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Do Green Bonds Benefit Issuers?

The Effect of Green Bond Issuance on CARs, BHARs, and ESG Score of Issuing Companies

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Abstract

With rising climate issues, the green bond market has been growing since the first issuance in 2007. This empirical study investigates the relationship between green bond issuance and stock price reaction, along with ESG score. The sample used consists of data from 33 countries with issuances from 2013 to 2022. After performing the regression, results show a positive and statistically significant relationship between the issuance and immediate stock price reaction proxied by 21-day event window cumulative abnormal returns (CARs). However, results do not show prolonged effects toward stock price as results showed a statistically insignificant negative relationship with the 13-month event window buy-hold abnormal returns (BHARs). Lastly, there was also no direct effect towards ESG score, despite environmental projects pursued using the green bonds. Overall, our findings suggest that the firm's issuance of green bonds is beneficial to the issuer in the short-run but long-term effects still lack significance due to ambiguity of results.

Key Words: Green Finance, Green Bonds, Event Study, ESG, CAR, BHAR

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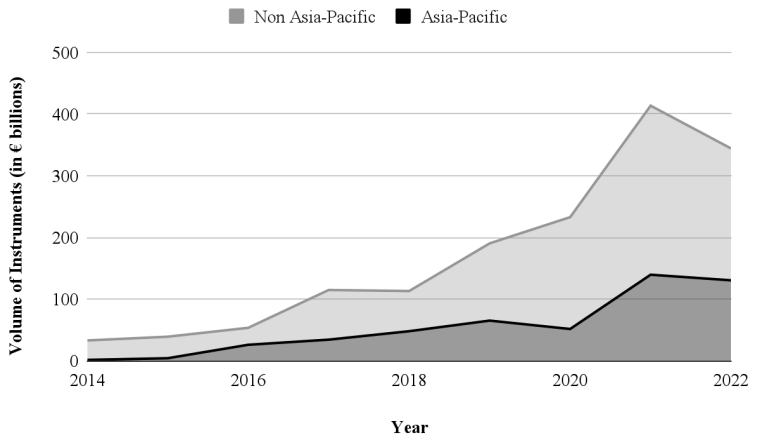
1. Introduction

1.1. Background Information and Motivation

As climate change reaches pressing levels, achieving sustainable development requires financial resources to be allocated towards low-carbon, climate-resilient activities (Barua, 2019). According to the World Bank Group (2015), private sustainable finance plays a vital role in closing the funding gap for sustainable projects. One of the most common and recent ways would be through green bonds. Various scholars and sources have defined green bonds differently, however this study follows the definition from Goldman Sachs (2023), which simply refers to green bonds as debt instruments financing projects with environmental benefits. Furthermore, the World Bank Group (2015) emphasizes that these bonds help connect investors with projects with focus on environmentally sustainable projects or efforts.

In 2022, Climate Bonds Initiative recorded a cumulative of approximately €805 billion green, social, and sustainability instruments, with €474.7 billion being green themed as seen from **Figure 1** (Climate Bonds Initiative, n.d.). From this, 72.5% of the instruments were sourced from the Asia-Pacific Region. Furthermore, the increasing awareness and relevance of green financial tools globally is highly evident as according to S&P Global Ratings (2023), green bond issuance reached USD 310 billion in the first half of 2023. However, issuing green bonds presents opportunities and challenges for stakeholders, both investors and issuers. On one hand, green bonds can widen the range of potential investors, mainly those who are more focused on ESG initiatives, who might offer financial advantages in comparison to conventional bonds. Differently, the issuance of green bonds would provide additional responsibilities and risks for the issuer, such as costs related to certification and the potential for reputational damage from greenwashing.

Figure 1: ESG Financial Instrument Volume per Region



Green bonds are considerably a newer financial instrument that requires to be certified by third parties. According to Tang and Zhang (2020), for first-time issuers, the process of issuing green

bonds requires a lot of time and can be costly. This raises the question of whether issuers are actually benefiting from opting to issue green bonds. Differentiation from issuing green bonds can lead to a positive response in stock price and thus abnormal returns due to the issuance suggesting that the firm is committed to being sustainable (Hachenberg and Schiereck, 2018). Furthermore, Wang et al. (2020) emphasizes that there is a statistically significant positive market reaction to the announcement of green bond issuances in the Asia-Pacific region. On the contrary, Suttichayapippat (2022) mentions that there is no significant market reaction in terms of abnormal stock returns following green bond announcements in the Asia-Pacific region. Furthermore, Gianfrate and Peri (2019) found that firms issuing green bonds tend to improve their ESG scores as there are strict qualifications to the required transparency and compliance with sustainability to be an issuer and to perform projects.

