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Towards environmentally responsible finance: How ESG and carbon efficiency shape green bond allocation in Asian firms

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Abstract: The accelerating environmental challenges in Asia have heightened the urgency for sustainable financing mechanisms that can balance economic growth with environmental preservation. Green bonds have emerged as a key financial instrument to mobilize capital for low-carbon and environmentally responsible projects. This study empirically examines the effect of Environmental, Social, and Governance (ESG) performance on the proportion of green bond issuance among publicly listed firms in Asia from 2019 to 2023. Using 177 firm-year observations, this research also examines the moderating role of firm size in the relationship between ESG performance and green bond issuance. The empirical results show that ESG performance has a significant negative impact on the proportion of green bonds issued. Furthermore, firm size negatively moderates the relationship between ESG performance and green bond issuance. Theoretically, this study contributes to the integration of signaling theory and capital structure in the context of sustainable finance in emerging Asian markets. The findings provide valuable insights for policymakers, regulators, and investors to design more targeted incentives and improve disclosure standards that encourage green financing among firms of different sizes and ESG maturity levels, while supporting a framework that enhances transparency, accountability, and inclusiveness in Asia's transition to a green economy.

Keywords: *Carbon efficiency, ESG performance, Firm size, Green bond, Signaling theory, Sustainable finance.*

1. Introduction

In recent years, sustainability has become a central concern of the global economy, with climate change emerging as one of the most pressing environmental challenges. The Asian region, home to several of the world's fastest-growing economies, faces severe ecological threats such as rising temperatures, melting glaciers, flooding in coastal areas, and deteriorating air and water quality. For instance, temperatures in Mitribah, Kuwait, reached 54°C in 2016, the highest ever recorded in Asia [1], while melting ice in Greenland contributed 532 billion tons of water to global sea level rise in 2019 [2]. Coastal cities such as Jakarta are projected to experience severe submergence by 2050 without adequate mitigation [3]. These environmental crises underscore the urgency of shifting toward sustainable development and environmentally responsible financial practices.

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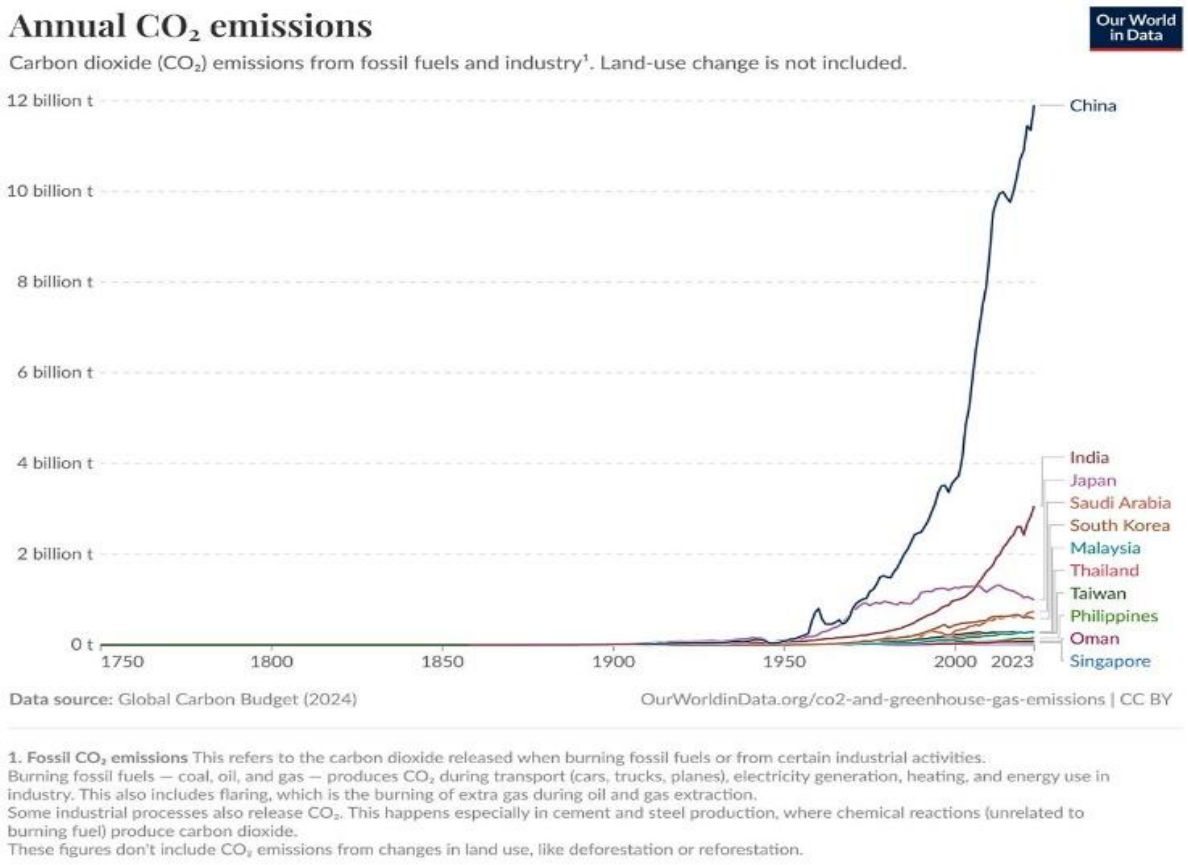

Figure 1.
CO_2 Emission Growth in Asia.
Source: Ritchie Hannah and Roser Max [4].

The rapid industrialization and urbanization in Asia have intensified carbon emissions and waste generation. China's annual CO_2 emissions tripled between 2000 and 2020, reaching more than 10 billion tons [4]. Industries such as fast fashion, which produce over 4 billion tons of CO_2 and 92 million tons of textile waste annually, further exacerbate the ecological imbalance [5, 6]. Waste recycling markets are growing but remain insufficient to offset increasing consumption and production [7]. Consequently, Asian economies face the dual challenge of maintaining growth while reducing environmental degradation.

In response to these global concerns, the Paris Agreement and the Sustainable Development Goals (SDGs) have established frameworks for countries to pursue low-carbon growth through mechanisms such as the Green Climate Fund and Climate Investment Funds [8]. Among the key instruments supporting this transition is the green bond, a financing tool dedicated to environmentally sustainable projects such as renewable energy, low-carbon transportation, and resource efficiency [9]. Global green bond issuance exceeded USD 575 billion in 2023 and reached USD 622 billion in 2024, representing an annual increase of around 8% [10, 11]. Asia has emerged as one of the fastest-growing regions for green finance, with issuance reaching USD 640 billion in 2024, driven largely by China, India, and ASEAN markets [12]. Nevertheless, disparities persist between Asian and ASEAN markets due to differences in market infrastructure, regulation, and investor awareness [13].

Despite this promising growth, several barriers hinder green bond market expansion in Asia, including inconsistent disclosure standards, limited investor knowledge, and high certification costs

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[14]. The establishment of the ASEAN Green Bond Standards in 2017 and their revision in 2018 have enhanced market transparency by aligning with the International Capital Market Association's Green Bond Principles [15]. These frameworks aim to promote investor confidence and prevent "greenwashing," yet implementation remains uneven across countries. The heterogeneity of regulation, firm size, and ESG performance among Asian companies calls for further empirical analysis of the determinants influencing green bond issuance.

