





“Factors influencing green bond yield: Evidence from Asia and Latin American countries”

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# FACTORS INFLUENCING GREEN BOND YIELD: EVIDENCE FROM ASIA AND LATIN AMERICAN COUNTRIES

## Abstract

Despite numerous studies in the domain of green bonds, a paucity of literature concentrates on emerging countries' green bonds. To fill this void, this study aims to examine the factors influencing green bond yield in the Asian and Latin American contexts. The data are compiled from the Bloomberg and Fred databases between 2017 and 2022. The panel regression with the Generalized Least Square method was employed. The results reveal that Asian green bonds provide higher yields with less risk to their investors than Latin American green bonds. The regression results of Asian green bonds show negligible effects of all factors, except coupon rate with a positive effect ( $\beta = 0.844$ ), indicating its remarkable influence on green bond yield. However, the findings of Latin American green bonds uncover that coupon ( $\beta = 0.780$ ), maturity ( $\beta = 0.025$ ), and bond rate ( $\beta = 2.472$ ) surpass the green bonds yield due to their positive effects, whereas issue size ( $\beta = -1.215$ ) causes a reduction in the green bonds yield with their negative effect. Further, Environmental, Social, and Governance disclosure shows a positive ( $\beta = 1.611$ ) effect, indicating better yield for investors due to their potential power to vanish greenwashing in these markets. Moreover, interest rate and GDP exert significant positive ( $\beta = 0.141$ ) and negative ( $\beta = -0.030$ ) effects on green bond yield, respectively. This observation implies that higher lending rates increase bond yield, whereas GDP-led growth provides lower yield due to better economic prospects and high investor demand for the bonds.

## Keywords

sustainability, green bond, bond yield, emerging countries, panel regression

## JEL Classification

Q56, G12, C33

## INTRODUCTION

The increasing problems of climate change necessitated all countries across the globe to maintain an eco-friendly economy. It has been opined that just a transition is critical to achieving climate goals, wherein finance plays a pivotal role in making a transition happen by prioritizing a "Net Zero Emission" target globally (UNFCCC, 2023). Henceforth, with the severe threats of climate change, green bonds as a new asset class have emerged from green finance (Su et al., 2023). Green bonds are fixed-income yield securities whose proceeds are utilized for sustainable projects.

Though green bonds offer good returns and ensure better environmental benefits to their investors, currently, institutional investors are the top buyers of green bonds. As green bond investors are the main drivers of this new asset tool, a greater number of retail investors along with institutional investors need to evolve in this market segment. With this view, the influence of multiple factors particularly, bond-specific factors, company-specific factors, and macro-economic factors on GB yield needs to be the focal point of discussion to stimulate potential as well as existing investors towards this market.

# 1. LITERATURE REVIEW AND HYPOTHESES

The growing importance of a sustainable economy propelled the researchers to emphasize the studies on green bonds globally. The literature concerned with green bonds mostly showed the nexus between green bonds and financial markets. A pioneering study in this field showed higher volatility in the “labeled” green bonds (Pham, 2016). Henceforth, this piece of work motivated many academicians and scholars to go deeper into this field.

Strong spillover between green bonds and the oil market in the short run shows portfolio benefits in the long run (Yousaf et al., 2024). Conversely, the volatility spillover of green bonds to renewable energy and crypto markets indicates a better diversification avenue in the short run (Yadav et al., 2023). Further evidence showed a lower spillover from clean energy to green bonds, indicating better portfolio benefits for their investors (Chen et al., 2023). Some suggested an equi-correlation between green and conventional assets such as green, precious metals, and cryptocurrency during a market downturn. However, there is a hedging provision for metals and cryptocurrencies, highlighting the portfolio benefits for investors (Naeem et al., 2023). Similar evidence was found in the case of green bonds and shale and natural gas in the U.S., indicating diversification benefits to their investors (Abakah et al., 2023). Against the variations in gas, industrial metals, and agricultural commodities, a green bond is termed a better hedging option (Naeem et al., 2021). To be specific, less volatility and better risk-return performance in terms of the Sharpe ratio were accounted for by green bonds. The evidence proved that green bond protects investors in terms of better return with less volatility by stabilizing huge oil and business fluctuations (Lichtenberger et al., 2022; Sohag et al., 2022).