1.2. Research Question and Novelty

Other than the study done by Tang and Zhang (2020) using a panel of public companies and Verma and Bansal (2023) in the context of India, there have not been many papers that have explicitly discussed the effect of green bonds on stock prices. Reboredo and Ugolini (2020) found that the green bond market has weak connections with the stock and bond markets, though can be a good risk management tool. Moreover, Liet al. (2021) implied that the green bond index positively impacts carbon prices in the short to medium term, though is negatively correlated to stock prices. However, there has yet to be research done on both the short-term and long-term effect of green bond issuance towards stock prices, specifically in the APAC region, along with its effect on ESG score. This relationship is important to examine as it contributes to our understanding of the long-term influence of sustainable investments on a company's valuation. This study can then show whether green initiatives will continue to improve financial performance after the first period of announcement and provides an understanding on how committing to green development can be profitable in the long-run for the emerging region. Therefore, the research question that this thesis aims to answer is: “How does the issuance of green bonds affect ESG score, along with short-term and long-term stock prices of publicly listed issuing companies?”

Therefore, with the collected data, the long-term and short-term effect on stock prices is being analyzed, along with the ESG score. It looks into how the issuance changes the company’s stock performance and actual efforts towards sustainable growth, proxied through the ESG score. Another point that has been discussed in other literature through alterations of the dataset is the significance of the effect for recurring issuers and specifically for the APAC regions. However, this study uses interaction terms to analyze the effects. With an interaction term focusing on the first issuance, it analyzes whether the effect of the first issuance of green bonds offers insights into whether the market reaction differs for initial issuances compared to subsequent ones. Next, including an interaction term for the APAC region allows for regional analysis, showing whether the market reaction and ESG impact differ in the Asia-Pacific context. With this analysis issuers can see whether issuing green

bonds is beneficial and for investors to see whether issuing green bonds actually mean that they are moving towards more sustainable efforts.

Findings of the study are actually in line with the findings of Tang and Zang (2020), Verma and Bansal (2023), and others that green bonds have a statistically significant positive relationship with short-term stock prices. However, in terms of long-term stock prices, it goes against the finding of Flammer (2021) but in line with Suttichayapippat (2022) where it is a negative and statistically insignificant relationship. Similarly, unlike what Chen et al. (2023) emphasized in their study, the results show an insignificant relationship between the two, despite the direct relationship sustainable projects should have with the increase in ESG score. Lastly, whether it is a first issuance or not, along with the region of the issuance also does not affect the aforementioned relationships. Thus this study shows some findings that are in line with past literatures, but others that are not, possibly implying a lag in effects or greenwashing practices.

1.3. Structure

To investigate the effect of green bonds and stock performance, along with ESG score, the study starts by evaluating past literature that discusses similar relationships. The theoretical framework and literature aims to collect information of the relationship found by past studies, along with the validity of the models. Exploration is done to find the most fitting proxies for the independent, dependent, and control variables. Therefore the section focuses on recent and older studies that also analyzed the relationship between stock performance and green bond issuance. The next session then discusses the data used for this study, inclusive of the sources, proxies, and sample size. Moreover, the methodology to build the dataset and to perform the regression is explained to provide an understanding of how the results are derived. Lastly, results of the main analysis are performed to understand the relationship. A robustness test is also included to ensure the robustness and validity of the finding in the main result section.

2. Literature Review

2.1. Green Bond Issuance Effect

There has been a rise in studies analyzing the impact of sustainability and green efforts on aspects of firm performance. With the current rise in awareness of climate change, there is evidence that many are now looking into the sustainability finance market. Green financial tools have various definitions, though the bottom line is that they are tools that allocate the funds specifically for projects and efforts that positively contribute to ecological preservation and sustainability (Flammer, 2021). Pham (2016), followed by Gatti & Florio (2018) and Jin et al. (2020), found that investors now see the green bond market as a “risk-alleviating tool”. Moreover, one of the earlier papers by Klassen and McLaughlin (1996) investigates the relationship between environmental practices and stock performance, finding that there is indeed a significant positive stock returns associated with positive

environmental actions. These findings are in line with the results of Bancel & Glavas, 2021, where positive market reaction from announcements of green bond issuances are a result of the signaling quality on issuers' environmentally oriented activities. Furthermore, Hacıömeroğlu, et al. (2022) used their evidence of conventional bond returns declining more than green bonds during the pandemic as an indicator that green bonds are suitable during abnormal market conditions.

