“Do bond attributes affect green bond yield? Evidence from Indian green bonds”

AUTHORS	Abhilash Sandeep S. Shenoy Dasharathraj K. Shetty Aditi N. Kamath

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Abhilash Abhilash (India), **Sandeep S. Shenoy** (India),
Dasharathraj K. Shetty (India), **Aditi N. Kamath** (India)

DO BOND ATTRIBUTES AFFECT GREEN BOND YIELD? EVIDENCE FROM INDIAN GREEN BONDS

Abstract

Over the years, green finance tools have gained considerable attention with the increased concern to achieve sustainability in the economy. Green bonds are one such new innovative green finance tool embodied with bonds and green attributes. However, research on the Indian green bond is relatively modest. Thus, this study aims to analyze the impact of bond attributes on green bond yield. The study retrieves green bond data from the Bloomberg and Climate Bonds Initiative databases from 2015 to 2022. To test the framed hypotheses, the study employs a panel regression technique with a random effect model. The findings of the study show a significant positive effect of bond ratings ($\beta = 2.80926$, $p < 0.05$) on green bond yield based on the argument that good-rated bonds serve as collateral in the security market. On the contrary, the result also reveals a significant negative effect of bond maturity ($\beta = -0.327296$, $p < 0.05$) and bond label ($\beta = -3.16480$, $p < 0.05$) on green bond yield. The results based on the observation suggest that when the certified bond is issued, this signals the greenness of the bond in the market and attracts high demand, whereas the long maturity ensures the green project construction for a longer period, resulting in a lower bond value. Thus, empirical findings reveal that bond attributes are the major factors in influencing bond yield. The obtained results serve as a prerequisite for potential issuers, investors, and policymakers to further popularize the green bond in the country.

Keywords sustainability, green finance, green bond, bond yield, India, panel regression

JEL Classification Q56, C33

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Abhilash Abhilash, Senior Research Fellow, Department of Commerce, Manipal Academy of Higher Education, India.

Sandeep S. Shenoy, Dr., Professor, Head of the Department of Commerce, Manipal Academy of Higher Education, India. (Corresponding author)

Dasharathraj K. Shetty, Dr., Associate Professor, Department of Data Science and Computer, Applications, Manipal Academy of Higher Education, India.

Aditi N. Kamath, Research Scholar, Department of Commerce, Manipal Academy of Higher Education, India.

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INTRODUCTION

Over the decade, the Climate Change or Global Warming issue has adversely affected all nations on their socio-economic development across the globe. To this end, the Paris Accord recommended reducing global emissions (UNFCCC, 2015), followed by the Sustainable Development Goals of 2030, which emerged with the main focus on countries' sustainable actions (United Nations, 2015). To mitigate these climate change problems, various financing sources at the national and international levels need to be deployed. In this way, the Green Bond is suggested as a suitable instrument to achieve the Net Zero Emission target (CBI, 2021). The recent Conference of the Parties 27 also emphasized the pivotal role of green bonds in developing economies to fight against climate change (COP27, 2022).

Thus, the green bond has been introduced as an innovative Green Finance tool with the prime objective of reducing climate risk by focusing on green project construction (MacAskill et al., 2021). The green bond is a green debt security whose proceeds are destined for green projects (Park et al., 2020). It is defined as "any type of bond where the proceeds will be exclusively used to finance or re-finance, in part or in full, new and/or existing eligible green projects" (ICMA,

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2017). According to Green Bond Principles, the projects include "renewable energy, energy efficiency, sustainable waste management, sustainable land use, biodiversity, clean transportation, clean water, and green buildings". The issuer utilizes bond proceeds for green project construction, whereas the investor receives a return (Jin et al., 2020).

Given the potential economic and financial benefits of green bonds, it is crucial to investigate the impact of various factors on green bond yield with the expectation to attract major stakeholders, particularly investors, issuers, and the government. Despite India's role in terms of green bond issuance from emerging countries' perspective, less focus is given to the country's green bond market. However, it cannot be ignored that the 'bond' and 'green attributes' of the green bond such as maturity, issue size, label, and bond ratings play a pivotal role in influencing the green bond yield.

