Green Bonds, Environmental, Social, and Governance Scores, and the Greenwashing Puzzle: Insights from the ASEAN Region

Crecia Viona, Esthervany Anrika, Camilla Tiara Dewi, Fitriya Fauzi*

Finance Program, School of Accounting, Universitas Bina Nusantara, Indonesia. *Email: fitriya@binus.ac.id

ABSTRACT

This study examines the relationship between green bond issuance and the achievement of sustainability goals within the framework of corporate social responsibility (CSR) in the ASEAN region. With the increasing attention to environmental and social responsibility, where green bonds play as a strategic financial instrument, it is important to evaluate the effectiveness of green bonds in encouraging sustainability practices and identify potential greenwashing practices in the region. Covering the six ASEAN countries, namely Indonesia, Singapore, Malaysia, Thailand, Vietnam, and the Philippines, this study uses random-effect GLS regression and logistics results over the period 2019-2023. The result shows that green bond issuance helps increase the ESG score indirectly through the green financing project. With this, we also uncovered that a higher ESG score but a lower carbon emissions score does not define the probability of greenwashing itself. Higher ESG scores are proven to lower the probability of greenwashing, while the emissions score has no significant impact on the probability of greenwashing. Overall, this indicates that green bond issuance really does help increase ESG score, making it a great strategic tool for both the environment and the firm's green financing. With this, we can rely on the ESG score to identify greenwashing practices for firms that issue green bonds, as the higher the ESG score, the lower the probability of greenwashing practices.

Keywords: Green Bonds, Greenwashing, Corporate Social Responsibility, Environmental, Social, and Governance, ASEAN-6
JEL Classifications: G12, G30

1. INTRODUCTION

Corporate social responsibility (CSR) can be defined as a company's commitment to minimizing or eliminating any harmful effects and maximizing its long-term beneficial impact on society (Gómez-Corona, 2020). Not only does CSR ensure that a business remains profit-oriented, but it also contributes to a positive impact on the environment and the surrounding community. One of the many goals of CSR is to focus on biodiversity. Companies that seriously implement corporate social responsibility (CSR) programs play a crucial role in preserving the environment. Through these programs, they reduce the negative impacts of operational activities on the ecosystem. Companies can manage waste by recycling, reducing carbon emissions, and using renewable energy to make their businesses more environmentally friendly while encouraging innovation to protect the environment.

The implementation of business ethics principles is reflected in the corporate social responsibility (CSR) Program, which requires companies to act responsibly and uphold moral values, such as rejecting forced labor practices, implementing a fair and transparent work system, and fighting corruption. These measures not only create a healthy and supportive work environment but also strengthen the foundation for long-term company growth, while enhancing public reputation, investor confidence, and consumer awareness of social issues—all crucial factors for maintaining business sustainability and strengthening a company's position and competitiveness in the market. Meanwhile, increasing public awareness of the negative impacts of industrial activities on the environment is encouraging various companies and institutions to seek more environmentally friendly funding. In this context, green bonds have become a highly sought-after financial instrument and are rapidly developing as a global solution to address environmental

issues. Unlike traditional financial instruments, green bonds demonstrate a shift toward a low-carbon economy, with funds allocated explicitly to projects that benefit the environment and the climate (Fatica et al., 2021). Green bond issuers range from private companies and financial institutions to governments, and the funds raised are strictly directed to support environmental conservation projects aligned with sustainability goals.

The concern of a company regarding social impact has now become an issue that increasingly attracts attention. Therefore, to assess whether a company prioritizes profit, an indicator known as ESG (Environmental, Social, and Governance) is crucial for investors and the public. ESG can be used to create long-term value and evaluate a company's risk management. Furthermore, ESG serves as a working structure encompassing aspects such as social responsibility, more comprehensive corporate governance, and environmental aspects (Darma Wijaya and Widiyo Iryanto, 2024). The goal of ESG is the same as that of CSR: to become more socially and environmentally responsible. However, the approaches used by ESG and CSR differ. ESG develops concepts based on CSR, allowing investors and other stakeholders to assess and compare a company's sustainability performance more objectively (Kaźmierczak, 2022). The development of this CSR concept is also carried out by incorporating performance evaluations to ensure greater compliance with regulations. With sustainability factors and management being more considered in decision-making, ESG has emerged, making it more strategic and measurable than CSR. This shift from CSR to ESG makes risk management and sustainable long-term value creation more systematic and measurable.

As a form of support for ESG implementation and projects that have a positive environmental impact, green financing has emerged. Green financing can encourage funding for renewable energy projects, including renewable energy transportation, waste management, more efficient energy use, and so on. Green obligations are a concrete form of green financing. In financing these environmentally friendly projects, green bonds can serve as a financial instrument with fixed income, a concrete example of bonds as green financing. Green bonds not only help companies reduce carbon emissions but also provide a tangible way to demonstrate their commitment to environmental responsibilities and goals. Therefore, this instrument can strengthen a positive image among investors and the public while playing a crucial role in implementing ESG strategies (Kàzmierczak, 2022). Currently, many companies rely on green bonds as a financing option for environmentally friendly projects, particularly in the renewable energy sector. For example, the construction of solar and hydroelectric power plants aims to reduce the use of fossil fuels. In addition, green bonds also contribute to the development of sustainable transportation by supporting the expansion of public transportation, the use of electric vehicles, and transportation systems that utilize renewable energy sources. The funds raised are also used for water and waste management projects, such as the provision of clean water, effective waste management, and recycling facilities, all of which help reduce environmental pollution.