Environmental, Social, and Governance (ESG) performance has become a crucial non-financial indicator used by investors and regulators to assess corporate sustainability and financing quality [16]. High ESG scores are often associated with improved reputation, lower capital costs, and greater investor trust, which may increase a firm's likelihood of issuing green bonds [17, 18]. Previous studies suggest that firms with higher ESG ratings demonstrate superior environmental responsibility and transparency, leading to enhanced financial stability and long-term value creation [19, 20]. However, evidence from emerging Asian markets remains mixed. While some studies find a positive relationship between ESG performance and green bond issuance [21], others reveal that ESG is often used symbolically to enhance legitimacy rather than to drive real financing decisions [22, 23].

Furthermore, firm characteristics, particularly firm size may influence this relationship. Large firms possess greater financial capacity, established reputation, and broader access to capital markets, making them more capable of issuing certified green bonds and bearing associated costs [24, 25]. Firm size can also act as a moderating factor, amplifying or reducing the strength of ESG's impact on green bond financing. For example, larger firms tend to achieve stronger market reactions and cumulative abnormal returns following green bond announcements [26], suggesting that investors perceive them as more credible in their sustainability commitments.

While the green bond market in Asia has expanded rapidly, most prior empirical studies focus on total issuance value rather than the proportion of green bonds within the firm's capital structure [17, 27]. This study addresses that gap by examining the green bond proportion, the ratio of green bonds issued to total assets, as a more precise indicator of how firms integrate sustainable financing into their funding decisions. By analyzing ESG scores as the main explanatory variable and firm size as a moderator, this study provides a nuanced understanding of how corporate sustainability practices influence financing strategies in emerging Asian markets.

This study employs secondary data from the Refinitiv database, covering 177 firm-year observations of publicly listed companies in 11 Asian countries (China, India, Japan, Korea, Malaysia, Oman, Philippines, Saudi Arabia, Singapore, Taiwan, and Thailand) during the period between 2019 and 2023.

This study contributes to the development of Signal Theory by placing it in the context of green finance and empirically demonstrating that the effectiveness of financial signaling mechanisms depends on a company's sustainability reputation. Contrary to the traditional assumption of Signal Theory, which states that high-quality companies send positive signals through high-cost instruments such as green bonds, the results of this study reveal a negative relationship between ESG performance and the proportion of green bond issuance. These findings indicate that companies with strong ESG reputations do not rely on green bonds as an additional signal to demonstrate their commitment to sustainability.

This research provides empirical evidence that the effectiveness of green bond signals depends on the credibility of a firm's ESG reputation. Companies with high ESG performance already have strong reputational capital, which serves as a credible signal to the market, making additional signaling through green bonds redundant or even financially inefficient. This insight expands the boundaries of Signaling Theory by showing that the common assumption that high-quality companies use costly signals may not hold in all contexts. Therefore, this research broadens the application of Signaling Theory from developed markets, where green bonds operate as positive signals, to emerging markets with more diverse regulatory frameworks and incentive mechanisms.

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2. Literature Review

2.1. Green Bond

Green bonds are debt-based financial instruments designed to finance projects that generate direct environmental benefits. According to Krystian and Sam [28], a green bond refers to a fixed-income security issued to raise funds for environmentally responsible projects, assets, or enterprises. Typical green projects include renewable energy, energy efficiency, low-carbon transportation, waste management, and natural resource conservation [29]. Since their introduction by the World Bank in 2008, green bonds have evolved rapidly and become one of the central mechanisms for sustainable finance [30].

Green bonds have gained strong appeal among institutional investors because they offer opportunities for environmentally sustainable investments without necessarily sacrificing returns [31]. As an integral part of environmental finance, green bonds represent a bridge between corporate environmental strategy and financial markets. Measuring the proportion of green bonds relative to total assets allows for a more consistent alignment with capital structure theory, which emphasizes financing ratios over absolute funding levels [32, 33]. Hence, the green bond proportion reflects not merely the absolute issuance of green bonds but rather the extent to which green financing is embedded within a firm's overall capital structure [17, 34].

To ensure that green bonds deliver genuine environmental outcomes and avoid the risk of greenwashing, clear and standardized regulatory frameworks are essential [35]. In Asia, green taxonomies have been developed to classify and define environmentally sustainable economic activities, but they remain highly diverse across countries. Many Asian jurisdictions adopt voluntary rather than mandatory disclosure mechanisms, in contrast to the European Union's binding approach, raising concerns about the effectiveness of these frameworks in curbing greenwashing [36].

A well-designed taxonomy can bring substantial benefits, including enhanced market clarity, increased investor confidence, and improved monitoring and tracking of sustainable financial flows [37]. For example, the Monetary Authority of Singapore (MAS) introduced its own green taxonomy to classify economic activities based on environmental impact and to help issuers and investors identify projects eligible for green financing. The MAS framework also provides incentives, such as subsidies for external verification costs, to encourage wider adoption of green bond issuance [38].

2.2. Hypothesis Development

2.2.1. ESG Score and Green Bond

The Environmental, Social, and Governance (ESG) score is a multidimensional indicator that reflects a firm's performance in managing environmental, social, and governance responsibilities [39]. It serves as a credibility metric of corporate sustainability and is increasingly recognized as an essential factor in long-term investment decisions, as investors become more aware of non-financial risks [40]. Firms with strong ESG performance are often perceived as more transparent, responsible, and resilient, making them attractive to investors who prioritize sustainability-oriented portfolios.

Green bonds, on the other hand, are debt instruments specifically issued to finance projects that generate positive environmental outcomes, such as renewable energy, energy efficiency, and waste management. Their issuance follows internationally recognized standards such as the International Capital Market Association (ICMA) Green Bond Principles and the Climate Bonds Initiative (CBI), which emphasize transparency and accountability in fund allocation [41]. Green bonds are found to positively influence stock prices and market confidence because they signal the firm's commitment to sustainability and responsible investment [42].

Within the framework of Signaling Theory, ESG performance functions as an external signal through which firms communicate their environmental commitment and effective risk management to investors and stakeholders. High ESG scores are interpreted as signals of good governance, social responsibility, and environmental awareness, enhancing market confidence and reducing information asymmetry [43]. However, Liu et al. [44] argue that green bond issuance itself can act as a substitute

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environmental signal, particularly for firms with lower ESG ratings that aim to improve their market perception. Conversely, firms with already high ESG scores may have less incentive to issue green bonds because their sustainability reputation is well established.

From the perspective of Capital Structure Theory, firms with superior ESG performance are typically associated with lower perceived risk and stronger reputations in the eyes of investors, enabling them to obtain financing at a lower cost of capital [45]. Following the logic of the Pecking Order Theory [46], financially strong firms prefer internal financing (e.g., retained earnings) over external debt issuance. Thus, highly rated ESG firms may rely less on green bonds, while firms with weaker ESG performance may issue green bonds to attract investor trust and enhance their legitimacy [31].

Although ESG has become a cornerstone of corporate sustainability assessment, a high ESG score does not necessarily correspond to a larger proportion of green bond issuance. Firms with strong ESG credentials often possess robust internal financing and long-term investor relationships, reducing their dependence on external sustainable debt [47]. In Asia, this dynamic is further complicated by inconsistent regulatory frameworks and non-harmonized ESG standards across countries. Sengupta et al. [48] note that regulatory asymmetry across Asian markets can heighten greenwashing risks and distort investor perceptions of green bonds. Empirical studies also show that some high-ESG firms deliberately avoid issuing green bonds to maintain financial independence and avoid increased scrutiny associated with "green-labeled" financing [23]. Similarly, Puspita and Hasnawati [49] find that firms with higher ESG scores may even face a higher cost of debt, reducing their incentive to issue green bonds. In addition, according to Tondang and Wedari [50], ESG disclosure has a greater influence on corporate dividend policy.