Although different in nature, green financial tools follow similar underlying theories as conventional tools. This includes the stakeholder theory, signaling theory, and institutional theory, which provides an explanation as to why companies and investors are moving towards sustainable practices. The stakeholder theory by Freeman (1994) emphasizes that companies aim to maximize value for all stakeholders, thus minimizing externalities that may also come from environmental issues. Therefore, tapping into more sustainable practices can adhere to a wider range of stakeholders. Nest, the signaling theory (Spence, 1973) uses management decisions to signal certain information to the market. With that, issuing green financial tools can be aimed towards attracting environmentally conscious investors. Lastly, the institutional theory by Meyer et al. (2008) mentions that companies align business decisions with institutional expectations and societal norms. With countries, mainly more developed ones, imposing more environmental standards and regulations to follow, companies are obliged to start altering their practices, thus resulting in the growing green market.

With that, Flammer (2020) opined that due to the signaling theory, corporate green bond issuances actually result in positive returns for companies. As investors expect more sustainable practices following the initial issuance, there is a demand for companies issuing them. Additionally, Li et al. (2020) integrated the aforementioned theories to find that these issues are also used as a company's CSR initiative. Despite having similar underlyings, the green bond market is closely linked to the fixed-income and currency markets but has negligible connectedness with the stock, energy and high-yield corporate bond markets according to Reboredo and Ugolini (2020). However, findings of Tang and Zhang (2020), Verma and Bansal (2023), and others prove otherwise as the studies find significant relationships between the green bond issuances on the market response.

2.2. Stock Price Reaction to Green Bonds

Green bonds indicate a company's dedication towards transitioning into more sustainable ways. One of the earlier by Klassen and McLaughlin in 1996 found significant positive stock returns associated with positive environmental actions, while negative environmental events are associated with negative stock returns. This is driven by the change in market perception of net present value of future profits and cash flows after a strong environmental performance. These findings are closely related to that of green bonds. As referred to previously, Tang and Zhang (2020) used a panel regression to compare green and corporate bonds, finding that stock market reacts positively in the short-run, analyzed through cumulative abnormal returns (CARs) to the announcement of green bonds and that the positive reaction is pronounced for firms in environmentally sensitive industries. Effects

were found to be even more immediate by Flammer (2021), who reported positive abnormal returns on the day of the green bond issuance announcement and also in the long term, analyzed through buh-hold abnormal returns (BHARs).

Differently, Lebelle, et al. (2020) found that the market reacts negatively to the announcement of green bond issuances, with results ranging between -0.5% and -0.2%. Furthermore, this negative reaction is more pronounced in developed markets and on the first issuance of a green bond by a company. However, even in more specific scopes, results are often positive and not statistically significant. Verma and Bansal (2023) emphasizes that in the context of India, over the 10-day period following the issuance, short-term cumulative abnormal returns are generally positive, indicating favorable reactions. Wang et al. (2020) emphasizes that there is a statistically significant positive market reaction to the announcement of green bond issuances in the Asia-Pacific region due to the perceived commitment of these companies to sustainability, which may enhance their reputation and investor appeal. Meanwhile, Suttichayapippat (2022) found that there is no significant market reaction in terms of abnormal stock returns following green bond announcements in the Asia-Pacific region, indicating that green bonds announcement does not significantly impact shareholder value. Effects differ per region due to the difference in regulations and incentives.

Reboredo and Ugolini (2020) discussed a related but different relationship, the price connectedness between green bond and financial markets by seeing if the changes in prices in various financial markets result in price changes in the green bond market and vice versa. They found that there are significant price spillovers from fixed-income and currency markets to the green bond market. However, the green bond market shows negligible reverse spillover effects to these markets, indicating weak connections between the market. These findings imply that the green bond issuance should not affect stock prices. However, Bachelet, green bond issuance and the stock market can be connected due to the transparency and accountability that comes with issuing green bonds that can attract new investors. What is still missing in literature would be the analysis of whether the region of the issuer and issuance frequency has a significant impact on whether or not issuers benefit from green bonds in terms of stock price. With that, CARs and BHARs are the most adequate proxies to test for immediate and sustained reaction of the stock market, respectively, with additional interaction terms with a region and issuance frequency variable.