Green bonds in the ASEAN region are proliferating and playing an important role in promoting sustainable financing. To support this, the ASEAN capital markets forum (ACMF) launched the ASEAN green bond standard (AGBS) as a guide for member countries to build a more structured and transparent green bond market, thereby attracting wider investor interest. By following these standards, ASEAN countries can expand access to global capital markets while securing greater funding for environmentally friendly projects. The standards also help ensure green bond funds are used appropriately and prevent greenwashing, which is the practice of making false claims about sustainability. While the green bond market in ASEAN remains smaller than in developed countries, its growth shows strong potential, particularly in Singapore, Indonesia, and Malaysia, which are actively issuing sukuk and green bonds to finance projects such as sustainable transportation and waste management. According to the Climate Bonds Initiative report, the region's progress is evident in increased bond issuance and strengthening of supportive policies, as well as in the improvement of technical and regulatory capacity in each member country. Green bonds are also an important tool for ASEAN countries in meeting their commitments to the Paris Agreement and the Sustainable Development Goals (SDGs), which are key drivers of this market's growth in the region.

In 2023, the Institute for Energy Economics and Financial Analysis (IEEFA) reported that the green bond market in ASEAN grew rapidly, with total issuance of green debt instruments such as bonds, sukuk, and loans reaching approximately $58.16 billion. This growth underscores the region's potential in building a sustainability-focused financial market, which is now viewed not only as a moral obligation but also as a lucrative business opportunity. Green bonds play a crucial role in encouraging companies to adopt sustainable business practices and encouraging investments that prioritize Environmental, Social, and Governance (ESG) factors (Nguyen et al., 2023). Many companies use green bonds as part of their corporate social responsibility (CSR) programs, which not only demonstrates a commitment to the environment but also successfully attracts the interest of investors and the public who care about sustainability issues. The proceeds from the issuance are typically directed to renewable energy projects that have proven effective in reducing carbon emissions and increasing energy efficiency. With this step, the company not only confirms its commitment to sustainability principles but also ensures transparency in fund management, which in turn strengthens its positive reputation in the eyes of investors and the wider community.

While green bonds offer numerous benefits, their effectiveness in helping companies achieve their corporate social responsibility (CSR) targets remains controversial, particularly due to the risk of greenwashing. In this practice, companies appear environmentally conscious but are not, such as overexploiting natural resources or relying on damaging fossil fuels. Furthermore, challenges such as misuse of funds, lack of transparency, and the issuance of green bonds solely to improve image without taking concrete action also frequently arise. Therefore, transparency and accountability are key to ensuring sustainability programs have a genuinely positive

impact. This study examines the relationship between green bond issuance and CSR implementation in addressing challenges and achieving sustainability goals, focusing on companies from six ASEAN countries, which are Indonesia, Malaysia, Singapore, Thailand, Vietnam, and the Philippines—selected based on their economic conditions, capital market development, and commitment to sustainability. The study also examines the potential for greenwashing practices and the environmental impact of green bonds in the region.

Singapore, Indonesia, and Malaysia are three pioneering countries in issuing green bonds in the ASEAN region, each developing them as part of their sustainable investment strategy. Singapore has positioned itself as a significant financial hub by providing policies and incentives that encourage environmentally friendly investments while expanding the adoption of ESG standards. Indonesia has actively issued green bonds in the international market, with proceeds directed to finance renewable energy projects and support climate change adaptation efforts. Malaysia, on the other hand, stands out through its issuance of green sukuk used to finance environmentally friendly projects such as solar power plants, and facilitates private sector participation through clear and structured regulations that allow for the smooth issuance of green bonds to support CSR programs and various environmental conservation initiatives. The consistent steps taken by these three countries serve as an example of how green bonds can be effectively used by governments and the private sector to accelerate sustainable development in the ASEAN region.

This study also included several other ASEAN countries with different financial system conditions to broaden the scope of the study. Although the bond markets in the Philippines, Thailand, and Vietnam continue to grow, these three countries still face various obstacles, particularly regulations and policies that do not fully support the development of the green bond market. In the Philippines, the government and the private sector have begun issuing green bonds, although investor engagement and information transparency still need to be improved for a healthier market. Thailand itself already has a nationally launched green finance program, but monitoring efforts and evidence of the program's real impact are still suboptimal. Vietnam, which is still developing its green bond market, shows great potential in supporting the financing of environmental projects and humanitarian programs in its region.

ASEAN countries are placing significant emphasis on increasing the issuance of green bonds and investments that prioritize ESG principles as part of their efforts to support sustainability and strengthen the environmentally friendly financial sector. This study aims to examine the relationship between green bond issuance and the achievement of corporate sustainability targets, especially in relation to CSR programs. This study focuses on six ASEAN countries to evaluate whether funds raised from green bond issuances are actually directed to beneficial environmental projects or are used as a tool to cover up greenwashing practices. In addition, this study also assesses the real impact of green bonds, such as environmental improvements and carbon emission reductions that have been achieved.

This study uses data from Refinitiv with a sample that includes six ASEAN member countries, covering 2019 to 2023. This period was chosen because it is considered capable of capturing important developments in green financing policies and initiatives. In addition, during this period, support from governments, international financial institutions, and the private sector provided a major boost to the significant increase in green bond issuance, both regionally and globally. Third, this period encompasses the post-COVID-19 pandemic dynamics, during which many countries are promoting a more sustainable economic recovery through green recovery programs. Therefore, this study is expected to analyze and identify the potential for greenwashing in ASEAN, where companies do not actually operate according to sustainability principles, but appear committed. Furthermore, this study is also expected to present a more comprehensive analysis of financial instruments that contribute to sustainability in various industrial sectors, and their effectiveness in enhancing transformation towards socially responsible, environmentally friendly, and transparent business practices based on the scope of data from the last 5 years in ASEAN.

For testing the relationship, this study applies a quantitative approach to a regression model, which measures the impact of green bond issuance on key sustainability indicators, namely carbon emission reduction and corporate environmental scores. This approach also reveals the extent to which green bond issuance positively impacts corporate sustainability practices, or whether green bond issuance often serves as a strategy for greenwashing without any fundamental changes to business operations that benefit the environment. By analyzing green bond issuance patterns and the resulting sustainability outcomes, this study aims to identify the practice of greenwashing and evaluate the actual impact of green bonds on corporate environmental responsibility.