While many global studies report a positive relationship between ESG performance and green bond issuance, findings from Asian markets remain mixed. The relatively weaker regulatory enforcement and uneven investor awareness in developing Asian economies imply that ESG may not yet exert the same influence on sustainable financing decisions as in Europe or North America.

H_5: ESG has a negative impact on the proportion of green bonds.

2.2.2. Firm size and ESG score

Firm size plays an essential moderating role in the relationship between ESG performance and the proportion of green bonds. Large firms typically possess greater access to conventional financing sources, stronger reputations, and established stakeholder trust, enabling them to secure funding without relying heavily on green bonds, even when their ESG performance is high. In contrast, smaller firms with strong ESG credentials often utilize green bond issuance as a strategic signal to attract investors and enhance their market credibility. Wang and Wang [18] highlight that while ESG performance significantly promotes green bond issuance, this effect varies depending on firm-specific characteristics such as size. Similarly, Wang and Liu [51] find that smaller firms operating in industries with high environmental pressure are more motivated to use green bonds as part of their sustainable investment strategy.

From the perspective of Signaling Theory, small firms tend to issue green bonds as a visible commitment to sustainability, aiming to reduce information asymmetry and improve investor perception. Conversely, large firms that are already well recognized by the public do not need additional signaling because their reputations for sustainability are already established, Fatmala and Pertiwi [52]. Li et al. [53] further suggest that green bond issuance encourages green innovation, particularly among firms with limited reputational capital, supporting the idea that signaling through sustainable finance instruments is more critical for smaller firms. Feldhütter and Pedersen [54] also note that for large firms with substantial ESG investor support, capital structure considerations become less relevant, as their financing profiles already reflect long-term sustainability commitments.

Within the framework of Capital Structure Theory, larger firms generally benefit from stronger financial reputations, higher leverage capacity, and lower costs of capital, which reduce their dependence

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on green financing instruments. These firms can secure funding through traditional debt markets or internal financing channels without resorting to labeled green bonds to attract investors [55, 56]. In contrast, smaller firms face greater financing constraints and may rely on green bonds to enhance their market positioning and legitimacy in the eyes of sustainability-focused investors.

Empirical research reinforces this moderating perspective. Bolibok [57] reports an inverse relationship between firm size and ESG-related risk, suggesting that larger firms exhibit greater ESG stability and therefore less need for external sustainability signaling. Shakil [58] finds that firm size does not always strengthen the relationship between ESG and financial outcomes, while Hoang et al. [59] demonstrate that the impact of green bond proportion within capital structures is more significant among smaller firms. Vieira et al. [60] emphasize that ownership structure and firm size jointly moderate ESG's influence on financing decisions, whereas [61] argue that issuance size and corporate characteristics shape market reactions to green bonds, supporting the notion that smaller firms benefit more from signaling effects than large, well-established firms.

Therefore, firm size is expected to act as a moderating variable that weakens the relationship between ESG performance and green bond proportion, as large firms with robust financial and reputational capital are less dependent on additional sustainability signals.

H_2. Firm size weakens the influence of ESG on the proportion of green bonds.

3. Research Methodology

3.1. Sample and Data Collection

The population of this study consists of all publicly listed companies in the Asian region during the observation period from 2019 to 2023. Tables 1 and 2 present the final sample, which includes 172 observations representing 85 companies across 11 Asian countries, with no sectoral restrictions applied. The data were obtained from the Refinitiv Eikon database, a globally recognized provider of standardized financial and non-financial information.

Refinitiv Eikon was selected because it offers comprehensive and standardized ESG performance data, covering overall ESG scores and the three sub-dimensions (environmental, social, and governance pillars), as well as key financial indicators, including firm size (total assets), market ratio (price-to-book value), return on equity (ROE), interest coverage ratio (ICR), and details on green bond issuance. The data selection ensures consistency, comparability, and transparency across countries and industries, which is crucial for cross-country empirical studies in sustainable finance.

Table 1.
Number of countries.

Country	Number of Firms
China	71
India	3
Japan	24
Korea	22
Malaysia	13
Oman	4
Philippines	8
Saudi Arabia	1
Singapore	8
Taiwan	1
Thailand	17

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Table 2.
TRBC industry.

Country	Number of Firms
Bank	108
Coal	4
Commercial REITs	2
Computer Hardware	1
Construction and Engineering	5
Department Stores	1
Diversified Industrial Goods Wholesale	1
Diversified Investment Service	1
Electric Utilities	5
Food Processing	2
Food Retail and Distribution	5
Heavy Electrical Equipment	1
Highway and Rail Tracks	2
Independent Power Procedures	4
Investment Banking and Brokerage Services	5
Investment Holding Companies	1
Investment Management and Fund Operators	3
Life and Health Insurance	3
Medical Equipment, Supplies, and Distribution	1
Oil and Gas Refining and Marketing	6
Pharmaceuticals	3
Real Estate Rental, Development, and Operation	6
Wireless Telecommunication Services	2

3.2. Variables

Table 3 presents the operational variables in this study, which consist of independent, dependent, moderating, and control variables.

Table 3.
Variable definitions and measures.

Variable		Definition and Measure	Predicted
Dependent Variable	Green Bond Proportion	Ratio of total green bond issuance to total assets from Refinitiv.	
Explanatory Variable	ESG Score	Composite environmental, social, and governance score from Refinitiv.	-
Moderating Variable	Firm Size (Total Assets)	Firm size is measured as total assets from Refinitiv.	-
Control Variable	ASEANandNonASEAN	Dummy variable (1=ASEAN;0= NonASEAN)	-
	Market Ratio (PBV)	Market ratio measured as PBV from Refinitiv.	+
	ROE	Return on equity from Refinitiv.	+
	ICR	Interest coverage ratio from Refinitiv.	+

1. The dependent variable in this study is the Green Bond Proportion, measured as the ratio of the total amount of green bonds issued to total assets. This proportional approach reflects the extent to which green bonds are integrated into a company's capital structure rather than focusing solely on nominal issuance value [17, 34]. Previous research in Asian markets has employed similar proportional measures to capture the relative intensity of green financing within firms' funding portfolios.
2. The independent variable is ESG Score, as a comprehensive indicator of corporate sustainability performance. The standardized ESG scores ranging from 0 to 100, where higher scores indicate stronger ESG performance. The ESG Score reflects the company's ability to manage

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environmental risks, social responsibilities, and governance quality [43].

3. The moderating variable is Firm Size, measured by Total Assets.
4. This study includes several control variables to account for firm-specific and regional characteristics. The ASEAN/Non-ASEAN dummy variable controls for regional differences in regulatory frameworks and market maturity in sustainable finance [62]. The Market Ratio (PBV) represents investors' market valuation of a firm's equity, indicating growth potential and market confidence [63]. Return on Equity (ROE) measures profitability, reflecting a firm's ability to generate income from shareholders' investments [64]. Meanwhile, the Interest Coverage Ratio (ICR) represents the firm's debt-servicing capacity, which may influence its need for alternative financing sources such as green bonds [17].

3.3. Model Design

Figure 2 presents the research framework, showing the relationship between ESG Score and Green Bond Proportion, with Firm Size as the moderating variable and ASEANA/Non-ASEAN, Market Ratio, ROE, and ICR as control variables.