1. LITERATURE REVIEW AND HYPOTHESES

With the increasing action on climate change, the studies on green finance started to grow expeditiously (Zhang et al., 2019). Green finance advocates the integration of companies' sustainable practices and their financial decision making. Green bond as an innovative tool of green finance is attaining significant importance in recent years. The green bond is also referred as "climate bond" or "sustainable bond" where the funds are destined for green projects which make the green bond a different tool as compared to a conventional bond (Mathews & Kidney, 2012). The green bond issuance debuted in 2007 at the global level with an active role of the European Investment Bank, followed by the World Bank. The linkage between green bond and a sustainable economy date back to 2011 for the immediate transformation of a fossil-based economy to a sustainable economy (Mathews, 2011). However, the literature in the domain of green bond has grown exponentially after the introduction of the Green Bond Principle in 2014, followed by the Paris Accord 2015 (Gün & Kutlu, 2021). Gradually, the green bond market witnessed the growing involvement of various stakeholders, which led academicians and researchers to further delve into green bond research, particularly in the developed and in some other emerging economies.

There is a growing debate on the benefits of green bond issuance towards environmental sustainability, and green bonds have proven to be the provider of favorable benefits toward environmental performance (Glomsrød & Wei, 2018; Fatica & Panzica, 2020; Oguntuase & Windapo, 2021). As green bond proceeds are ring-fenced for green projects, this showed a crucial role in the construction of various green projects particularly, during abnormal situations (Li et al., 2022). In addition, this also induces the country's Environmental, Social, and Governance practices in achieving a greener economy (Yang et al., 2022). In this way, green bond issuance tends to have favorable effects on environmental sustainability.

Green bond as a new asset class sparked researchers to investigate its behavior in terms of bond volatility (Pham, 2016). Further evidence added the ingredients to it by analyzing the green bond behavior and its connectedness with other market forms such as conventional financial markets, energy markets, and commodity markets. In response to this, the evidence proved the green bond as a risk-mitigating tool for investors and thereby supported the green bond as a new promising tool for its continuous growth (Ferrer et al., 2021; Naeem et al., 2021). Henceforth, the understanding of the green bond market volatility and its connectedness with other markets was increased on the part of various investors.

Given the fact of maturation of the green bond market, it deciphered the market observers in obtaining a consensus on the existence of "green bond premium" or "greenium" ("the yield differential between green bond and conventional bonds"), accordingly, the findings strongly exerted the existence of greenium in the green bond market with the strong influence of several environmental, economic, and social factors. However, significant attempts were made to convince the rationale for the lower yield for green bond investors by revealing the investor's high preference towards sustainability. Alongside, it is further jus-

tified by the availability of its double-edged benefits such as financial and non-financial benefits (Loffler et al., 2021; MacAskill et al., 2021; Teti et al., 2022).

Nevertheless, the studies concerned with the Indian green bond are relatively less and only a few researchers have attempted to focus on the country's green bond. The academicians proved the dominance of the banking sector in the Indian green bond market due to increased preference towards banking companies (Ray & Bisbey, 2020). Interestingly, the green bond issuance obtained a strong positive response from the stock market in the country (Verma & Bansal, 2021). It is believed that green bonds could be a better financial tool for India's rapid bus transit system with the effective use of a sustainable Public Private Partnership model (Sarkar & Sheth, 2022).

Though the green bond is a new phenomenon in the Indian financial market, only a few organizations have issued green bonds, and most of the issued bonds remained non-green due to the absence of certification (Dash, 2021). Moreover, India's green bond market development is lagging as there exist multiple factors such as lack of awareness, poor credit rating, low country rating, and non-availability of financial benefits (Verma & Agarwal, 2020; Bhatnagar & Sharma, 2022). Furthermore, it is observed that greenwashing is a critical factor for the slow growth of the country's green bond market (Prajapati et al., 2021).