This study also focuses on potential challenges facing the implementation of green bonds, based on a systematic data-driven analysis. These include the potential for misuse of green bonds to promote a positive image, the lack of comprehensive standards across countries, and issues with transparency. This study will provide valuable insights for corporations, regulators, investors, and other stakeholders involved in policy and strategy development to ensure the proper function of green bonds as a legitimate financial tool for sustainability. In conclusion, this study aims to investigate (1) the role of green bonds in achieving CSR sustainability goals within ASEAN and (2) the extent to which potential greenwashing practices using green bonds undermine the achievement of CSR goals.

2. LITERATURE REVIEW

As the world becomes more conscious of climate change issues and the significance of shifting to a green economy grows, green bonds are becoming increasingly popular and gaining global attention. Thus, understanding the different aspects of green bonds is crucial for academics, policymakers, and market players as the need for sustainable finance grows. In line with that, the impact of green bonds has been the subject of numerous studies. (Estiningrum and Husodo, 2024; Oktavio and Riyanti, 2021; Pietsch and

Salakhova, 2016; Baity, 2024a; Tamula et al., 2024). Dewayanto (2024) highlighted that the number of studies on green bonds has increased considerably, indicating that there is growing interest in their advancement.

The diverse methodological approaches employed in the studies highlight the comprehensive nature of green bond research. To identify trends and research gaps in the body of existing literature, specific journals have adopted the systematic literature review (SLR) approach. To map the relationships between authors, citations, and keywords that are commonly used in the literature, some have opted to use the bibliometric analysis. Quantitative approaches, such as panel regression, have been used to analyze the effect of green bonds on corporate financial performance or specific environmental indicators. Latent links between variables that affect one another have been examined using the structural equation modelling (SEM) approach. This variety of methods keeps the research field dynamic and enhances understanding of green bonds.

By definition, green bonds are financial instruments that are used to finance or refinance climate and environmental projects (World Bank Group, 2015). Their growing popularity suggests a potential shift towards sustainability. Some studies suggest that green bonds have the potential to finance sustainability, which can positively contribute to sharia-compliant green bonds, sustainable loans, community-based funding, and other environmentally friendly initiatives (Kapoor et al., 2020; Otek Ntsama et al., 2021; Saa, 2024). This potential offers optimism for a future when sustainable projects will receive sufficient funding. However, some argue that despite their potential to fund sustainable projects, green bonds still face numerous challenges and rigorous evaluation, casting doubt on their impact and effectiveness (Development Bank, 2022; Dimas and Saputro, 2023).

Comparing ESG (Environmental, Social, and Governance) assessments with a company's sustainability performance and commitment to CSR is one way to understand the real impact of green bonds. ESG scores reflect how a company manages resources, its environmental footprint, and promotes sustainable business practices (Morsli and Touat, 2022). Several studies show that companies issuing green bonds usually have better ESG scores, especially in environmental aspects (Chen et al., 2023; Chen et al., 2025; Zhou and Kythreotis, 2024). In fact, companies with good ESG performance tend to be more active in issuing green bonds (Biju et al., 2024).

In developed countries, green bonds are increasingly seen as a strategic tool that can support the ESG agenda. For example, Flammer (2023) notes that large US companies that issued green bonds managed to enhance their reputation for environmental concerns. There is also a study by Wang and Wang (2022) which found the "greenium" phenomenon — namely, higher prices for green bonds — which indicates that markets in developed countries provide financial benefits to companies that conduct business with sustainable principles. In addition, research by Chang et al. (2022) finds that green bonds are proven to improve environmental quality in several European countries, though they also emphasize a need for clearer regulations and stronger policy. All these findings emphasize the important role of green bonds as a driver of ESG implementation in the region.

Not only in developed countries, but also in developing countries, the use of green bonds is now skyrocketing as an instrument to support sustainable development and achieve ESG goals. A study conducted by Tamula et al. (2024) confirmed that green bonds play an important role in financing various environmentally friendly projects, such as the construction of energy-efficient buildings, the development of renewable energy, and environmentally friendly transportation in India and several ASEAN countries. According to the Development Bank report (2023), there has been a significant increase in interest in the issuance and purchase of green bonds in Southeast Asia, although the use of this instrument is still in its early stages of development.

Green bonds are increasingly being used as a financing tool for projects that support environmental conservation. According to the signaling theory, companies use green bonds to demonstrate their commitment to operating in an environmentally friendly and sustainable manner. Several studies, such as Luo and Lyu (2024) and Yang Zhang (2024), have shown that green bonds can convince stakeholders that companies care about the environment. However, there are concerns that some companies are prioritizing attracting investors over truly protecting the environment. Aini et al. (2023) found that although green bonds are attractive to investors, their environmental impact is not necessarily significant, while García et al. (2023) noted that corporate environmental performance often remains unchanged after the issuance of green bonds. This situation is similar to the practice of greenwashing, where claims of environmental concern are exaggerated without any real contribution.

On the other hand, many companies do choose green bonds because this instrument has been shown to be closely linked to improved environmental performance, especially in sectors that are at high risk from climate change and are seeking to reduce carbon emissions. Guesmi et al. (2025) noted that companies in sectors such as aviation and international transportation (Kartal et al., 2024) tend to be more active in issuing green bonds to manage risk, although the results vary between sectors. The findings of Pang et al. (2024) and Fatica and Panzica (2020), Alamgir & Cheng (2023), strengthen the evidence that green bond issuance can significantly reduce emissions, while Rao et al. (2022) added that this instrument also encourages environmentally friendly innovation, thus becoming an important means of creating positive change.