2.3. ESG Score

Essentially green bonds are designed to raise capital targeted towards projects that are environmentally or sustainably oriented. This would be the main reason as to why people associate these issuances with the commitment of issuers towards creating a positive impact for the environment (Shenoy et al., 2023). As strategies are anticipated to be aligned with the improvement of environmental and social performance, these efforts should be reflected in the ESG score. Gianfrate and Peri (2019) proves this by finding that for companies that allocate funds sustainable projects

experience an improvement in the environmental score. Chen et al. (2023) supports this by providing evidence that green bond issuance positively enhances corporate ESG performance mainly through the internal attention effect and external supervision effect. Effects are more prominent for companies of larger size and ones that receive higher government subsidies.

Due to the signaling effect, companies issuing green bonds often better fulfill their ESG commitment to have a long-term capital and reputation advantage (Zheng et al., 2023). Firms that issue green bonds must also be verified by a third party, thus needing to comply with certifications (Flammer, 2021). With requirements to internalize externalities, GBI can motivate issuers to strengthen ESG performance, according to Tang and Zhang (2020). Therefore, there is more motivation and incentive for issuers to improve their ESG score. Moreover, Hoang et al. (2022) also finds that green bond issuance is positively related to ESG disclosure scores and its three dimensions. The reason being, the process of acquiring the certification to issue the green bonds requires teamwork that improves the social aspect and the involvement of all directory levels to prepare the issuance, which improves the governance dimension. However, the differentiation between its effects in different regions and whether it is a first or recurring issuance has yet to be discussed. Therefore, to add to the analysis on effects towards stock performance, it is also necessary to test for the issuance effect towards ESG performance of the issuer.

2.4. Control Variables

Based on the findings of aforementioned studies, it is important to control for certain variables to better estimate the effects of green bond issuance to the issuing firm. Firstly, the size of the firm indicates the amount of resources and lower volatility of the company (Fama and French, 1992). According to Dang et al. (2018), market cap provides a real-time snapshot of a firm's economic state that takes into consideration current market conditions. With that, larger firms should have a more pronounced positive impact from the issuance of green bonds towards both stock price and ESG score (Flammer, 2021). Next, leverage can indicate the risk profile of the company as it is the ratio of the firm's debt to equity. With that, Myers (1977) found that a high leverage ratio implies higher financial risk, which impacts short-term CARs negatively as investors are often concerned with high debt levels. Therefore, there should be a negative relationship between the variables as lower risk should interest investors more (Gianfrate & Peri, 2019).

For financial performance, higher ROA and total equity indicates better financial management performance and stability, thus improving investor perceptions of the issuer as it indicates a higher ability to adopt sustainable practices in the long-run. In line with this, Flammer's (2021) study found that there is a positive and significant relationship between firms with higher ROA with ESG score and stock performance. In terms of market-to-book ratio, it compares the firm's market value to the book value. As a higher ratio implies higher growth, a positive relationship with CARs, BHARs, and ESG score is expected as it normally shows better growth prospects and green investment

opportunities (Smith and Watts, 1992; Zerbib, 2019). Lastly, for the coupon size, it affects the attractiveness for the bond itself and therefore, the market reaction. Bachelet, Becchetti, and Manfredonia (2019) have shown that green bonds with lower coupon rates are often associated with better-performing issuances, leading to positive impacts on CARs and BHARs.

2.5. Hypothesis

The aim of this study is to determine whether green bonds, as a sustainable finance tool, benefit issuers in terms of the stock performance of issuing companies as it can be timely and costly. Due to rising awareness on climate change, there has also been an increase in attention towards sustainable development tools. In line with the signaling theory, the issuance of a green bond can signal that the company is increasing its efforts in being sustainable, therefore improving its reputation and confidence of investors, thus increasing the firm's stock price (Ross, 1977). According to (Fama, 1970), there can be an immediate reaction to the issuance announcement that would result in abnormal returns due to the market view that the firm is moving towards sustainable growth. Therefore, the first hypothesis is as follows:

H_1: *The increase in the issuance amount of green bonds will result in positive short-term cumulative abnormal returns (CARs).*