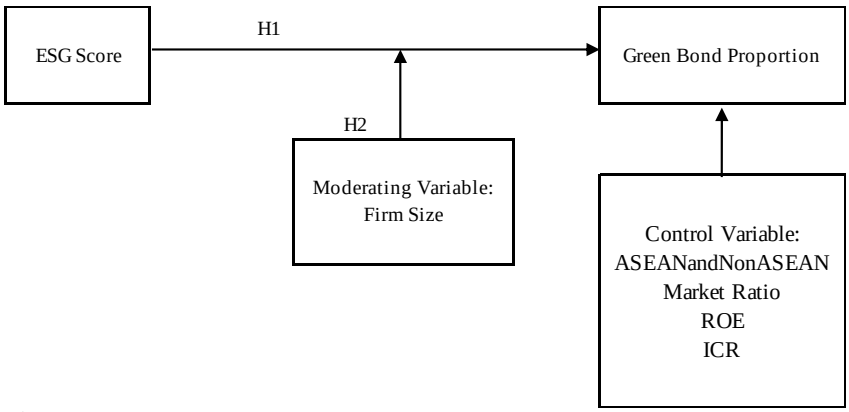

Figure 2.
Research Framework.

A panel regression model is employed to evaluate the impact of ESG performance and Firm size as a moderating variable on green bond proportions across Asian firms during the 2019-2023 period. To address potential heteroskedasticity and autocorrelation across firms, clustered standard errors at the firm level are applied.

$$GreenBondProportion_{it} = \beta_0 + \beta_1 ESG_{it} + \beta_2 FirmSize_{it} + \beta_3 (ESG_{it} + FirmSize_{it}) + \beta_4 \text{ASEANandNonASEAN}_{it} + \beta_5 \text{PBV}_{it} + \beta_6 \text{ROE}_{it} + \beta_7 \text{ICR}_{it} + \varepsilon_{it}$$

Information:

- $GreenBondProportion_{it}$ = Green bond Proportion
- ESG_{it} = Environmental, Social, Governance
- $FirmSize_{it}$ = Firm Size
- $\text{ASEANandNonASEAN}_{it}$ = ASEANandNonASEAN
- PBV_{it} = Price Book to Value
- ROE_{i} = Return on Equity
- ICR_{it} = Interest Coverage Ratio
- β_0 = Constant
- $\beta_1, \ldots \beta_7$ = Regression Coeficient
- ε = Error

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- i = Company
- t= Year

A random effects panel regression model is utilized to examine how ESG performance and Firm size as moderators affect the proportion of green bond issuance among Asian firms from 2019 to 2023, with firm-level clustered standard errors employed to correct for heteroskedasticity and autocorrelation.

4. Result

4.1. Descriptive Statistical Results

Table 4 presents the descriptive statistics of the variables used in this study. The results show that the average proportion of green bonds (Green Bond Proportion) is 0.010 (1%), indicating that the use of green bonds as a financing instrument among Asian listed firms remains relatively low. This finding suggests that green bonds have not yet become a primary component of corporate capital structures in the region. The Asian green bond market is still at a developmental stage compared with Europe or North America, where stronger regulatory frameworks and fiscal incentives have encouraged green financing [65]. Moreover, the relatively high issuance costs, stemming from the need for certification, reporting, and verification, discourage many firms from using this instrument and lead them to prefer conventional debt financing [17].

The average ESG Score is 59.11, slightly above the midpoint of 50, implying a moderate level of ESG compliance among firms in the sample. This result suggests that while most companies have begun to integrate ESG principles into their operations and governance, the overall commitment to sustainability remains in the developing stage rather than being fully institutionalized.

The Firm Size variable, measured by total assets, records an average value of USD 736,258 million, with a minimum of USD 543 million and a maximum of USD 5,620,000 million, reflecting wide variation in firm scale. Smaller firms represent entities with limited financial capacity, while larger firms possess stronger financial resources and broader access to external funding. Larger firms can also absorb the additional costs associated with green bond certification and verification. However, they may choose not to issue green bonds due to easier access to conventional bonds that are less complex and less costly. Therefore, differences in firm size play an important role in explaining variations in green financing strategies across Asian companies.

Table 4.
Descriptive statistics.

Variable	Obs.	Mean	Std.Dev	Min.	Max.
Green bond proportion	172	0.01	0.01	0.00	0.14
ESG score	172	59.11	19.02	19.32	91.91
Firm size (USD Million)	172	736.258	1.27	543	5.620.000
Market ratio (PBV)	172	1.15	2.02	0.14	18.78
ROE	172	4.44	5.47	0.01	18.08
ICR	172	12.48	42.25	0.07	291.36

Table 5 presents that 26.7% of the data observations are from ASEAN and 73.3% are from non-ASEAN countries. This significant difference in proportion makes it important to analyze further because the context of green bond policies, regulations, and market developments in the ASEAN region may differ from other Asian countries, so it will be tested further in a robustness check at the advanced analysis stage.

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Table 5.
ASEANandNonASEAN frequency.

Variable	Code	Number of Firms
ASEAN	1	46
NonASEAN	0	126
Total	N/A	172

4.2. Multicollinearity Test

The multicollinearity test was conducted to identify any strong linear relationships among the independent variables in the regression model. Table 6 presents the results of the Variance Inflation Factor (VIF) test, indicating that no multicollinearity issues exist.

Table 6.
Multicollinearity test results.

Variable	VIF	1/VIF
ESG score	1.62	0.619019
Firm size (Total Assets)	1.98	0.505293
ASEAN and NonASEAN	1.84	0.544562
Market ratio (PBV)	1.19	0.841117
ROE	1.95	0.513448
ICR	1.08	0.921939
Mean VIF	1.61	

4.3. Analysis Based on Random Effect Model Clustered Standard Error

Table 7 presents the model without interaction; the coefficient of ESG Score is –0.00 with a p-value of 0.55, suggesting that ESG Score has no significant effect on green bond proportion. Hence, **H1** is rejected. This finding implies that ESG performance does not play a decisive role in green financing decisions among Asian firms. The result does not support the trade-off theory of capital structure, which posits that firms balance the costs and benefits of debt instruments, including green bonds, to achieve an optimal capital mix.

The insignificant relationship may stem from the structural characteristics of Asian financial systems, which are predominantly bank-based and characterized by underdeveloped corporate bond markets [66]. As a result, firms face limited access to bond financing, including green bonds, as an alternative source of long-term funding. Although firms with strong ESG performance are expected to have greater incentives to issue green bonds aligned with sustainability strategies, the empirical evidence indicates that ESG is not yet a major factor in financing choices. High issuance and verification costs, immature market mechanisms, and limited fiscal incentives further reduce the financial attractiveness of green bonds [67].

The signal

ling theory also does not fully apply in the Asian context, primarily due to inconsistent ESG standards and the prevalence of greenwashing, which undermines investor trust [68]. The absence of standardized reporting reduces the credibility of ESG scores as reliable market signals, leading investors to rely more on traditional financial metrics.

Empirical studies in the literature remain inconclusive regarding the ESG to green bond nexus. Some, such as Flammer [17] and Tang and Zhang [31], report a positive relationship, suggesting that firms with strong ESG performance are more likely to issue green bonds to enhance credibility and lower their cost of capital. However, Gianfrate and Peri [45] and Fatica and Panzica [69] argue that firms with already strong ESG reputations are less inclined to issue green bonds, as they do not need additional signaling mechanisms.

To address this ambiguity, this study introduces Firm Size (Total Assets) as a moderating variable. The interaction model shows that ESG Score has a positive and significant effect on green bond proportion, with p-value = 0.04, while the interaction term ESG Score × Total Assets has a negative

and significant effect with p-value = 0.03. This indicates that firm size weakens the positive influence of ESG on green bond proportion, leading to the acceptance of H2.