Several studies have shown that issuing green bonds can encourage the use of renewable energy and environmentally friendly technologies, but strong evidence on their impact on reducing carbon emissions is still limited and controversial (Wu et al., 2025). In fact, one study found that even when the sustainability scores of companies issuing green bonds improve, the reductions in carbon emissions are not always significant (Pekanov et al., 2023). This raises the question of whether green bonds actually have a meaningful environmental impact or are simply a means of strengthening a company's image. In addition, many companies

also run Corporate Social Responsibility (CSR) programs as a complement to ESG scores to demonstrate their commitment to sustainability, through voluntary activities that focus on social and environmental issues and are reported in sustainability reports in various ASEAN countries. CSR is seen as an important strategy for building a sustainable reputation and is often associated with green financing, such as green bonds. However, like ESG, this program is vulnerable to abuse if there are no clear standards and consistent implementation, thus opening up opportunities for greenwashing practices.

While they may appear to care about the environment, companies that engage in greenwashing actually prioritize a "green" image over taking concrete steps to reduce their negative environmental impacts. This practice often occurs when there is minimal transparency and no independent verification (Seberíni et al., 2024). This phenomenon is highly concerning because it can undermine investor and public trust in sustainable financial instruments. In fact, such unethical practices have also been found in large, well-known companies (Zhou and Cui, 2019), causing concern among global investors. This challenge is made even more difficult by the imbalance of information and weak enforcement of regulations (Lionello, 2023).

Besides attracting investor approval, regulatory pressure also plays a role. Firms may feel pressured to hide environmentally harmful practices in order to reveal higher ESG scores. As a result, companies with higher ESG scores are often accused of greenwashing, and the score may be unreliable to measure the actual environmental effect (Kathan et al., 2025; Wang and Wang, 2022). In investigating greenwashing indicators, Treepongkaruna et al. (2024) discovered that firms with better ESG ratings but also higher carbon emissions, resulting in a low emission reduction score, are more likely to engage in greenwashing. However, Aggarwal and Kadyan (2011) found no significant relationship between greenwashing and CSR scores.

Green bonds have the potential to finance environmental progress and promote corporate sustainability. Although green bonds can serve as tools for sustainable transformation, the presence of greenwashing, weak verification, and inconsistencies in ESG and CSR measures raises questions about whether these instruments truly drive environmental outcomes or merely create the illusion of sustainability. This calls for a deeper empirical investigation, primarily because the economy is highly dynamic, with limited oversight.

H_1: Firms with higher levels of green bond issuance are associated with greater improvements in their CSR-related ESG performance.

H_2: Firms with higher ESG scores but relatively poor emissions reduction scores are more likely to engage in potential greenwashing behaviour.

3. METHODOLOGY

The sample for this study comprises firms from the ASEAN-6 countries: Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Data is sourced from Refinitiv and quantitative analysis, covering the observation period from 2019 to 2023. The dataset will include firm-level information on the amount of green bond issuance, emissions scores, ESG scores, and relevant control variables. A stratified sampling method was employed to achieve balanced representation across countries and industries. This study included 31 companies, resulting in a balanced panel with a total of 155 observations from 31 firms across 5 years.

The dependent variables in this study include CSR Environmental Performance and the Likelihood of Greenwashing. CSR Environmental Performance is proxied by the ESG Score (ESG), which represents a firm's environmental, social, and governance practices, consistent with an earlier study by Chen et al. (2023). Greenwashing Likelihood is a dummy variable proxied by two indicators: The controversy score (CS), which captures ESG-related controversies, and the product responsibility score (PRS), which indicates the firm's use of responsible product and marketing practices. Both are used to evaluate whether reported ESG initiatives correspond to the actions actually implemented.

The independent variables used in this study include Green Bond Issuance (GBI), ESG Score (ESG), and Emission Score (Emission). Green Bond issuance reflects a company's financial commitment to the aspiration, as measured by the natural logarithm of the total dollar value of green bonds issued annually. ESG scores are often used to measure a company's performance, and many recent studies have also used these scores, including those conducted by Treepongkaruna et al. (2024). Moreover, the emission score is also significant because it shows the extent of a company's impact on carbon emissions. Hence, it is a key indicator for assessing a company's environmental friendliness. In this study, we used ESG emission reduction score data from LSEG, where the higher the score, the more it appears that the company is serious and effective in reducing carbon emissions (Davis and Jamie, 2024). We also used several control variables based on references, such as company size, calculated from the natural logarithm of total assets (TA), as larger companies are typically subject to greater scrutiny by various stakeholders (Treepongkaruna et al., 2024). Another variable used is leverage, namely the ratio between debt and assets (DER), which reflects the extent to which the company's financial condition limits its ability to carry out social programs, for example, to overcome poverty (Biju et al., 2024).

Panel data regression analysis was used to examine the impact of green bond issuance on companies' ESG performance, particularly in relation to their CSR programs. Panel data regression accounts for unobserved heterogeneity across firms, as well as variations across both cross-sectional and time-series data (Baltagi, 2021; Wooldridge, 2010), and has been effectively applied in several ESG and green bond studies (Farzana et al., 2024; Kathan et al., 2025; Wang and Wang, 2022). A series of diagnostic tests was

Table 1: Specification testing result

Source	P-value
Skewness	0.0105
Kurtosis	0.0343
Heteroskedasticity	0.0000
Autocorrelation	0.0000

performed to assess whether key assumptions were violated prior to conducting the regression analysis. The results are summarized below Table 1:

Results from the skewness and kurtosis tests suggest that the data deviate moderately from normality, but not enough to invalidate regression analysis, given the size of the sample and the robustness of panel methods to mild non-normality. The LM and Wald tests for groupwise heteroskedasticity strongly reject the null hypothesis of homoscedastic errors across panels (P < 0.01), indicating that the variance of the error term differs across firms (Baltagi et al., 2008). The Wooldridge test for first-order autocorrelation also provided strong evidence of serial correlation (P < 0.01), implying that residuals are correlated over time within firms (Wooldridge, 2002). To further prepare the data for model estimation, all continuous variables were winsorized at 0.01 to reduce the influence of extreme outliers that can bias regression coefficients and inflate standard errors (Qura and Gad, 2016). Subsequently, all continuous predictors were mean-centered before being included in the models in order to address any potential multicollinearity.