Aforementioned theories and assumptions also hold for long-term effects. The issuance of green bonds will attract socially conscious investors, increasing demand, leading to better stock performance (Friede, Busch, & Bassen, 2015). Particularly in the long run, Flammer (2021) found that as a result, there would be a long term effect on financial performance as investors hold on to stocks due to the perception that the issuance would be the first step to the firm's continuous efforts in considering environmental issues. Hachenberg & Schiereck (2018) suggests that there is an improved sustainability profile that would act as a strategic move to retain investors, Therefore, the second hypothesis is:

H_2: *The increase in the issuance amount of green bonds will result in positive long-term buy-hold abnormal returns (BHARs).*

Green bonds, mainly ones that thoroughly follow the ICMA principles issued to finance green projects, show the firm's commitment to environmental and social responsibilities. Gianfrate and Peri (2019) found that issuing green bonds can improve a company's sustainability credentials and commitment towards doing better. This is due to the certifications and requirements to issue green bonds in the first place. Due to the relationship found in past literatures, it is hypothesized that:

H_3: *The increase in the issuance amount of green bonds will result in a higher Environmental, Social, and Governance (ESG) score.*

Moreover, Tang and Zhang (2020) found significant results that announcement returns are larger for first-time issuers than for repeat issuers. This is found to be in line with older literature that discusses the relationship between corporate environmental performance and firm value. As previously mentioned, the issuance of green bonds signals the market and prospective investors that the company is moving towards sustainable growth. Thus, it can attract a number of new investors, while the effects for recurring issuers may be influenced by more factors, including the bond's coupon and also strategic decisions made since the first issuance. The fourth hypothesis is as follows:

H_4: The impact of the increase in the issuance amount of green bonds on short-term CARs, long-term BHARs, and ESG scores is significantly larger for firms first issuance compared to subsequent issuances.

Lastly, there has been growth in awareness and demand of green financial tools in the Asia-Pacific region as momentum is driven by regulatory development, investor demand, and government plans towards sustainability. Based on LSEG (2023), the APAC region accounted for approximately 25% of the global impact bond issuance, including green bonds as the main issuance. Japan and China continue to be market leaders for green bond issuances due to the support from regulations and general frameworks to fund mainly renewable energy and sustainable transportation (Vejarano, 2023). Furthermore, the APAC region has both highly developed markets and emerging markets that are currently developed, thus resulting in the following hypothesis:

H_5: The impact of the increase in the issuance amount of green bonds on short-term CARs, long-term BHARs, and ESG scores is significantly larger for firms located in the Asia-Pacific (APAC) region.

3. Data and Methodology

3.1. Data

In analyzing the effect of green bond issuance towards stock price and ESG score, Bloomberg was used as the main source to obtain data on companies that have issued green bonds as it has the most extensive list with over 5000 issuances by corporations. The study focuses on issuances by public companies from various regions from 2014 until 2022. Data that were obtained from Bloomberg includes the security ISIN, issuer ISIN, issuance dates, maturity dates, coupon rate, currency of the bond, and the amount being issued. From the available green bonds, the data was filtered to issuances that follow the ICMA green bond principles. This ensures the green bonds being analyzed all follow the same standards in terms of the use of proceeds, process for project evaluation and selection, and the management of proceeds and reporting (ICMA, 2021). The list of green bonds was further reduced by excluding those with many missing data for other variables included in the model. Moreover, countries from the United States of America (US), Canada, Cayman Islands, and countries that have issued only one or two green bonds are also excluded. This is due to the difference

in maturity of the US and Canadian security market and the difference in data source for other variables. For others, it is due to the discrepancy in codes and lack of data availability.

To gather the Cumulative Abnormal Returns (CARs) and Buy-Hold Abnormal Returns (BHARs) that are being used as the main dependent variables, the Compustat database within the Wharton Research Data Services (WRDS) event study tool was used. In creating a list of Issuer ISIN codes and dates of the green bond issuance, the tool can directly calculate the (-5,5) and (-10,10) daily CARs, along with (-6,6) and (-9,9) monthly BHARs as the database has access to both daily and monthly stock prices. Due to data availability, there are less companies with a BHARs value in comparison to CARs. Therefore, companies with incomplete data on the CARs and BHARs value are still included in the analysis. However, when data on all three variables are not accessible, the company is then removed from the dataset.