Empirically, this finding suggests that larger firms, with greater financial resources and established reputations, are less dependent on ESG performance in deciding to issue green bonds. In contrast, small and medium-sized enterprises (SMEs) with limited resources tend to use ESG initiatives to strengthen their credibility and attract investors. In such cases, ESG acts as a credibility signal, particularly for firms lacking market recognition.

This aligns with Signaling Theory [70], which posits that firms use non-financial indicators, such as ESG disclosure to convey managerial quality and long-term prospects to the market. For investors, strong ESG signals reflect a firm's commitment to sustainability and its capacity to manage environmental and social risks. Hence, a higher green bond proportion represents a tangible manifestation of this signaling behavior.

The ASEAN and Non-ASEAN dummy variable results show p-values of 0.88 (without interaction) and 0.99 (with interaction), indicating no significant regional effect on green bond proportion in the full model.

Among the control variables, the Market Ratio (PBV) remains positively significant in both models with p-value = 0.00 and 0.00, indicating that firms with higher market valuations tend to allocate a larger share of green bonds in their capital structure. Meanwhile, ROE and ICR are statistically insignificant, suggesting that profitability and interest coverage do not materially influence green bond proportion among Asian firms.

Table 7.
REM with clustered standard error results.

	Without interaction		**With interaction**	
	coef	**p-val**	**coef**	**p-val**
ESG score	-0.00	0.55	0.00	0.04**
Firm Size (Total Asset)	-0.00	0.00***	0.00	0.59
ESG score x Total asset	N/A	N/A	-0.00	0.03**
ASEANandNonASEAN	0.00	0.88	-9.28	0.99
Market Ratio (PBV)	0.00	0.00***	0.00	0.00***
ROE	0.00	0.01**	0.00	0.14
ICR	0.00	0.34	0.00	0.26

Note: *,**,*** Correlation is significant at the p < 0.10, p<0.05, p<0.01.

4.4. Haussman Test

The Hausman test was conducted to determine the most appropriate panel data model between the Fixed Effect Model (FEM) and the Random Effect Model (REM). The test produced a Chi-square value of 8.96 with a p-value of 0.1108, which is higher than the 0.05 threshold. Therefore, the null hypothesis is not rejected, indicating that the REM is more suitable for this study. This result suggests no significant correlation between individual effects and independent variables, meaning that the REM assumptions are satisfied and the model effectively captures both cross-sectional and time-series variations.

4.5. Robustness Test

The purpose of this test is to ensure the consistency of results, particularly in assessing whether the effects of Market Ratio (PBV), ROE, and the interaction term 'ESG × Total Assets' remain significant when regional contexts are considered. This test also strengthens the external validity of the findings by examining whether the determinants of green bond dynamics differ between ASEANandNonASEAN firms.

Table 8 present ASEANandNonASEAN subsample. In ASEAN subsample, the ESG Score shows no significant effect on green bond proportion with p-value = 0.52, indicating that ESG performance has

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not yet become a major determinant of green financing decisions in the region. Conversely, in non-ASEAN markets, the ESG Score exhibits a significant negative relationship with green bond proportion, with p-value = 0.02. This divergence reflects differences in market maturity, policy enforcement, and the effectiveness of green finance frameworks across regions.

Firm Size (Total Assets) presents a significant negative effect in ASEAN countries with p-value = 0.04, implying that larger firms tend to rely on conventional financing due to lower issuance costs and simpler reporting requirements [71]. In contrast, the relationship is insignificant in non-ASEAN markets with p-value = 0.08, suggesting that company size does not play a major role in determining green bond issuance within more mature financial systems.

In the ASEAN region, the interaction term ESG Score × Total Assets is insignificant with p-value = 0.52, indicating that firm size does not influence the relationship between ESG performance and green bond proportion. This result reflects the heterogeneous level of ESG integration and the uneven implementation of sustainable finance policies across ASEAN countries, where ESG reporting standards remain in the developing stage [62].In contrast, within non-ASEAN markets, the interaction between ESG Score × Total Assets shows a significant negative effect with p-value = 0.01. This finding suggests that firms with higher ESG scores in developed Asian economies are less likely to rely on green bonds as a sustainability signal because their environmental credibility is already well established [17].

This difference can be explained by policy and institutional readiness. Non-ASEAN countries have taken proactive measures to build comprehensive green finance ecosystems. China has implemented a national Emissions Trading System (ETS) since 2021, making it the world's largest carbon market, initially covering the power generation sector [72]. Moreover, the Green Finance Committee China Society for Finance and Banking [73] provides clear project classifications and enhances transparency in green bond issuance [74]. South Korea launched the Korea Emissions Trading Scheme (K-ETS) in 2015, the first in East Asia, complemented by fiscal incentives and subsidies for companies investing in green technologies and demonstrating strong ESG performance [75]. Similarly, Japan introduced the Green Transformation (GX) Basic Policy in 2022, offering public financing and tax incentives to support the clean energy transition and corporate green bond issuance [76]. Taiwan also introduced the Taiwan Sustainable Taxonomy in December 2022 to define sustainable economic activities and improve market transparency in green financing. This was further strengthened through the Green Finance Action Plan 3.0, which expands governmental support for low-carbon transition by enhancing policy incentives, financial instruments, and the capacity of financial institutions [77].

In contrast, most ASEAN countries remain in the early stages of developing carbon and green finance policies. In Indonesia, incentives for green bond issuance are regulated under OJK Regulation No. 60/POJK.04/2017, which allows the Financial Services Authority to provide benefits for eligible issuers. However, these incentives remain optional and limited in scope, offering minimal fiscal or tax advantages to encourage private sector participation [78]. In addition, Indonesia's Financial Services Authority (OJK) has established an ESG regulatory framework and introduced green bond guidelines to facilitate the mobilization of sustainable financing, although these are not mandatory [79]. Malaysia announced the Voluntary Carbon Market (VCM) initiative in 2023, but with no direct fiscal incentives for green bond issuers [80]. Singapore is currently the only ASEAN country with a functioning carbon pricing system through the Singapore Government [81] with plans to raise the carbon tax to SGD 80 per ton CO_2e by 2030 [82].

These policy differences explain why the effect of ESG performance on green bond proportion is significant in non-ASEAN, but insignificant in ASEAN. Non-ASEAN countries exhibit stronger regulatory pressure, well-established carbon market mechanisms, and comprehensive fiscal incentives, which encourage firms to issue green instruments. As a result, ESG integration in financing decisions is more pronounced in these developed markets, supported by coherent national policies that facilitate the transition toward low-carbon economies [17, 65].

Meanwhile, in ASEAN, the green bond market remains nascent, characterized by uneven policy adoption and inconsistent ESG practices. The ASEAN Green Bond Standards, first introduced in 2018,

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are largely voluntary and applied inconsistently across member countries [62]. Under such conditions, ESG performance has yet to serve as a strong signal for investors due to limited data availability, weak transparency, and insufficient regulatory incentives. Consequently, both issuers and investors in ASEAN continue to prioritize traditional financial considerations, such as profitability, liquidity, and cost of capital, over ESG factors when making green bond issuance decisions [55].

Table 8.
Subsample ASEANandNonASEAN.

	ASEAN		NonASEAN	
	coef	**p-val**	**coef**	**p-val**
ESG score	-0.00	0.52	0.00	**0.02****
Firm Size (Total Asset)	-0.02	**0.04****	0.13	**0.08***
ESG score x Total asset	0.00	0.52	-0.00	**0.01****
Market Ratio (PBV)	-0.00	**0.01****	0.00	**0.09***
ROE	0.16	**0.00*****	0.00	**0.29**
ICR	-0.00	**0.00*****	0.00	**0.22**

Note: *,**,*** Correlation is significant at the $p < 0.10$, $p<0.05$, $p<0.01$.