The Hausman test was used to determine the appropriate panel data specification for each hypothesis after cleaning and adjusting the dataset. (Hausman, 1978). The Hausman test yielded a P = 0.1257. For Hypothesis 1, which assesses the effect of green bond issuance on ESG performance, the random effects (RE) model is preferred as it offers reliable and efficient estimates. Conversely, Hypothesis 2 shows a Hausman P = 0.0026; thus, the random effects (RE) model is rejected and replaced with a fixed effects (FE) model. This means the fixed effects model is more appropriate because there is a possibility that unobserved company characteristics are related to the predictor variables in the context of greenwashing. To examine the relationship between ESG Score (ESG) and green bond issuance (GBI), the following panel data with a random effects model is used to test Hypothesis 1 (H_1):

$$ESG_{it} = \alpha_0 + \alpha_1 GBIit + \Sigma\beta_j Controls_{it} + \varepsilon_{it}$$

ESG_{it} it indicates the sustainability performance of firm i at time t., $GBIESG_{it}$ t is the log of total green bond issuance, and $Controls_{it}$ it include firm size (TA) and leverage (DER), which are commonly used as controls in ESG performance studies (Kathan et al., 2025).

This study uses a panel logistic regression model and the generalized estimating equation (GEE) method to examine greenwashing practices, in accordance with methods commonly used in sustainability disclosure research and longitudinal data. Panel logistic regression was chosen because the analyzed data are binary outcomes from companies over time, and this method is often used to identify companies that may be exaggerating their ESG claims (Gorovaia and Makrominas, 2024). In addition, this study also uses GEE, which is specifically designed to process panel data with correlated observations, so that it can provide valid results even though the correlation between the data is not perfectly defined (Liang and Zeger, 1986; Zorn, 2001). This model is designed to test Hypothesis 2 (H_2), which states that even companies with high sustainability scores may engage

in greenwashing, considering the relationship between ESG performance and emission levels.

$$P\left(Greenwashing_{it}=1\right)=\frac{e^{\alpha_0+\alpha_1 Emission_{it}+\alpha_2 ESG_{it}+\pounds\beta_j Controls_{it}+\varepsilon_{it}}}{1+e^{\alpha_0+\alpha_1 Emission_{it}+\alpha_2 ESG_{it}+\pounds\beta_j Controls_{it}+\varepsilon_{it}}}$$

The dependent variable is a binary indicator of greenwashing likelihood, proxied by either the Controversy Score or product responsibility score, coded as 1 if either indicates a high level of concern, scoring below the 25th percentile of the data, and 0 otherwise. Independent variables include emission score and ESG score, while control variables include firm size (TA) and leverage (DER).

4. FINDINGS AND DISCUSSION

Table 2 presents the descriptive statistics of the key variables used in the analysis. The use of the log of total green bond issuance (GBI) helps normalize the distribution, especially in datasets with skewed financial values. A mean of 5.557 suggests a moderately high level of green bond issuance across the sample, but the significant standard deviation of 3.604 points to substantial disparities among firms or countries. This variation is expected, particularly because the ASEAN-6 countries (Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam) are at different stages of green finance development. For instance, Singapore and Malaysia may have more mature green finance ecosystems. Indonesia and Vietnam are likely still building policy and market infrastructure for green bonds. The reference to Frandon and Filkova (2018) supports this explanation, noting that regulatory maturity, investor appetite, and institutional support vary widely in the region. However, further research is necessary to fully understand these disparities and guide the future of green finance. The average ESG Score is 53.99 out of 100, with a standard deviation of 20.311, reflecting a mix of both strong and weak ESG performers. This indicates a mid-level average ESG performance among sampled firms. However, the widespread (SD = 20.311) suggests a diverse range of corporate sustainability practices. The presence of both strong and weak ESG performers can be attributed to sectoral differences (e.g., energy vs. finance), varying national ESG disclosure standards, and uneven market incentives. The comment that strong ESG performance is not viewed as a strategic advantage in ASEAN markets (per Prabawati and Rahmawati, 2022) helps explain this:

Companies may lack incentives to invest in ESG practices, especially if investors or regulators do not reward such behavior consistently. This cultural and policy environment may reduce pressure on firms to improve ESG metrics. These observations are supported by the results of the emission scores, with a mean

Table 2: Descriptive statistics

Variable	Obs.	Mean	Standard deviation
Amount issued (GBI)	155	5.557	3.604
ESG score (ESG)	155	53.990	20.316
Emission score (emission)	155	51.992	26.232
Debt to equity (DER)	155	1.734	7.588
Total assets (TA)	155	10.122	0.759

of 51.992 and a standard deviation of 26.232, which show that some companies still struggle to manage their emissions footprint effectively. Further, this reflects how well firms are managing emissions, with higher scores generally indicating better performance. A mean of around 52 again suggests a moderate performance, but the high standard deviation points to some firms performing quite poorly. The high variability may reflect a lack of emission regulations or carbon pricing in some ASEAN countries; Technological or capital constraints in adopting cleaner production methods; Sectoral issues (e.g., energy-intensive industries like cement or mining). This supports the earlier ESG findings: firms in the region are uneven in their sustainability practices, and green bond issuance does not necessarily correlate with strong environmental performance. These descriptive statistics suggest that green bond markets are developing, but unevenly; corporate ESG and emission performance varies widely, with many firms still facing challenges. This environment reflects a regional context where ESG is not yet a dominant strategic concern and green finance is still gaining traction. In sum, while there is evidence of progress, the wide spreads in key variables underline the need for stronger ESG policies, better disclosures, and market incentives in ASEAN economies.