Using Eikon, formerly known as the Thomson Reuters database, ESG Scores were also taken as another dependent variable used in the analysis and all control variables were derived. All the values of the data points are taken based on the issuer ISIN and the date of the green bond issuance. The ESG Scores used for the analysis is the overall ESG score that is taken from the Refinitiv database as for some companies, data is not available for the individual components. When ESG Scores are not available for the time of the green bond issuance, it is left blank instead of using the earliest available score to avoid biases in the result. For firm-specific control variables, this includes total debt, market capitalization, net income, total assets, total equity, along with the industry and region the issuer operates in. Additionally, coupon rate and the maturity of the bond is also included as bond-specific control variables. The summary of variables and sources are summarized and can be seen in **Table 1** below.

Table 1: Variable Summary

Variable	Description	Name	Measure
Independent	Issuance amount of green bonds	GreenBond	Total issuance amount in euros
Dependent	CARs (-5,5)	CARs5	(-5,5) daily CARs window
	CARs (-10,10)	CARs10	(-10,10) daily CARs window
	BHARs (-6,6)	BHARs6	(-6,6) monthly BHARs window
	BHARs (-9,9)	BHARs9	(-9,9) monthly BHARs window
	ESG Score	ESG	Refinitiv ESG score
Control	Size	FirmSize	Log of market capitalization
	Leverage	FirmLeverage	Log of total debt / total asset

Return on Asset	FirmROA	Log of net income / total asset
Market to Book Ratio	FirmMarket	Log of market cap / total equity
Coupon Rate	Coupon	Coupon rate of issued bond

3.2. Methodology

3.2.1. Independent Variable

To analyze the effect of green bonds on stock prices, an event study was performed. Green bonds are proxied using the total issuance amount, which refers to the total value of the bond itself. As green bonds are used to fund green projects that have clear environmental benefits, the face value is important as it determines how much can be used for these projects and therefore the scope of projects for investors. The first step was to remove any duplicates in the issuance dates and the issuer code. This eliminates bonds that are issued on the same day by the same company. Then, countries that have discrepancies between the country of issuance and ISIN codes are removed to avoid including invalid data and having difficulties during data collection. As mentioned previously, the list of green bonds are issued by different countries, thus making data on the issuance amount in different currencies. Therefore, the values are all converted into euros to keep the data standardized and to make the analysis valid. Lastly, the value is logged to avoid skewness and to make the value of similar scale to the other variables used in the model.

3.2.2. Dependent Variables

For the dependent variable, the primary metrics being used are Cumulative Abnormal Returns (CARs) and Buy-Hold Abnormal Returns (BHARs). The event windows used for this study includes a daily window of (-10,10) days for CARs to capture the short-term effect on stock price and a monthly window of (-6,6) months, equivalent to approximately 126 trading days, for BHARs to capture the long-term effect. Additionally, ESG scores are also included as a min dependent variable to see whether issuing a larger amount of green bonds also means that the issuers are improving their green practices. First, data for the independent variable dependent variables, and control variables are collected. Starting with the green bond value, as the issuances are done in different countries, the face values are all converted into euros for a more comprehensive analysis. Following that, the abnormal returns are computed and taken directly using the WRDS event study tool. For the CARs, it estimates the normal market returns for stock *i* at time *t* using the standard market model using the following equation:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \quad \textbf{(1)}$$

It is a regression of the return of the market index, R_{mt}, on the return of stock, R_{it}. The abnormal returns are then calculated for each day of the event window, which in this case is the 21-day and

253-day event window. This is done by taking the difference between the actual return and abnormal return using the equation:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \quad \textbf{(2)}$$

Finally, the abnormal returns of the event window are summed to get the CARs value using the equation below:

$$CAR_i = \sum_{t=T_1}^{T_2} AR_{it} \quad \textbf{(3)}$$

In this equation, T_1 and T_2 denote the start and end of the event window respectively. For the BHARs calculation, it follows the same method until the calculation of the abnormal return. Instead of using **Equation (3)**, it uses the following equation:

$$BHAR_i = \prod_{t=T_1}^{T_2} (1 + R_{it}) - \prod_{t=T_1}^{T_2} (1 + E[R_{it}]) \quad \textbf{(4)}$$

In **Equation (4)**, R_{it} is the actual return and E[R_{it}] is the expected return. After the CARs and BHARs calculations, ESG scores are taken from Refinitiv as the final dependent variable. The scores are taken specifically for the dates of the green bond issuance and if not available, it is kept empty and excluded from the dataset, instead of taking the value from the closest available date.