Apart from the varied evidence on green bonds, there requires proper documentation about green bond issuance in consideration with suitable green bond attributes before the issuance. Additionally, the readability of well-governed documentation on green bond issuance also obtains huge importance for the faster expansion of this market. To this end, academicians highlighted future work in the green finance domain to address various issues (Zhang et al., 2019; Tao et al., 2022). Since the green bond is coming in a greater way, further work on green bonds from a developing market's perspective is required (Kumar et al., 2022). Though India is showing a noticeable interest in green bonds, the research on this realm is sparse. In addition, there exists a knowledge deficit about the country's green bond market that made existing and potential market participants less inclined toward this new emerging market (Abhilash et al., 2023). Moreover, the Indian green bond market is in the infancy stage, which requires proper research work to draw the attention of all investors in the economy (Prajapati et al., 2021). To date, no empirical study has been conducted on the factors that influence Indian green bond yield. However, the role played by green bond attributes with 'green features' in affecting the bond yield cannot be denied.

The green bond yield serves as a benchmark for bond performance to attract all existing and potential market participants (Gruber & Kamin, 2012; Bag, 2020). It helps in investment decisions on the one hand, and on the other hand, it leads to the success of green projects (Gün & Kutlu, 2021). Green bond with varying features in terms of bond attributes showed a huge impact on their yield. It is observed that bond tenure, issue size, bond ratings, and Environmental, Social, and Governance scores influence the green bond yield (Baldi & Pandimiglio, 2022). It is also proved that coupon, bond maturity, credit rating, market liquidity, and macroeconomic factors drive the green bond yield (Grishunin et al., 2023). Interestingly, the maturity, issue size, currency, and liquidity of green bonds showed negligible effects on bond yield (Febi et al., 2018; Hachenberg & Schiereck, 2019). In addition, the bond certification in the form of a label also accounted for a significant effect on the bond yield (Simeth, 2022). Further, it was uncovered that the bond yields depend on green projects such as "renewable energy, energy efficiency, clean transportation, green buildings, sustainable water management, and sustainable waste management" (Russo et al., 2021). Therefore, the main purpose of the study is to examine the impact of bond attributes on green bond yield. Thus, based on the theoretical background and literature support, the study framed the hypotheses as follows:

H1: Bond maturity has a significant effect on green bond yield.

H2: Issue size has a significant effect on green bond yield.

H3: Green label has a significant negative effect on green bond yield.

H4: Bond ratings have a significant positive effect on green bond yield.

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2. METHOD

To examine the impact of bond attributes on green bond yield, the study employs the regression method. The data for corporate green bonds are retrieved from the Bloomberg database. As the first green bond issuance started in 2015 in India, the sample period was included between 2015 and 2022. The study has selected all green bonds in the database and accordingly gathered the data related to all the variables except the label. The description for each variable is provided in Table 1. The data were confined only to corporate green bonds where the newly issued green bonds by the Government and the Municipal Corporation were discarded. Further, the data for the variable 'label' were collected from the Climate Bonds Initiative database, which provides a comprehensive framework on green bond issuance in terms of green bond monitoring, reporting, and compliance with climate bond standard taxonomy (Hyun et al., 2020). In the final sample, the study included only corporate green bonds with confirmed 180 observations. The study dataset contains unbalanced panel data for analysis.

The panel regression is used in the study to overcome the issue of heterogeneity and unobserved effects (Su & Tokmakçıoğlu, 2023). The panel regression is of great importance over the Ordinary Least Square due to its ability to handle heterogeneity and to observe the effects, which are unable to capture via "time series" or "cross-sectional" regression method (Hsiao, 2014). To select the appropriate regression method between the fixed effect model and the random effect model, the study performed the Hausman test, which revealed that the random effect model (Generalized Least Square) is appropriate (Hausman, 1978). Hence, the study deploys panel regression technique with a random effect model to investigate the effects of bond attributes on green bond yield. The equations of the base model, and the constructed models are shown in equations (1) and (2).