5. Conclusion and Limitation

This study aims to examine the effect of ESG performance on the proportion of green bonds, with firm size (total assets) as a moderating variable in the context of Asian capital markets during 2019 - 2023. Using panel data from Refinitiv Eikon, the empirical findings reveal that the ESG score does not have a significant direct effect on green bond proportion, leading to the rejection of **H1**. This suggests that a high ESG rating is not a key determinant in corporate green financing decisions. Instead, funding choices appear to be more influenced by traditional financial factors, such as profitability, leverage, and national market policies, rather than sustainability performance. Firms with strong ESG reputations tend to rely on internal financing and do not necessarily need to issue green bonds as an additional sustainability signal.

Conversely, the moderating analysis confirms that firm size significantly weakens the relationship between ESG performance and green bond proportion, supporting **H2**. The positive influence of ESG on green bond issuance is stronger among smaller firms but diminishes among larger firms. Large firms already possess established reputations and greater access to low-cost capital, reducing their need for external signaling through green bonds.

When comparing sub-samples between ASEAN and non-ASEAN firms, ESG performance remains insignificant across both regions, influencing green bond proportion. However, the moderating effect of firm size differs in ASEAN markets; firm size does not significantly moderate the ESG, green bond relationship, while in non-ASEAN markets (Japan, South Korea, and China), firm size negatively moderates this relationship. This reflects the maturity of green finance frameworks and higher market liquidity in non-ASEAN economies. In such markets, large firms no longer depend on green bonds for signaling sustainability since their ESG reputation and disclosure practices are already well institutionalized. In contrast, ASEAN markets are still developing their green finance ecosystems, resulting in weaker institutional pressure to link ESG performance with green financing.

From a theoretical standpoint, these findings indicate that classical capital structure theories, particularly the trade-off and pecking order models, may not fully apply in the Asian sustainable finance context. ESG performance does not directly influence green bond proportion, but its interaction with firm size becomes significant and negative. This implies that corporate decisions regarding green bond issuance are shaped not only by sustainability performance but also by the firm's financial capacity and market reputation. Large, financially stable firms with high ESG performance tend to rely on internal capital sources, while smaller firms use green bonds strategically to strengthen their legitimacy and investor appeal.

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This study extends the literature on sustainable finance by demonstrating regional heterogeneity in the adoption of green bonds across Asia, driven by differences in regulation, ESG standardization, and market maturity. The findings suggest that policymakers and regulators should enhance incentives, transparency, and standardization of ESG disclosure to strengthen the link between ESG performance and green financing instruments. This can help accelerate the integration of sustainability into corporate funding strategies.

From a practical perspective, the results highlight the need for differentiated policy approaches between large and small firms. For smaller companies, improving ESG performance can serve as an effective strategy to attract green financing. For larger firms, policy incentives should instead emphasize measurable environmental impact reporting and standardized disclosure frameworks to maintain credibility and stimulate sustainable market growth.

The main limitation of this study lies in its restricted observation period (2019-2023) and sample size, which includes only firms that issued green bonds during that timeframe. Future research should expand the data coverage and extend the observation period beyond five years to capture evolving market dynamics, policy changes, and the full impact of recent frameworks such as the ASEAN Taxonomy for Sustainable Finance and the ISSB Sustainability Standards.

The results of this study provide several important policy implications for strengthening the effectiveness of green bonds as sustainable financing instruments in Asia. The negative relationship between ESG performance and the proportion of green bond issuance indicates that firms with strong ESG reputations do not automatically increase their use of green bonds. This finding suggests that the Asian green finance market has not yet developed a fully supportive regulatory ecosystem that makes green bonds an attractive and efficient financing option for companies with strong sustainability performance.

To address this gap, regulators and policy institutions such as the Financial Services Authority (OJK), the Asian Development Bank (ADB), and the ASEAN Green Bond Standards Secretariat should enhance policy coordination to improve both incentives and credibility in the green bond market. First, fiscal incentives, such as tax reductions or lower certification costs, should be introduced to reduce the financial burden of green bond issuance, making it a more appealing financing alternative for ESG-strong firms. Second, harmonized regional standards on ESG disclosure and green taxonomy are necessary to ensure comparability, transparency, and the credibility of sustainability signals across markets. Third, strengthening verification mechanisms and disclosure transparency regarding the use of proceeds can minimize reputational costs and investor uncertainty, thereby improving market confidence in green bonds. By improving regulatory alignment and incentive structures, these measures can enhance the strategic role of green bonds as an integral component of sustainable financing, accelerating Asia's transition toward a low-carbon economy and more resilient capital markets.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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References

[1] Skip Derra, "WMO verifies third and fourth hottest temperatures recorded on Earth. Arizona State University," 2019. https://surl.li/jammlz. [Accessed May 24, 2025]

[2] J. Mouginot *et al.*, "Forty-six years of Greenland Ice Sheet mass balance from 1972 to 2018," *Proceedings of the National Academy of Sciences*, vol. 116, no. 19, pp. 9239-9244, 2019. https://doi.org/10.1073/pnas.190424211

[3] Douglas Broom, "Around the world, these are just some of the cities at risk of rising sea levels," 2021. https://surl.li/ghbknl. [Accessed May 23, 2025]

[4] Ritchie Hannah and Roser Max, "CO_2 emissions. Our World In Data, Jun," 2020. https://surl.li/byugbe. [Accessed May 10, 2025]

[5] P. Centobelli, S. Abbate, S. P. Nadeem, and J. A. Garza-Reyes, "Slowing the fast fashion industry: An all-round perspective," *Current Opinion in Green and Sustainable Chemistry*, vol. 38, p. 100684, 2022. https://doi.org/10.1016/j.cogsc.2022.100684

[6] Lawson Abelvik Helle, "How fast fashion fuels climate change, plastic pollution, and violence. Green Peace," 2023. https://surl.lu/ryayib. [Accessed May 10, 2025]

[7] S. Nikolina, "Environmental impact of textile and clothes industry," 2019. https://surl.lu/txfltt. [Accessed Nov. 14, 2025]

[8] United Nation, "Key aspects of the Paris Agreement," 2018. https://surl.li/qlgfht. [Accessed Jun. 13, 2025]

[9] J. Piñeiro-Chousa, M. Á. López-Cabarcos, J. Caby, and A. Šević, "The influence of investor sentiment on the green bond market," *Technological Forecasting and Social Change*, vol. 162, p. 120351, 2021. https://doi.org/10.1016/j.techfore.2020.120351

[10] Bloomberg Professional Services, "Global regulatory brief: Green finance, March edition," 2024. https://surl.li/txtceh. [Accessed Jun. 13, 2025]

[11] S&P Global, "Sustainability insights: Global sustainable bond issuance to hold steady at $1 Trillion in 2025. S&P Global," 2025. https://surl.li/rjpcxo. [Accessed May 24, 2025]

[12] ICMA, "The Asian international bond markets: Issuance trends and dynamics," 2025. https://surl.li/hpdnof. [Accessed Nov. 14, 2025]

[13] S&P Global, "Sustainability insights: Sustainable bond outlook 2025: Asia- pacific issuance could hit record high," 2025. https://surl.li/vrncwo. [Accessed Apr. 29, 2025]

[14] Backer McKenzie, "Critical challenges facing the greenbond market. International Financial Law Review," 2019. https://surl.li/xfxigl. [Accessed Nov. 14, 2025]

[15] ACMF, "ASEAN green bond standart," 2018. https://surl.li/ikzgfk. [Accessed Nov. 14, 2025]

[16] A. Melinda and R. Wardhani, *The effect of environmental, social, governance, and controversies on firms' value: evidence from Asia. In Advanced issues in the economics of emerging markets*. Emerald Publishing Limited, 2020.