3.2.3. Control Variables

Several firm-specific and bond-specific control variables are included in the model to control for other variables that may also affect the stock price and ESG score of the issuer. First, the paper uses the log of market capitalization as a proxy for firm size. Next, leverage is computed by dividing total debt by total assets of the firm. Return on asset (ROA) is then computed by dividing net income by total assets. The natural logarithmic form of ROA is then generated and used for the regression. Then, the market book ratio value, along with coupon rate is also logged and used in the analysis. Lastly, the industry that firm is operating in is also grouped into 11 different industries, including: (1) Communication Services, (2) Consumer Discretionary, (3) Consumer Staples, (4) Energy, (5) Financials, (6) Health Care, (7) Industrials, (8) Information Technology, (9) Materials, (10) Real Estate, and (11) Utilities.

To generate the interaction terms, first, the region of the issuers are grouped. It is divided into countries in the APAC region and outside of the APAC region. For the second interaction term, a binary variable is generated. As some companies in the list have issued more than one green bond during the time horizon of the analysis, a variable is created wherein the value is equal to 1 if it is the first issuance made by the issuer. To do this, the data was sorted by issuer ID and the issuance date and then filtered to create the interaction term. With all the variables generated, summary statistics were gathered using Stata.

3.2.4. Baseline Regression

To capture and understand the effect of green bonds on stock prices and ESG performance, various models are regressed in stages. Referring to **Table 2**, the list of regressions being analyzed is presented. Models (1), (2), and (3) are the baseline regressions, Models (4), (5), and (6) include the first issuance interaction while Models (7), (8), and (9) have the regional international interaction term. Diagnostic tests were then performed on all the models to ensure that it fulfills the assumptions. This includes the heteroskedasticity test, multicollinearity, skewness, and autocorrelation test. Following that, using cross-sectional Ordinary Least Squares (OLS) regressions, the baseline models are performed by regressing the green bond issuance value on the CARs, BHARs, and ESG Score.

Using Stata, Models (1), (2), and (3), were regressed with additional industry and time fixed effects to control for correlations within groups. For all the models, this is done instead of directly doing a fixed effect regression as the data is weakly balanced and does not have enough variance within the groups to perform a panel analysis. In adding industry fixed effects, the model reduces omitted variable bias as different industries have different project types and investors. Therefore, controlling for industry-specific factors can help to counter unobserved heterogeneity. Year time fixed effects were also included as reactions of the stock market are highly dependent on economic and political changes that happen through the years, thus needing to control for the temporal variations to improve the reliability of the results as a whole. Additionally, due to the models being heteroskedastic, it is being regressed with clustered Issuance ID. With that, all the models are robust-clustered at firm level to allow for correlation within clusters that will adjust for heteroskedasticity and autocorrelation (Drukker, 2003; Torres-Reyna, 2007).

3.2.5. Regression with Issuance and Regional Interaction Term

To delve deeper into the relationship between green bonds and stock price, models with an interaction term between issuance amount of the green bond and a dummy variable indicating whether or not it is the first issuance from the company are also being tested. This is included as previous studies have found that the relationship between green bonds and CARs become insignificant after the first issuance (Lebelle, et al., 2020). The assumption that the intensity of the effect changes is based on the hypothesis that as the market no longer has a shift in perspective with the announcement, it no longer becomes a shock that affects stock price. Moreover, it is also to see whether the impact on the ESG performance of the issuer is positive and stays significant for repeated issuers. Therefore, by regressing Model (4), (5), and (6), it aims to see whether first-time issuers experience different market reactions compared to repeat issuers. Similarly, the models are also being regressed with robust-clustered standard errors, along with industry fixed effects.

Lastly, another interaction term between the issuance amount and a dummy variable which indicates whether the issuing company is based in the Asia-Pacific (APAC) region is introduced. This relationship is also being tested as the increase in the understanding of urgency towards green

development and sustainable financing is an international phenomenon. Considering that APAC's economy has been growing more rapidly with many emerging countries being in the region, this may have an effect on how the market responds to green bond issuances and how effectively funds are being used. With that, Models (7), (8), and (9) are included to determine if there are regional differences in market reactions and ESG scores to green bond issuances. In line with the other model, it is also regressed with robust clustered standard errors and both industry and time fixed effects. Through these comprehensive analyses, the study aims to provide a detailed understanding of the financial and ESG impacts of green bond issuances in the short-term and long-term.