The studies delved into stock market reactions post green bonds announcement witnessed a positive response from the equity markets, which highlighted the green bonds issuance as a signal of the issuing company indicating their environmental commitments (Roslen et al., 2017; Tang & Zhang, 2020). As green bonds share similar characteristics in terms of bond attributes, scholars al-

so delved into the investigation of “greenium:” the difference between green bonds and conventional bond returns to investors (Huynh et al., 2022; Lau et al., 2022). Despite the evidence of positive and negative greenium existence, the recent finding showed that greenium only existed in the primary market and not in the secondary markets (MacAskill et al., 2021).

Given the potential impact of various factors on green bond yield, the studies also delved into the realm of green bonds to examine bond attribute impact as well as macroeconomic factor impact. In this way, bond maturity, types of issuers, country rating, and market-wide factors highly influenced the yield of green bonds at the time of bond issuance in the markets. It was also documented that bond-specific factors significantly affect bond yield globally (Baldi & Pandimiglio, 2022; Braga, 2020). The country-level study also supported this evidence by delineating the green bond attribute effect on the green bond yield, indicating the influence of bond characteristics on green bond returns (Abhilash et al., 2023).

There is growing interest in the impact of ESG criteria on corporate performance. The studies between ESG and corporate financial performance started in the 1970s. It has been exerted that the performance of corporate bonds positively correlated with the bond’s ESG score (Polbennikov et al., 2016). Governance score disclosure of a firm has significantly affected corporate financial performance, followed by their social and environmental score disclosure (Xie et al., 2019). A review study on bond performance revealed that the demand for green bonds is led by the bond’s ESG reputation (Braga, 2020). Despite the different opinions on the part of various studies, the association with ESG disclosure, policy adoption, and corporate performance offers a wide variety of privileges to all parties (Tolliver et al., 2021). Further study succeeded in establishing a strong positive relationship between bond yield and a company’s orientation toward transparency and sustainability in terms of social and environmental performance (Russo et al., 2021).

Macroeconomic factors are fundamental factors that play a crucial role in the financial market. Bandholz et al. (2009) studied the traditional

bond market to determine to what extent macroeconomic factors influence the bond yield performance in the US bond market. They claimed that the development of US bond yield was led by several macroeconomic and structural factors. Moving to green bonds literature, previous studies have rarely focused on the presence of the significant effect of macroeconomic factors on green bond performance. The structural equation model-based quantitative study showed that stock market capitalization and trade openness have a significant positive effect on green bond issuance (Tolliver et al., 2020) and the efficient monetary policy of a country, the official interest rate of bond has induced the supply of green bonds (Tu et al., 2020). Siswanto (2018) also opined that the performance of green Sukuk bonds has come down due to unstable macroeconomic factors.

Though emerging countries are defined as fast-growing economies with the main intention of enhancing global economic development, studies on green bonds from emerging countries have focused on the factors influencing their green bond market growth and development. The development of green bonds is palpable only in developed and some emerging countries. The issuance of green bonds shows the highest growth and maturity in emerging markets (Chiesa & Barua, 2019). Though the issuance of green bonds accounted for positive reactions in these markets, green bond development is palpable only in developed countries (Lebelle et al., 2020). In the context of the emerging market green bonds index, only 9% of the weightage is maintained (Amundi & IFC, 2021). Moreover, the size and scope of the green bonds are limited, and the full potential has not been utilized yet. So far, only limited companies and institutions from several countries have issued green bonds (CBI, 2020).