[17] C. Flammer, "Corporate green bonds," *Journal of Financial Economics*, vol. 142, no. 2, pp. 499-516, 2021. https://doi.org/10.1016/j.jfineco.2021.01.010

[18] S. Wang and D. Wang, "Exploring the relationship between ESG performance and green bond issuance," *Frontiers in Public Health*, vol. 10, p. 897577, 2022. https://doi.org/10.3389/fpubh.2022.897577

[19] C. J. García, B. Herrero, J. L. Miralles-Quirós, and M. del Mar Miralles-Quirós, "Exploring the determinants of corporate green bond issuance and its environmental implication: The role of corporate board," *Technological Forecasting and Social Change*, vol. 189, p. 122379, 2023. https://doi.org/10.1016/j.techfore.2023.122379

[20] J. Wu, W. Raghupathi, and V. Raghupathi, "An exploratory study of the association between green bond features and ESG performance," *Sustainability*, vol. 17, no. 5, p. 2094, 2025. https://doi.org/10.3390/su17052094

[21] A. Biju, A. Alora, A. Sasidharan, and A. Kallany, "Investigating the factors determining green bond issuance in emerging markets: Emphasizing the direct and moderating role of board characteristics and ESG performance," *Corporate Ownership & Control*, vol. 21, no. 4, pp. 60-74, 2024. https://doi.org/10.22495/cocv21i4art6

[22] D. Zhou and A. Kythreotis, "Why issue green bonds? Examining their dual impact on environmental protection and economic benefits," *Humanities and Social Sciences Communications*, vol. 11, p. 1761, 2024. https://doi.org/10.1057/s41599-024-04318-1

[23] Njuafac and Muoshuo Donatus, "Do Green Equity issuers perform better than Green Bonds Issuers? A comparative analysis of environmental and financial performance," 2024. https://surli.cc/xfxfgf. [Accessed Nov. 14, 2025]

[24] E. Tri Wahyuni, T. Santoso, Z. Azhar, P. Sihotang, and N. Fajriati, "The determinants of green bond issuers: Does sustainability reporting matter?," 2024. https://surl.lt/rbpjir. [Accessed Nov. 14, 2025]

[25] S. S. Nithin, Kumari and P. R. Chowdhury, "A look at how climate bonds can help emerging markets grow their economy-an analysis based on newly industrialised countries (NICs)," *International Journal of Advances in Business and Management Research*, vol. 2, no. 4, pp. 10-18, 2025. https://doi.org/10.62674/ijabmr.2025.v2i04.002

[26] R. Pietrzyk and P. Węgrzyn, "The value of being green: Assessing the impact of green bond issuance on stock prices of European listed companies," 2025. https://surl.li/cnfwhc. [Accessed Nov. 14, 2025]

[27] M. Immel, B. Hachenberg, F. Kiesel, and D. Schiereck, "Green bonds: shades of green and brown," *Journal of Asset Management*, vol. 22, no. 2, pp. 96-109, 2021. https://doi.org/10.1057/s41260-020-00192-z

[28] C. Krystian and S. Sam, "Green bonds: An introduction and legal considerations," 2016. https://surl.li/rbguua. [Accessed Jul. 12, 2025]
[29] S. Dai, H. Yu, F. Aiya, and B. Yang, "Green bonds and sustainable development: theoretical model and empirical evidence from Europe," *International Journal of Sustainable Development & World Ecology*, vol. 31, no. 6, pp. 668-683, 2024. https://doi.org/10.1080/13504509.2024.2325366
[30] M. U. Khurram, W. Xie, S. S. Mirza, and H. Tong, "Green bonds issuance, innovation performance, and corporate value: Empirical evidence from China," *Heliyon*, vol. 9, no. 4, p. e14895, 2023. https://doi.org/10.1016/j.heliyon.2023.e14895
[31] D. Y. Tang and Y. Zhang, "Do shareholders benefit from green bonds?," *Journal of Corporate Finance*, vol. 61, p. 101427, 2020. https://doi.org/10.1016/j.jcorpfin.2018.12.001
[32] F. Modigliani and M. H. Miller, "The cost of capital, corporation finance and the theory of investment," *The American Economic Review*, vol. 48, no. 3, pp. 261-297, 1958.
[33] S. C. Myers, "The capital structure puzzle," *Journal of Finance*, vol. 39, no. 3, pp. 574–592, 1984.
[34] B. Hachenberg and D. Schiereck, "Are green bonds priced differently from conventional bonds?," *Journal of Asset Management*, vol. 19, no. 6, pp. 371-383, 2018. https://doi.org/10.1057/s41260-018-0088-5
[35] N. Dahhou, S. Bahetta, S. Bouyghrissi, and O. Kharbouch, "Renewable energy, green finance, and economic growth in Morocco: Evidence from an ARDL approach," *International Journal of Energy Economics and Policy*, vol. 15, no. 3, p. 98, 2025. https://doi.org/10.32479/ijeep.18522
[36] Ramnath, "Sustainable finance in Asia: A comparative study of national taxonomies," 2024. https://surl.li/whddeg. [Accessed Nov. 14, 2025]
[37] OECD, *Developing sustainable finance definitions and taxonomies. in Green Finance and Investment*. Paris, France: OECD, 2020.
[38] Shook Lin & Bok, "Green bonds and the Singapore-Asia taxonomy of sustainable finance: the next level of ambition and credibility," 2025. https://surl.lt/gelztd. [Accessed Nov. 14, 2025]
[39] P. Ge, Y. Liu, C. Tang, and R. Zhu, "Green bonds and corporate Environmental social and governance performance: Innovative approaches to identifying greenwashing in green bond markets," *Corporate Social Responsibility and Environmental Management*, vol. 32, no. 1, pp. 1060-1078, 2025. https://doi.org/10.1002/csr.3005
[40] A. Vuokko and M. Vaihekoski, "Equity market reaction to green bond issuance announcement global empirical evidence of corporate green bonds in 2013-2021," 2023. https://surl.lu/woiqie
[41] Stefano Bresciani, "The market of green bonds," 2023. https://surli.cc/jtzari
[42] Teemu Tanner, "Effect of green bond issuance to stock prices," 2024. https://surl.li/poestl. [Accessed Nov. 14, 2025]
[43] A. Fatemi, M. Glaum, and S. Kaiser, "ESG performance and firm value: The moderating role of disclosure," *Global Finance Journal*, vol. 38, pp. 45-64, 2018. https://doi.org/10.1016/j.gfj.2017.03.001
[44] Y. Liu, Y. Li, and H. Chen, "The keywords in corporate social responsibility: A dictionary construction method based on MNIR," *Sustainability*, vol. 17, no. 6, p. 2528, 2025.
[45] G. Gianfrate and M. Peri, "The green advantage: Exploring the convenience of issuing green bonds," *Journal of Cleaner Production*, vol. 219, pp. 127-135, 2019.
[46] S. C. Myers and N. S. Majluf, "Corporate financing and investment decisions when firms have information that investors do not have," *Journal of Financial Economics*, vol. 13, no. 2, pp. 187-221, 1984.
[47] K. A. Wicaksono, "The impact of green bond issuance and ESG performance on firm profitability: Evidence from listed companies in China, South Korea and Thailand," *Cakrawala Repositori IMWI*, vol. 6, no. 6, pp. 2604-2628, 2023. https://doi.org/10.52851/cakrawala.v6i6.575
[48] R. Sengupta, A. Bhattacharjee, and K. Bhattacharjee, "Regulatory framework for green bonds: A comparative cross-country analysis," *IUP Journal of Accounting Research & Audit Practices*, vol. 24, no. 1, pp. 327–344, 2025. https://doi.org/10.71329/IUPJARAP/2025.24.1.327-344
[49] A. N. Puspita and S. Hasnawati, "The effect of ESG disclosure on cost of debt (an empirical study on manufacturing and energy sector companies listed on the Indonesia Stock Exchange in 2019–2023)," *Journal of Innovative and Creativity*, vol. 5, no. 2, 2025. https://doi.org/10.31004/joecy.v5i2.532
[50] R. D. R. Tondang and L. K. Wedari, "The influence of ESG disclosure, corporate governance, and financial performance on dividend policy in manufacturing companies listed on the Indonesia Stock Exchange (IDX) during 2018–2022," *Dinasti International Journal of Economics, Finance & Accounting*, vol. 6, no. 4, pp. 3270–3280, 2025. https://doi.org/10.38035/dijefa.v6i4.4802
[51] X. Wang and Q. Liu, "Information disclosure and ESG rating disagreement: Evidence from green bond issuance in China," *Pacific-Basin Finance Journal*, vol. 85, p. 102350, 2024.
[52] N. I. Fatmala and T. K. Pertiwi, "The effect of environmental social governance (ESG) disclosure and debt policy on firm value moderated by firm size," *East Asian Journal of Multidisciplinary Research*, vol. 4, no. 8, pp. 4151–4164, 2025. https://doi.org/10.55927/eajmr.v4i8.350
[53] C. Li, X. Cao, Z. Wang, J. Zhang, and H. Liu, "The impact of green bond issuance on corporate green innovation: A signaling perspective," *International Review of Financial Analysis*, vol. 102, p. 104113, 2025.