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it}, \quad (1)$$

$$\begin{aligned} Bond\ Yield_{it} &= \alpha + \beta_1 maturity_{it} + \\ &+ \beta_2 issue\ size_{it} + \beta_3 bond\ ratings_{it} + \\ &+ \beta_4 label_{it} + \beta_5 interest\ rate_i + \\ &+ \beta_6 \sec tor_{it} + \varepsilon_{it}. \end{aligned} \quad (2)$$

In the model, Y_{it} is bond yield, which is the dependent variable, where i represents i^{th} bond return, t indicates trading days, α is constant, and β is the regression coefficient. The four main bond attributes such as maturity, issue size, bond ratings, and label are independent variables, and interest rate, and sector are control variables, and ε_{it} is an error term.

Table 1. Variable descriptions

Variable	Descriptions
Yield to maturity	The long-term yield of each bond from the date of issuance to its maturity
Maturity	Number of years the bond is supposed to last from its inception till the end
Issue size	Natural logarithms of bond issuance amount as on the issue date
Ratings	A dummy is equal to 1 if the bond obtains ratings from a rating agency such as S&P, Moody's, otherwise 0
Label	A dummy is equal to 1 if the bond is certified by the certification authority, otherwise 0
Interest rate	The risk-free interest rate of government bonds issued by the treasure of the country
Sector	A Dummy is equal to 1 if the issuing sector belongs to the manufacturing sector (industrial goods, consumer goods). Otherwise, 0, if the issuing sector belongs to the service sector (financial, utility, telecommunication, and energy)

3. RESULTS

The study employed the panel regression technique to analyze the impact of bond attributes on green bond yield. The study used the EViews software for the analysis. To detect problems such as heteroskedasticity and autocorrelation, the study performed certain diagnostic and specification tests. It was understood from the result of the Breusch-Pagan test and Durbin-Watson tests that there are problems in the obtained results.

Table 2. Variance inflation factor

Variable	Variance Inflation Factor
Maturity	3.430
Issue size	1.697
Label	3.200
Rating	1.559
Interest rate	1.464
Sector	1.346

Table 2 depicts the Variance Inflation Factor results in which the considered variables have a value less than 5. This suggests that there is no mul-

ticollinearity problem in the dataset. To correct the heteroskedasticity and serial correlation problem in the results, the study also performed robust covariance matrix estimation i.e., Sandwich Estimation. This estimate helps in obtaining efficient least square estimators with appropriate statistics and thereby gives unbiased results (Parker, 2018; Barua & Chiesa, 2019). Therefore, the study obtained the final results after applying "Arellano-robust-standard-error-estimation" (Arellano, 1987), which confirms that the obtained results are reliable and accurate (Neogi & Ghosh, 2023).

Table 3. Summary statistics

Variable	Mean	Median	Std. dev.	Min	Max
YTM	6.34	7.26	2.33	1.67	12.3
Maturity	6.09	6.00	3.29	1.00	18.0
Issue size	23.1	23.0	1.02	21.7	24.3
Label	0.956	1.00	0.207	0.000	1.00
Rating	0.644	1.00	0.480	0.000	1.00
Interest rate	1.54	1.62	0.295	1.14	2.12
Sector	0.933	1.00	0.250	0.000	1.00

Table 3 shows the descriptive summary of bond attributes. It is observed that on average green bond offers 6.34% of return for bondholders, which is relatively better and important to attract both existing and potential investors towards this green investment tool. Table 4 depicts regression results in terms of bond attributes and their impact on green bond yield. The obtained results demonstrate interesting facts about the impact of green bond attributes on its yield. The first hypothesis (*H1*) predicted that bond maturity has a significant effect on bond yield. The result delineates a significant effect with a negative coefficient (= –0.327296, $p < 0.05$) at a 1% significance level. It is noted that the bond with longer maturity offers a lower yield. This finding implies that the 1% change in bond maturity lowers bond yield by 32%. Thus, the study findings support the framed first hypothesis (*H1*).