Among the financial controls, a mean DER of 1.734 indicates that, on average, firms in the sample use approximately 1.73 units of debt for every 1 unit of equity, suggesting moderate financial leverage. However, the substantial standard deviation of 7.588 reveals high dispersion, implying that while most firms may have typical leverage levels, a few firms in the sample have extremely high DER values, indicating that they are highly leveraged. This skewness could stem from a few outliers, firms that rely heavily on debt financing (possibly state-owned, infrastructure-heavy, or capital-intensive). The result is not surprising in the context of green bonds, which are often used to fund large-scale, capital-intensive environmental projects (like renewable energy plants or green infrastructure). These types of projects typically require substantial upfront investment, and firms may issue green bonds as part of a broader debt strategy to finance them. The high leverage observed supports the narrative that green bond issuance is often associated with firms engaged in capital-heavy operations, where debt is a standard financing tool. However, the financial risk associated with high leverage should also be considered in performance and risk-return evaluations.

Total assets are presented in logarithmic form, which is a standard practice to normalize skewed asset size distributions and reduce the influence of outliers, thereby improving model stability in

regressions. A mean log (total assets) of 10.122 roughly translates to exp (10.122) ≈ 24,700 million, or USD 24.7 billion if the units are in millions. This suggests that the average firm in the sample is medium to large. A standard deviation of only 0.758 suggests low variability in firm size, indicating that most companies included in the sample are similar in scale, which reinforces the consistency of the sample selection. This consistency in firm size makes the analysis more reliable, as it reduces the risk that results are being driven simply by size differences. In studies linking green bonds and performance, controlling firm size is crucial, as larger firms are more likely to access green capital markets, receive ESG ratings, and invest in emission-reducing technologies. The high DER dispersion suggests a diverse risk profile, with some firms taking on very high debt burdens, possibly to finance green projects. The stable firm size (in terms of Total Assets) provides a balanced and robust analytical sample, minimizing distortions due to scale differences.

The regression results presented in Table 3 show that the amount of green bonds issued has a statistically significant and positive impact on a firm's ESG score. It was shown that with a million green bond issuances, there is an approximate 0.36-point rise in ESG score, holding other variables constant. These findings suggest that firms deploying capital through green bond instruments tend to improve their sustainability performance, particularly in areas related to environmental responsibility, governance, and stakeholder engagement. The result is similar to findings by Chen et al. (2023), who also found a similar positive relationship among Chinese listed firms. This shows the beneficial impact of green bonds on ESG performance across markets in Asia.

Furthermore, the outcome of this regression supports that issued green bond funds have been effectively used for environmental and climate-related initiatives (Rao et al., 2022). Projects that focus on energy efficiency, renewable energy, or pollution reduction can enhance ESG score metrics. These findings highlighted the role of green bonds as both financial instruments to mobilize capital and strategic tools to drive corporate sustainability, resulting in green bonds being seen as a financing mechanism, a signal to attract environmentally conscious investors, and to strengthen a long-term reputation and trust. In the context of Debt-to-Equity Ratio (centered_DER) as a control variable, the coefficient was statistically insignificant, indicating that there is no meaningful relationship between leverage and ESG scores in this model. This result suggests that highly leveraged firms do not necessarily score better or worse on ESG, and leverage itself does not confound

Table 3: Random-effect GLS regression results (dependent variable: ESG score)

Variable	Coefficient	Standard error	z	P-value	95% confidence interval
Centered_GBI	0.3598**	0.1635	2.20	0.028	(0.0394, 0.6802)
Centered_DER	1.5173	2.8788	0.53	0.598	(−4.1252, 7.1597)
Centered_TA	13.86***	3.9173	3.54	0.000	(6.1827, 21.5383)
Constant	0.0000	3.2877	0.00	1.000	(−6.4439, 6.4439)
Number of observation	155				
Number of groups	31				
Wald χ^2 (3)	21				
Prob>Chi2	0.0000				
Legend	*P<0.1	**P<0.05		***P<0.01	

the observed relationship between green bonds and ESG. The coefficient for total assets (centered_TA) is 13.86, $P < 0.01$, 95% CI: (6.1827, 21.5383). This is a highly significant positive coefficient, indicating that larger firms (after log transformation) tend to have significantly higher ESG scores. This finding is consistent with the literature, which shows that larger firms have more resources, public exposure, and regulatory pressure, enabling and incentivizing them to perform better in ESG assessments.

This shows that the project was really implemented and not only as a facade to fulfill the regulatory or stakeholders' expectations, contributing to the firm's environmental responsibility. Together, these results provide strong empirical evidence for the first hypothesis (H_1) that proposes a positive correlation between higher green bond issuance and improvements in a firm's ESG performance. This validates that green bonds are effective as a financial tool in driving sustainable practice and commitment to ESG.

However, while the first hypothesis indicates a positive relationship between the total amount of green bonds issued and ESG outcomes, it remains essential to examine whether those improvements are genuine or potentially driven by reputational motives. In other words, do higher ESG Scores reflect true sustainability efforts, or might some firms enhance their scores while concealing poor practices? To evaluate this, the second hypothesis (H_2) is tested using a random-effects logistic regression model, where the dependent variable is the probability of greenwashing.

To determine whether a real impact on ESG was made, Table 4 presents the probabilities of a particular firm having a specific characteristic associated with potential greenwashing actors, the coefficient odds ratio of the ESG score and emission score.