Though the concept of green bonds is a hot topic across the world (Kila, 2020), only a handful of studies have been conducted on green bonds, examining certain factors and their impact on bond performance as proxied by bond yield. Focusing on green bond characteristics among Asia Pacific, Europe, and North American regions, Taghizadeh-Hesary et al. (2021) revealed that Asian green bonds share a high risk-return profile along with higher heterogeneity than the other

regions. Grishunin et al. (2023) investigated the green bond yield determinants in the European regions and delineated that various bond factors and macroeconomic factors determine the bond yield in these regions. Moreover, the study urged a strong need for future studies in the context of emerging countries' green bonds. Therefore, to understand the factors influencing green bond yield, particularly from the emerging perspective, this study aims to investigate the impact of the variables considered on emerging countries' green bond performance. The following hypotheses are elaborated on:

- H1: *The coupon rate of the bond has a significant effect on the green bond yield.*
- H2: *The maturity of the bond has a significant effect on the green bond yield.*
- H3: *The issue size of the bond has a significant effect on the green bond yield.*
- H4: *The bond rating has a significant effect on the green bond yield.*
- H5: *The issuer's ESG performance disclosure has a significant effect on green bond yield.*
- H6: *GDP has a significant effect on green bond yield.*
- H7: *Interest rates have a significant effect on green bond yield.*

## 2. METHODOLOGY

Since the study emphasizes emerging countries' green bonds, the report on emerging countries' green bond issuance was referred to and accordingly listed the top green bond issuing countries (Amundi & IFC, 2021). Though the list includes more than 43 countries, only a few countries' green bonds are actively trading. Henceforth, based on data availability, the study finally chose five countries for the sample: China, India, Chile, Mexico, and Brazil. The study used Bloomberg to retrieve data for GB-specific factors, and company-specific variables. The Fred database is used to gather data for macroeconomic factors. The sample ranges

from 2017 to 2022. To examine the green bonds performance in different markets, the sample was segregated into Latin American (Brazil, Mexico, and Chile) and Asian (China and India) regions.

As the study focuses on a major impacting factor on green bond yield, it employs the regression method. The Pooled Ordinary Least Square (OLS) is of no use due to heterogeneity issues across the different groups. To overcome this issue, the panel regression has great advantages over OLS regression (Su & Tokmakçioğlu, 2023). Moreover, panel regression is of great importance over the OLS as it enables the handling of heterogeneity and the observation of effects that cannot be captured via time series or cross-sectional regression analysis (Hsiao, 2014). The presence of a time-invariant variable disallows the usage of a fixed effect (FE) model. Further, adding FE and other dummies causes collinearity issues in the model (Taghizadeh-Hesary et al., 2021). Therefore, the study considers panel regression with the random effect (Generalized Least Square) method as used by Hachenberg and Schiereck (2018). Therefore, the study employs panel regression techniques with a GLS technique to investigate the effects of major determinants on bond yield. The following equation specifies the functional relationship among the variables:

$$GB\ YTM = f \left( \begin{matrix} \text{Bond factors,} \\ \text{company – specific factors,} \\ \text{macroeconomic factors,} \\ \text{controls} \end{matrix} \right). \quad (1)$$

The study begins by illustrating the regression model for the main purpose of investigating the impact of bond attributes, company factors, and macroeconomic factors on bond performance. In the model, the Yield to Maturity (YTM) is the regressand, and the bond-specific factors such as a coupon, maturity, issue size, bond rating, ESG disclosure, and macro-economic factors such as GDP, and interest are the main explanatory variables. However, D/E ratio, total assets, and sector are treated as the control variables in the model.

Based on the above regression technique, the equation for testing the framed hypotheses is as follows:

$$\begin{aligned} GB\ YTM_{it} = & \alpha + \beta_1 coupon_{it} \\ & + \beta_2 maturity_{it} + \beta_3 issue\ size_{it} \\ & + \beta_4 bond\ rate_{it} + \beta_4 ESG\ disclosure_{it} \\ & + \beta_5 GDP_{it} + \beta_6 interest_{it} + \beta_7 \frac{D}{E} ratio_{it} \\ & + \beta_8 Total\ assets_{it} + \beta_9 sector_{it} + \mu_{it}, \end{aligned} \quad (2)$$

where  $\alpha$  represents constant,  $\beta$  is the regression coefficient for all explanatory variables, and  $\mu$  is an error term. The coupon, maturity, issue size, bond rate, ESG disclosure, GDP, and interest are explanatory variables, and D/E ratio, total assets, and sectors are control variables (Table 1).