[54] P. Feldhütter and L. H. Pedersen, "Is capital structure irrelevant with ESG investors?," *The Review of Financial Studies*, vol. 38, no. 8, pp. 2362-2385, 2025. https://doi.org/10.2139/ssrn.4227547

[55] P. Wulandari and D. F. Istiqomah, "The effect of environmental, social, governance (esg) and capital structure on firm value: the role of firm size as a moderating variable," *Jurnal Riset Akuntansi Politala*, vol. 7, no. 2, pp. 307-324, 2024.

[56] Y. B. Adeneye, I. Kammoun, and S. N. A. Ab Wahab, "Capital structure and speed of adjustment: The impact of environmental, social and governance (ESG) performance," *Sustainability Accounting, Management and Policy Journal*, vol. 14, no. 5, pp. 945-977, 2023.

[57] P. M. Bolibok, "Does firm size matter for ESG risk? Cross-sectional evidence from the banking industry," *Sustainability*, vol. 16, no. 2, p. 679, 2024.

[58] M. H. Shakil, "Environmental, social and governance performance and stock price volatility: A moderating role of firm size," *Journal of Public Affairs*, vol. 22, no. 3, p. e2574, 2022.

[59] T.-H.-V. Hoang, R. BERROU, and L. Pham, "The impact of green bond issuance on firms' financial and esg performance: Does the proportion of green bonds matter?," *Available at SSRN 4227810*, 2022. https://doi.org/10.2139/ssrn.4227810

[60] E. S. Vieira, M. Madaleno, and M. E. Neves, "The moderating effect of family firms on the relationship between business sustainability and capital structure," *Journal of Family Business Management*, 2025. https://doi.org/10.1108/JFBM-03-2025-0064

[61] S. Patel and R. Desai, "Green bond issuance and investor response in an emerging economy: does COVID-19 and issue size moderate the stock market reaction?," *Macroeconomics and Finance in Emerging Market Economies*, pp. 1-20, 2025.

[62] Securities Commission Malaysia, "ASEAN capital markets forum: continuing to facilitate regional growth through sustainable, resilient and inter-connected capital markets," 2025. https://surl.lu/vkkvbl

[63] E. F. Brigham and J. F. Houston, "Fundamentals of financial management: Concise by Cengage," *Cengage Learning*, pp. 1-7, 2019.

[64] R. Moro Visconti, "Corporate profitability: Return on equity, return on investment, modigliani & miller proposition ii and economic value added," *SSRN Electronic Journal*, 2018. https://doi.org/10.2139/ssrn.3144286

[65] OECD, "Sustainable Finance in Asia: ESG and climate aligned investing and policy considerations," 2023. https://surl.li/hvxplj

[66] T. H. Ng and J. Y. Tao, "Bond financing for renewable energy in Asia," *Energy Policy*, vol. 95, pp. 509-517, 2016.

[67] A. H. Nguyen, T. G. Hoang, D. T. Nguyen, L. Q. T. Nguyen, and D. T. Doan, "The development of green bond in developing countries: insights from Southeast Asia market participants," *The European Journal of Development Research*, vol. 35, no. 1, p. 196, 2022. https://doi.org/10.1057/s41287-022-00515-3

[68] T. V. Nguyen, *Sustainable finance: The environmental, social, and governance (esg) contractual bargain: case study of vietnamese law. in green economic development and transition to low-carbon economy in the east and southeast Asia*. Singapore: Springer Nature Singapore, 2025.

[69] S. Fatica and R. Panzica, "Green bonds as a tool against climate change?," *Business Strategy and the Environment*, vol. 30, no. 5, pp. 2688-2701, 2021. https://doi.org/10.1002/bse.2771Digital

[70] M. Spence, "Job market signaling," *The Quarterly Journal of Economics*, vol. 87, no. 3, pp. 355–374, 1978.

[71] OECD, "ESG ratings and climate transition," 2022. https://surl.li/plfcoi

[72] International Energy Agency, "Enhancing China's ETS for carbon neutrality: Focus on power sector," 2022. https://surl.li/szuazd

[73] Green Finance Committee China Society for Finance and Banking, *Green Bond Endorsed project catalogue (2015 Edition)*. Beijing, China: People's Bank of China, 2015.

[74] CBI, "China green finance policy," 2021. https://surl.li/xcrvpj

[75] ICAP, "Korea emissions trading system," International Carbon Action Partnership, 2015. https://surl.lt/mrwenu

[76] GR Japan, "Japan GX plans," 2024. https://surl.lt/oirncb

[77] Taiwan Sustainable Taxonomy, "FSC, Jan," 2023. https://surl.li/wzerel

[78] Alchemist Group, "The existence of green bonds in Indonesia," 2025. https://surl.li/ciemcm

[79] N. Mishra and S. Grima, "A study of the impact of green banking practices on bank's environmental performance: An Indian perspective," *International Journal of Sustainable Development and Planning*, vol. 20, no. 4, pp. 1345–1355, 2025.

[80] P. E. Stek, T. Vasudhevan, and R. Lima-De-Oliveira, "Malaysia's new voluntary carbon market: Origins, ecosystem and prospects," 2023. https://surl.li/yvafxi

[81] Singapore Government, *Carbon pricing act (Chapter X, Singapore)*. Singapore: Ministry of Sustainability and the Environment, 2019.

[82] NEA, "Carbon tax national environment agency," 2025. https://surl.li/lqxwzn