The second hypothesis (*H2*) predicted that issue size has a remarkable influence on bond yield. The result shows a non-significant effect with a negative coefficient (= –0.162306). Hence, the study rejects hypothesis 2. However, due to the negative coefficient, it is observed that the issuance size of green bond leads to a change in the bond yield. It further understood that the higher the issuance amount, the lower the bond yield. As the bond issuance amount gets bigger, this results in a lower yield for investors.

The third hypothesis (*H3*) predicted that certification in the form of a label has a significant effect on bond yield. The result demonstrates a significant effect with a negative coefficient (= –3.16480, $p < 0.05$) at a 5% level of significance. It is found that the labelled green bond offers a lower yield than a non-labelled green bond. The coefficient value indicates that any change in bond label leads to a change in green bond yield to the extent of 3.16%. In other words, as the cost of green bond issuance increases due to its certification, the bond yield tends to decline. Thus, the study findings support the hypothesis 3.

Table 4. Regression results showing the impact of bond attributes on green bond yield

Variable	Coefficient	Std. Error	Z value	Hypothesis
constant	7.65185	13.3653	0.5725	–
Maturity	–0.327296***	0.0282808	–11.57	Accepted
Issue size	–0.162306	0.479281	–0.3386	Rejected
Label	–3.16480**	1.33391	–2.373	Accepted
Rating	2.80926***	1.04454	2.689	Accepted
Interest rate	3.71429***	0.612723	6.062	–
Sector	–0.260967	1.18823	–0.2196	–
Mean dependent variance	6.342472		–	
S.D. dependent variance	2.331348		–	
Sum squared residual	242.1729		–	
S.E. of regression	1.179745		–	
Adjusted R squared	0.776593		–	
F statistic	104.7050		–	
Prob (F- statistic)	0.000000		–	

Note: *** and ** represent 1% and 5% significance levels, respectively.

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The fourth hypothesis (*H4*) predicted that bond ratings have a remarkable influence on bond yield. The finding reveals a significant effect of bond ratings with a positive (= 2.80926, $p < 0.05$) coefficient at a 1% significance level. It is observed that the bond with good ratings provides a higher return as compared to non-rated bonds. The coefficient value indicates that the 1% change in bond ratings leads to an increase in the bond yield around 2.80%. Further, it is understood that rated bonds play a crucial role in offering attractive returns to investors. Thus, the finding strongly supports hypothesis 4. Overall, the results of adjusted R-squared values show 77%. Therefore, this implies that about 77% variability in the green bond yield could be explained by the bond attributes considered in the study.

4. DISCUSSION

The growing importance of sustainability across the globe led researchers to delve into the green bond market. However, scholarly work on the green bond, especially in the Indian context, is lacking. To set out this knowledge gap, this study attempted to examine the impact of bond attributes on green bond yield. To do so, the study considered the major determinants in terms of bond attributes. Akin to this, the findings revealed interesting facts about green bond yield.

The findings of the first hypothesis (*H1*) clearly showed that the maturity of the bond has a significant negative effect on green bond yield. This finding is in line with Baldi and Pandimiglio (2022) who opine that green bond investors agreed to receive a lower return due to their increased concerns over the green project construction for a longer period. Since the green bond use-of-proceeds are ringfenced for the construction of green projects such as renewable energy, energy efficiency, and many others, the bond maturity tends to be aligned with the tenure of green project development.