**Table 1.** Description of variables included in the study

Variable	Descriptions
Yield to Maturity	Long-term yield to maturity of bonds from the date of issuance to its maturity
Coupon	The coupon rate of each bond shows a fixed rate of return
Maturity	Number of years the bond is supposed to exist
Issue size	The Log issuance amount of each bond
Bond rate	A dummy variable equals 1 if the bond is rated by a rating agency such as S&P or Moody's; otherwise, 0
ESG disclosure	The dummy variable equals 1 if the issuer discloses ESG-oriented performance
GDP	The GDP growth rate prevailing in the markets
Interest rate	The interest rates prevailing in the markets
D/E Ratio	Debt to equity ratio of the bond issuing company
Total assets	The Log of total assets of the issuing company in dollar
Sector	A dummy is equal to 1 if the green bonds issuer belongs to the manufacturing sector (such as "industrial goods or consumer goods"); otherwise 0 if the issuer sector belongs to the service sector (such as "financial, utility, telecommunication, and energy")

### 3. RESULTS

The employed model depicted the impact of bond-specific factors, company-specific factors, and macroeconomic factors on yield. However, these results showed heteroskedasticity and autocorrelation in the obtained findings. Therefore, to obtain unbiased results, the study ran certain diagnostic tests, and the results revealed no problems. Study



variables are free from the collinearity problem as the considered variables' VIF values are less than 10 (Chatterjee & Price, 1991), as shown in Tables 2 and 3. Thus, the obtained results in the final model after applying "Arellano-robust-standard-error-estimation" are reliable and more accurate (Arellano, 1987; Neogi & Ghosh, 2022). It is noted that the considered method is a "goodness-of-fit" by adjusted  $R^2$  values.

**Table 2.** Variance inflation factor values for Asia

Variable	Variance Inflation Factor
Coupon	1.739
Maturity	1.232
Issue size	1.725
ESG	2.077
GDP	1.022
Interest rate	1.522
Total Assets	1.995
D/E Ratio	1.645
Sector	1.793

**Table 3.** Variance inflation factor values for Latin America

Variable	Variance Inflation Factor
Coupon	3.731
Maturity	3.922
Issue size	2.407
Bond rate	8.795
ESG	3.599
GDP	1.110
Interest rate	1.268
Total Assets	2.248
D/E Ratio	1.550
Sector	4.287

Table 4 shows the summary statistics on considered variables in the study. Latin American green bonds offer a better return with greater risk than

**Table 4.** Summary statistics

Variable	Mean (Asia)	Mean (Latin A)	Median (Asia)	Median (Latin A)	S.D. (Asia)	S.D. (Latin A)	Min (Asia)	Min (Latin A)	Max (Asia)	Max (Latin A)
YTM	4.18	5.06	3.61	4.82	1.79	2.06	1.05	1.95	9.50	11.1
Coupon	4.13	4.38	3.70	4.38	1.61	1.52	1.13	1.85	8.95	9.13
Maturity	3.38	10.8	3.00	6.50	1.85	14.6	1.00	2.00	9.00	60.0
Issue size	23.0	23.6	23.1	24.1	0.728	0.847	21.7	21.3	24.8	24.7
Bond rate	0.000	0.500	0.000	0.500	0.000	0.502	0.000	0.000	0.000	1.00
ESG	0.264	0.737	0.000	1.00	0.441	0.442	0.000	0.000	1.00	1.00
GDP	5.52	1.51	4.80	1.48	5.56	4.16	-21.9	-13.0	22.1	12.4
Interest rate	3.10	5.66	2.91	4.29	0.656	4.39	2.33	0.000	6.38	13.7
Total Assets	10.1	9.61	10.2	9.04	1.79	2.25	4.84	6.19	15.6	18.2
D/E Ratio	99.5	87.1	98.1	52.9	51.9	74.6	0.000	16.0	278.	388.
Sector	0.368	0.632	0.000	1.000	0.483	0.484	0.000	0.000	1.00	1.000

Asian green bonds. In addition, Latin American green bonds are witnessed for larger issue sizes, high coupon rates, and longer maturity compared to Asian green bonds. However, investors are less likely to suffer from green bonds due to green bond returns with less risk in the case of Asia.