The odds ratio for ESG Score (centered_ESG) is 0.9053, $P = 0.002$, 95% CI: (0.8601, 0.9529). The result was negative and statistically significant at the 1% level, indicating that for every one unit increase in ESG Score, the odds of a firm engaging in greenwashing decrease by approximately 9.47%. In other words, the higher the ESG Score, the lower the probability of greenwashing, even after accounting for the firm size and leverage. The significance of this relationship reduces the likelihood of firms that issue green bonds purely for reputational reasons through ESG Scoring (greenwashing) and instead suggests that such issuance that results in a higher ESG Score is really linked to tangible improvements in sustainable performance.

This outcome rebuts earlier concerns by Kathan et al. (2025) and Treepongkaruna et al. (2024), who argued that firms may enact a classic form of greenwashing with high ESG ratings to show that they care about sustainability, but in reality, perform poorly on emissions. However, the current findings indicate otherwise, that better ESG ratings may, in fact, reflect genuine corporate responsibility rather than deception. This result is more aligned with studies like Flammer (2023) and Chen et al. (2025) found that ESG improvements following green bond issuance are linked to real operational changes instead of superficial rebranding [CTD1].

In contrast, Emission Score shows a positive but statistically insignificant relationship with greenwashing (odds ratio = 1.0279, $P = 0.149$), suggesting that the emission score alone does not reliably predict greenwashing behavior in the model. While the direction may imply that firms with worse emission performance might be more inclined to greenwash, the lack of significance does not provide sufficient evidence that emission alone is a reliable predictor of greenwashing. This finding adds nuance to the argument by Treepongkaruna et al. (2024), who found that ESG-emission mismatches could signal greenwashing, but here, such patterns do not emerge strongly [CTD2].

It is important to note that methodological limitations may have influenced this outcome. Although a fixed effects model was initially considered, diagnostic results did not support its implementation, leading to the selection of a random effects model instead. Overall, the findings do not support the second hypothesis (H_2). Instead, it highlights that firms with better ESG Scores are less likely to engage in greenwashing, contradicting the initial assumption that firms with higher ESG Scores may engage in greenwashing to protect or enhance their reputation. Meanwhile, Emission Score on its own does not emerge as a robust predictor of greenwashing behaviour. For the model diagnostic, the number of observations is 155, and the number of groups is 4. The data has a panel structure, likely representing firm-year data for 31 firms. Wald $\chi^2(4) = 10.14$, Prob > Chi2 = 0.0381: The model is statistically significant overall at 5% level, meaning that the joint influence of the independent variables significantly explains the variance in greenwashing probabilities.

Therefore, policymakers and financial regulators in ASEAN should view ESG scoring as effective indicator for greenwashing and consider the following actions: (1) incentivize ESG-linked Issuances such as offering tax incentives, preferential listing rules,

Table 4: Random-effect logit results (dependent variable: Greenwashing probability)

Variable	Odds ratio	Standard error	z	P-value	95% confidence interval
Centered_GBI	0.9053***	0.0237	−3.80	0.002	(0.8601, 0.9529)
Centered_Emission	1.0279	0.0194	1.51	0.149	(0.9915, 1.0674)
Centered_DER	1.7843	0.7078	1.46	0.063	(0.8199, 3.8828)
Centered_TA	0.3738	0.1792	−2.05	0.134	(0.1461, 0.9564)
Constant	0.2606***	0.0912	−3.84	0.001	(0.1313, 0.5174)
Number of observation	155				
Number of groups	31				
Wald χ^2 (4)	10.14				
Prob>Chi2	0.0381				
Legend	*P<0.1	**P<0.05		***P<0.01	

or lower financing costs for firms that issue certified green bonds and demonstrate verifiable ESG improvements; (2) Establish robust verification mechanisms to prevent greenwashing and maintain investor trust; it is essential to implement independent third-party verification and transparent reporting of proceeds used for green bonds (3) standardize ESG Metrics Regionally to encourage the harmonization of ESG rating methodologies across ASEAN to ensure consistency and comparability, which would enhance market confidence and regional investment flow.

While the logit regression above focuses on subject-specific or firm-level effects, capturing how changes within individual firms over time relate to the likelihood of greenwashing, it does not provide population-averaged interpretations, which are important for understanding the average effect of predictors on the dependent variable across the entire population. To address this, the Generalized Estimating Equations (GEE) was implemented as a complementary analysis, which allows us to estimate the overall effect of the independent variables on the likelihood of greenwashing across all firms in the sample, without focusing on firm-specific trajectories. This approach is particularly well-suited

for panel data structures, as used in this study, as it accounts for the correlation of observations within firms over time.

Table 5 shows that the Wald χ^2 statistic (10.2, P = 0.0372) indicates that the model, as a whole, is statistically significant at the 5% level. This suggests that, collectively, the independent variables included in the GEE model have explanatory power in predicting the likelihood of greenwashing across the firms. The regression shows that the higher ESG Scores of a firm significantly reduce the likelihood of greenwashing effects (coef = −0.0792, P = 0.002). This statement is the same as the logit regression in Table 4, showing that this fact is implemented all over the firm. This shows that though higher ESG Scores would likely experience a greenwashing accusation and are unsuitable for measuring real environmental impact (Kathan et al., 2025; Wang and Wang, 2022), this result supports that ESG Scores may act as a deterrent to greenwashing behavior across firms.