Moving to the second hypothesis (*H2*), even though it is found that the issue size has a negative coefficient on bond yield, the result is insignificant. This finding is in contrast with the study by Baldi and Pandimiglio (2022). The findings of the third hypothesis (*H3*) showed that there is a remarkable influence of bond certification on green bond yield in the form of label with a negative effect. This finding is consistent with Braga (2020) who also found a negative effect of label on green bond interest cost. As the bond gets certified by the concerned authority, this signals the bond issuance and thereby increases information symmetry and credibility in the market. In addition, the labelled green bond increases the greenness information in the market, which creates a huge demand for green bonds, resulting in lower yields. Further, the label in the form of certification plays a vital role in the market. The issuers highlight the greenness of the bond where investors could easily be informed about the green features of the bond.

As far as the findings are concerned with the fourth hypothesis (*H4*), it is depicted that there is a strong positive influence of bond ratings on green bond yield. This finding is in line with Ziebart and Reiter (1992) and Baldi and Pandimiglio (2022), who showed the direct impact of bond ratings on bond yield. As the bond gets rated by the rating agencies, it continued to offer higher yields. The high bond ratings indicate a borrower's ability to repay the debt, and vice versa. With the increasing issues such as default risk in the markets, investors tend to focus on bond ratings as it is one of the main attributes to judge the collateral of the security. In addition, as the green bond market is a new phenomenon in the country, due to the lack of proper proxy measures to decide the bond creditworthiness, investors give priority to bond ratings. Furthermore, the ratings act as a main element of guarantee in terms of a timely provider of increased benefits to the investors.

CONCLUSION

The study aimed to analyze the impact of bond attributes on green bond yield with the main goal of motivating major market participants, particularly issuers and investors. By conducting an empirical investigation, the study demonstrated that the bond rating increases the yield, whereas the label and bond maturity cause the reduction of bond yield for bondholders.

The findings strongly highlight that good-rated green bonds continue to offer higher yields, whereas the bond featured with the label alongside longer maturity provides a lower yield. Hence, the study concludes that the green bond should be rated with good ratings so that profit-seeking investors would benefit from this tool. Furthermore, green bonds should also be issued with green labels having long tenure to attain the environmental objectives as expected by ethical investors. Therefore, the study strongly recommends that issuers and policymakers should focus on the green bond framework, as well as on bond attributes prior to the bond issuance in the market to attain the objective of environmental benefits without causing financial damage to the bondholders.

Since this study examined the impact of bond attributes on corporate green bond yield with considered variables based on their data availability, future research could consider other types of green bonds such as Sovereign green bonds and Municipal green bonds with multiple factors to increase awareness of the country's green bonds and help the nation to move from a fuel-based country to a greener economy.

AUTHOR CONTRIBUTIONS

Conceptualization: Abhilash Abhilash, Sandeep S. Shenoy, Dasharathraj K. Shetty.
Data curation: Abhilash Abhilash, Dasharathraj K. Shetty.
Formal analysis: Abhilash Abhilash, Sandeep S. Shenoy, Dasharathraj K. Shetty.
Funding acquisition: Abhilash Abhilash, Sandeep S. Shenoy.
Investigation: Abhilash Abhilash, Sandeep S. Shenoy, Dasharathraj K. Shetty.
Methodology: Abhilash Abhilash, Sandeep S. Shenoy, Dasharathraj K. Shetty.
Project administration: Sandeep S. Shenoy, Dasharathraj K. Shetty.
Resources: Abhilash Abhilash, Sandeep S. Shenoy, Dasharathraj K. Shetty, Aditi N. Kamath.
Software: Abhilash Abhilash.
Supervision: Sandeep S. Shenoy, Dasharathraj K. Shetty.
Validation: Sandeep S. Shenoy, Dasharathraj K. Shetty, Aditi N. Kamath.
Visualization: Sandeep S. Shenoy, Dasharathraj K. Shetty, Aditi N. Kamath.
Writing – original draft: Abhilash Abhilash, Sandeep S. Shenoy, Dasharathraj K. Shetty.
Writing – review & editing: Abhilash Abhilash, Sandeep S. Shenoy, Dasharathraj K. Shetty, Aditi N. Kamath.

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