**Table 5.** Regression results of factors influencing green bonds yield in Asia

Variable	Coefficient	Std. Error	p-value
constant	-5.969	4.291	0.164
Coupon	0.844***	0.047	< 0.0001
Maturity	-0.050	0.088	0.567
Issue size	0.238	0.196	0.224
ESG	0.339	0.323	0.294
GDP	0.011	0.008	0.178
Interest rate	0.343	0.253	0.176
Total Assets	0.007	0.068	0.911
D/E Ratio	0.000	0.003	0.904
Sector	-0.138	0.296	0.641
Observations	309	—	—
Adj $R^2$	0.40	—	—

Note: \*\*\* represents a significance level at 1%.

Table 5 depicts the regression result on the impact of various factors on the yield of Asian green bonds. The first hypothesis concerned with coupon rate and its effect on bond yield shows a positive coefficient (0.844). It indicates that a 1% change in coupon rate leads to a change in bond yield to the extent of 84%. Thus, hypothesis 1 is accepted.

The hypothesis concerned with bond maturity and its effect on bond yield shows a negative coefficient (-0.050) but it is insignificant. The hypothesis concerned with issue size and its effect on bond yield shows a positive coefficient (0.238) but it is insignificant. The finding concerned the company's ESG

**Table 6.** Regression results of factors influencing green bonds yield in Latin America

Variable	Coefficient	Std. Error	p-value
constant	24.844*	13.615	0.068
Coupon	0.780***	0.179	< 0.0001
Maturity	0.025*	0.014	0.080
Issue size	-1.215**	0.568	0.032
Bond rate	2.472***	0.437	< 0.0001
ESG	1.611***	0.236	< 0.0001
GDP	-0.030**	0.012	0.013
Interest rate	0.141***	0.025	< 0.0001
Total Assets	0.180***	0.061	0.003
D/E Ratio	0.003	0.002	0.138
Sector	-0.041	0.180	0.819
Observations	152	—	—
Adj R <sup>2</sup>	0.66	—	—

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

activities, and its disclosure shows a positive coefficient (0.339) but it is insignificant. Similarly, the findings on macroeconomic factors, such as GDP and interest rates, also show a positive coefficient (0.011 and 0.343) but it is insignificant, respectively. Overall, the adjusted  $R^2$  value shows 0.40. This implies that 40% of variations in the Asian bond yield could be explained by the variables considered in the study.

Table 6 shows the regression results on the impact of various factors on Latin American green bonds yield. The first hypothesis concerned with coupon rate shows a positive coefficient (0.780). It implies that a 1% change in the coupon rate leads to a change in bond yield to the extent of 78%. The findings concerned with maturity show a positive coefficient (0.025). It indicates that a 1% change in the tenure of a bond leads to a change in bond yield by 2%. The findings concerned with the issue size effect show a negative coefficient (-1.215). It implies that the higher the issue size, the lower the yield. The result concerned with the bond rate shows a positive coefficient (2.472). It indicates that the rated bonds yield a higher return than non-rated bonds. The findings concerned with the issuer's ESG activities and its disclosure show a positive coefficient (1.611). It is observed that ESG reporting firms yield a better return to their investors than non-ESG reporting firms. In addition, the findings on the GDP effect on bond yield show a negative coefficient (-0.030). It is likely noted that the higher the economic growth of a country, the lower the yield. Conversely, the interest rate shows a positive coefficient (0.141). This

implies that the higher the lending rates, the better the returns. Overall, the adjusted  $R^2$  value shows 0.66. This indicates that 66% of yield variations in Latin American regions could be explained by the variables considered.

## 4. DISCUSSION

The study intended to examine the major factors affecting emerging countries' green bond yield. The results on the effects of tri-dimensional factors on green bond yield revealed mixed findings. The findings showed a positive effect of coupon rate on bond yield. It is likely that bonds attached with high coupon rates yield better returns for bondholders in the Asian region.