On the other hand, the coefficients of the Emission Scores and control variables were not found to be statistically significant or to have a meaningful impact on the likelihood of greenwashing,

Table 5: GEE random-effect regression results (dependent variable: Greenwashing probability)

Variable	Coefficient	Standard error	z	P-value	95% confidence interval
Centered_ESG	−0.0792	0.0229	−3.07	0.002***	(−0.1151, −0.0253)
Centered_Emission	0.1411	0.0131	1.08	0.282	(−0.0116, 0.0397)
Centered_TA	0.4161	0.2708	1.54	0.124	(−0.1146, 0.9468)
Centered_DER	−0.6598	0.5146	−1.28	0.2	(−1.6685, 0.3489)
Constant	−1.1184	0.2767	−4.04	0.000***	(−1.6606, −0.5762)
Number of observation	155				
Number of groups	31				
Wald χ^2 (4)	10.2				
Prob > χ^2	0.0372				
Legend	*P<0.1	**P<0.05		***P<0.01	

Table 6: Regression result summary

Variable	Model 1			Model 2			
	OLS	OLS RE	NW	OLS	RE	RE odds ratio	XT GEE
Constant							
Coefficient	9.70e−06	6.14e−06	6.14e−06	−1.3446***	−1.3446***	−0.2607***	0.3032***
T-value	0.000	0.00	0.00	−3.84	−3.84	−3.84	7.19
P-value	(1.000)	(1.000)	(1.000)	(0.000)	(0.000)	(0.000)	(0.000)
Centered-GBI							
Coefficient	0.2439	0.3598*	0.3598**				
T-value	1.22	1.88	2.20	-	-	-	-
P-value	(0.224)	(0.060)	(0.028)				
Centered_ESG							
Coefficient	-	-	-	−0.0994***	−0.0994*	0.9053***	−0.0129***
T-value				−3.80	−3.80	−3.80	−4.72
P-value				(0.000)	(0.000)	(0.000)	(0.000)
Centered_Emission							
Coefficient	-	-	-	0.0284	0.0284	1.0288	0.0030
T-value				1.51	1.51	1.51	1.56
P-value				(0.132)	(0.132)	(0.132)	(0.118)
Centered_DER							
Coefficient	1.7122	1.5173	1.5173	−0.9841**	−0.9841**	0.3739**	−0.1151*
T-value	0.78	0.74	0.59	−2.05	−2.05	−2.05	−1.72
P-value	(0.438)	(0.459)	(0.530)	(0.040)	(0.040)	(0.040)	(0.085)
Centered_TA							
Coefficient	25.2145***	13.8606***	13.8605***	0.5790	0.5790	1.7842	0.0771
T-value	3.41	3.64	3.54	1.46	1.46	1.46	1.60
P-value	(0.001)	(0.000)	(0.000)	(0.144)	(0.144)	(0.144)	(0.110)

suggesting a lack of robustness in this sample. This may be due to firm-level heterogeneity or limited within-group variation over time. Although statistically insignificant, the positive coefficient for Emission Scores (coef = 0.1411, P = 0.282) suggests a potential trend in which higher scores may be associated with a greater likelihood of greenwashing. This finding contradicts the intended purpose of the emission score, which is to reflect a firm's reliability in managing its carbon emissions. However, as previously noted, this relationship is not statistically robust in the current sample and should be interpreted with caution.

Overall, the GEE results support the rejection of the second hypothesis (H_2), as the Emission Score does not offer statistically meaningful explanatory power in predicting greenwashing behavior at the population-averaged level. In contrast, as summarized in Table 6, the significance of the ESG Score across both the logit and GEE models underscores its robustness in capturing greenwashing tendencies among firms. This cross-model consistency suggests that better ESG performance is reliably associated with a lower likelihood of greenwashing, both at the firm-specific and population-wide levels. Such findings strengthen the credibility of the ESG Score as a valid indicator of a firm's authenticity in sustainability reporting.

5. CONCLUSION

This study provides insights regarding the relationship of green bond issuance, ESG performance, carbon emission score, and potential greenwashing within the firms of the ASEAN-6 countries. Referring to a panel dataset through the method employed, the findings show there are several notable contributions from green bond issuance to the existing sustainability of a particular corporation. The first result suggests that green bond financing serves as both a compliance mechanism and a strategic lever for enhancing ESG performance. This reinforces the argument that green bonds contribute to corporate sustainability outcomes when effectively deployed, aligning with prior research evidence done in different environments (e.g., Chen et al., 2023; Rao et al., 2022). The second result, which came out as more critical, reveals a different outcome from the hypothesis. It was shown that higher ESG scores are significantly and negatively associated with the probability of greenwashing. This relationship rejects the second hypothesis that regards ESG-emission mismatches as potential indicators of greenwashing; the current findings indicate that strong ESG performance may reflect genuine corporate sustainability efforts rather than strategic misrepresentation. On the other hand, with the emissions score, these variables do not show a statistically significant impact on greenwashing likelihood in this context, even though theoretically they are linked to environmental performance. While the directionality of the coefficient suggests that firms with poorer emissions performance may be more susceptible to greenwashing, the absence of statistical robustness implies that emission metrics alone are insufficient for reliably detecting deceptive sustainability practices. This finding highlights the nuanced complexity of assessing corporate environmental responsibility, especially in emerging markets where reporting standards and enforcement mechanisms remain uneven.

In summary, this study contributes to the growing discourse on sustainable finance by demonstrating that green bond issuance can promote authentic ESG improvements and that higher ESG ratings, within this sample, are more indicative of real corporate responsibility than greenwashing. However, the inconclusive role of emission scores signals a need for further scrutiny into how emission reduction data is measured, reported, and integrated into ESG frameworks. Future research could explore sectoral variations, regulatory pressures, and longitudinal shifts in ESG-emission alignment to deepen the understanding of greenwashing dynamics across different institutional contexts.

The result also provides strong evidence that green bond issuance is associated with real, positive ESG performance outcomes rather than merely symbolic actions intended to boost reputation without substance. The significant and positive coefficient for green bond issuance, even after controlling for firm size and leverage, implies that green finance is more than a branding tool; it is linked to actual improvements in sustainability. This challenges the notion of widespread greenwashing in the ASEAN context and supports policy arguments for enhancing the adoption of green bonds as a mechanism for driving corporate sustainability. At the same time, the insignificant role of financial leverage suggests that ESG performance is not solely a function of capital structure. Lastly, the significant impact of firm size highlights the need for regulatory and institutional support to help smaller firms adopt ESG practices, potentially through access to the green bond market or ESG capacity-building programs.

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