicates that there are still notable structural distinctions between the developed and emerging bond markets, even when it comes to environmentally conscious financial products. Green bonds are priced mostly in line with traditional fixed-income market principles, with the goal of promoting sustainable development. Because the research was exploratory and relied on secondary data, the results should be viewed as associational rather than causal. Regression analysis and correlation, in any event, significantly improve the financial evaluation of green bonds.

7. Market Challenges

The green bond market has a number of structural constraints despite its growth trajectory:

- Greenwashing Vulnerabilities: Capital may be termed "green" without producing confirmed environmental results due to the absence of globally accepted criteria.
- Reporting Asymmetries: Impact tracking after issuance is still uneven. Comparative study is hampered by the substantial differences in verification metrics for saved emissions between countries.
- Friction expenses: Smaller business issuers may be discouraged, especially in emerging economies, by the additional overhead expenses associated with external auditing, second-party reviews, and continuous compliance requirements.

- Liquidity and "Greenium" Variations: Issuers' price advantage ("greenium") varies depending on the market. Green bonds frequently trade similarly to conventional products in developing capital markets, which lessens the financial incentive to offset compliance costs.

8. Policy Recommendations and Conclusions

The following actions are advised in order to improve the green bond market's effectiveness in financing sustainable infrastructure, notwithstanding its scaling trajectory:

• Mandatory Disclosure Standards: Instead of using voluntary reporting rules, regulators should adopt standardized disclosure frameworks that call for quantifiable measures like avoided emissions and capacity additions (MW).

• Targeted Fiscal Incentives: Governments can use partial credit guarantee structures, expedited certification procedures, or targeted tax credits to reduce obstacles for corporate issuers in emerging economies.

• Reducing the Risk of Greenwashing: Mandatory third-party verification procedures and independent monitoring organizations will safeguard investor confidence and market integrity.

9. Conclusion

This study supports the alternative hypothesis (H_1), confirming that green bonds serve as an effective instrument for scaling renewable energy finance. They offer clear capital cost advantages over traditional bank financing while supporting international carbon reduction initiatives.

However, empirical modeling underscores that these instruments do not escape standard fixed-income pricing dynamics; sovereign and credit risks continue to drive yield behaviors. Optimizing the capacity of green bonds requires stronger regulatory frameworks, standardized impact metrics, and targeted incentives to support long-term sustainable energy transitions.

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