The remarkable influence of coupon rates could be due to investors' increased preference for coupon rates while investing in green bonds (Birzhanova et al., 2024). The bond maturity showed a negative effect on bond yield, although it was insignificant. This finding is in tandem with Taghizadeh-Hesary et al. (2021). It is noted that the longer the bond tenure, the lower the yield. This could be due to the construction of green projects in the long run, particularly in this region. On the contrary, the issue size showed an insignificant effect with a positive sign. This could be interpreted as the larger bond issuance volume lowers the yield. These findings confirm that banking sectors dominate the Asian financial markets, which leads to an impact on the characteristics of green bonds (Taghizadeh-Hesary et al., 2021). As a result, the

bond yield tends to be affected by other factors in this region. Moreover, the issuer's ESG orientation and its disclosure revealed an insignificant effect on bond yield. As opined by Tolliver et al. (2021), ESG disclosure is lacking in the Asian region, which needs to be disseminated in the financial reporting to provide the necessary information about the firm's non-financial aspects. Furthermore, the results of macroeconomic variables showed no effect on bond yield. This could be due to other factors, such as institutional factors and market conditions, which are prevailing in this region.

In the wave of findings, the results concerned with Latin American regions accounted for interesting key takeaways. The findings showed a positive effect of coupon rate on bond yield. It is likely that bonds attached with high coupon rates yield a better return for bondholders in the Latin American region. The findings of maturity show a significant positive effect. This finding is similar to Taghizadeh-Hesary et al. (2021), who showed the favorable effect of maturity on bond returns. Similarly, the bond ratings accounted for positive effects. The finding is in line with Abhilash et al. (2023). It is worth noting that the rated bonds having longer tenure yield better returns for bondholders in these markets since the bond rating acts as collateral in the bond market. Hence, the investors continue to benefit from the invested bond. Conversely, the issue size demonstrated a negative effect on bond yield. It is observed that the larger the bond issued, the lower the returns. Since the bond funds are deployed for green project devel-

opment, a huge amount of issued green bonds would continue to be utilized for sustainable activities. As a result, the bonds lead to lower yields to the investors.

The findings about the company's ESG activities and disclosure delineated a significant positive effect on bond yield. This finding is similar to Russo et al. (2021). The company's orientation toward ESG activities tends to increase the bond yield. The result is further supported by the signaling theory, which indicates that as the companies disseminate the required information to all their stakeholders, the information asymmetry in the markets is reduced. As issuers disseminate their non-financial-oriented information to all stakeholders, the bond yield tends to go up. Further, it also helps issuers manage the issuance of green bonds.

The findings on macroeconomic factor, namely GDP, depicted a negative effect. This finding is contrary to Gruishin et al. (2023). Since the GDP is recognized as an economic growth indicator in any country, it leads to a better economic prospect and high demand for bonds. Hence, the bond yield tends to decrease due to better economic growth and prospects in the market. On the contrary, the interest rate showed a positive significant effect. This finding is in line with Bandholz et al. (2009), who showed a similar effect of interest rate on bond yield. It symbolizes that an increase in interest rate leads to an increase in bond yield. This observation underscores the role of monetary policy and arbitrage in influencing bond yield.

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## CONCLUSION

The study aimed to examine the impact of tri-dimensional factors on the yield of Asian and Latin American green bonds. The results demonstrated mixed results regarding the impact of bond factors, company ESG-oriented activities, and macroeconomic factors on the yield of green bonds.

Since Asian green bonds do not account for any significant effect on their yield, investors, issuers, and policymakers are suggested to consider the various plausible factors, such as country-specific and institutional factors, before green bond issuance to provide better returns to their investors. Given the lower risk and better returns in the Asian green bonds, it implies the more matured green bonds market in this region than in the Latin American region.

Since the result uncovered the significant influence of bond-specific factors on its yield in the Latin American region, issuers and policymakers need to prioritize the green bonds frameworks and bond



attributes before issuing green bonds in this region. It is highly suggested that both potential as well as existing investors align with green bond attributes to reap the maximum benefits. While the results of issuers' oriented activities and their disclosure exert a favorable influence on bond performance, the study urges the green bond issuers to disclose their ESG-oriented activities to all stakeholders, which also reduces the information asymmetry in the markets. In addition, investors need to be aware of market conditions due to the influence of macroeconomic factors on bond yield. Overall, the study concludes that the various plausible factors examined in the study need to be considered as the influencers of green bond yield. As a result, the new green bond issuance will take place exponentially, and the bondholders will benefit financially. Other stakeholders, such as issuers and the general public, will obtain environmental benefits from green bonds, leading to environmental sustainability.

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