3.2.6. Robustness Test

To check and ensure the results of the main regressions are valid and robust, additional models are being tested. Firstly, to check the first hypothesis, a longer event window for the CARs are being tested for. The independent variable and control variables used stays the same, however it is tested against a (-5,5) daily-window for the CARs to see if the result that there is a positive and significant relationship in the short-run holds. Moreover, to check the second hypothesis, a longer event window for the BHARs is also being tested for. With that, the model is tested again with a (-9,9) monthly-window for the BHARs to ensure the long-run analysis is robust. This is done with the baseline models, issuance interaction model, and the regional interaction model. Additionally the models are also regressed without the fixed effects to show that model is parsimonious.

Table 2: Regression Models Summary

Model	Equation
(1)	$CARs_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 Controls_i + \gamma_i + \varepsilon_i$
(2)	$BHARs_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 Controls_i + \gamma_i + \varepsilon_i$
(3)	$ESG_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 Controls_i + \gamma_i + \varepsilon_i$
(4)	$CARs_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 First_i + \beta_3 GreenBond \times First_i + \beta_4 Controls_i + \gamma_i + \varepsilon_i$
(5)	$BHARs_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 First_i + \beta_3 GreenBond \times First_i + \beta_4 Controls_i + \gamma_i + \varepsilon_i$
(6)	$ESG_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 First_i + \beta_3 GreenBond \times First_i + \beta_4 Controls_i + \gamma_i + \varepsilon_i$
(7)	$CARs_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 APAC_i + \beta_3 GreenBond \times APAC_i + \beta_4 Controls_i + \gamma_i + \varepsilon_i$
(8)	$BHARs_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 APAC_i + \beta_3 GreenBond \times APAC_i + \beta_4 Controls_i + \gamma_i + \varepsilon_i$
(9)	$ESG_i = \beta_0 + \beta_1 GreenBond_i + \beta_2 APAC_i + \beta_3 GreenBond \times APAC_i + \beta_4 Controls_i + \gamma_i + \varepsilon_i$

3.3. Descriptive Statistics

From **Table 3**, it shows that despite negative minimum values for the CARs and BHARs value, the average is still positive. In terms of the number of observations, due to data availability, there are more data points for the CARs value in terms of the BHARs value and ESG score. This is a result of available data points in the WRDS Compustat database and the reporting done by the issuing company, respectively. There is a wide spread in the value of the ESG score and issuance amount. As the size of the issuance is not being limited for this study, the logged issuance amount ranges from € 6.04 to 21.19. For the rest of the control variables, the spread is more minimal as the values are logged and so looks at the differences to avoid skewness. With a lower spread, this can mean that the companies involved are similar in performance. ESG score still has a higher standard deviation but due to the distribution of the variable, it was not logged. Additionally **Table 4** presents the distribution of the sample in terms of industry, year, region, and frequency of issuance.

Table 3: Descriptive Statistics

Variable	***N***	***Mean***	***SD***	***Min***	***Max***
CARs (-5,5)	711	0.00049	0.05253	-0.24063	0.24215
CARs (-10,10)	721	0.00681	0.08384	-0.33660	0.51727
BHARs (-6,6)	589	0.03055	0.27718	-0.89392	2.02619
BHARs (-9,9)	423	0.04669	0.42778	-1.07494	2.62184
GreenBond	728	16.08253	3.01904	6.04257	21.19427
ESG Score	548	60.34254	19.48014	5.86844	95.73148
Leverage	728	0.33256	0.17901	0.00073	0.87497
ROA	680	-3.96887	1.17090	-11.67644	-0.77223
Market to Book Ratio	727	0.22446	0.81802	-4.24395	6.15783
Size	728	3.0976	0.07071	2.59667	3.33693
Coupon Rate	728	0.31252	1.23553	-4.60517	4.02404

Table 4: Sample Distribution

Industry	***N***	***Percent***
Communication Services	9	1.24
Consumer Discretionary	26	3.57
Consumer Staples	13	1.79
Energy	9	1.24
Financials	197	27.06
Health Care	5	0.69
Industrials	95	13.05
Information Technology	16	2.20
Materials	39	5.36
Real Estate	198	27.20

Year	***N***	***Percent***
2013	1	0.14
2014	3	0.41
2015	3	0.41
2016	4	0.55
2017	17	2.34
2018	46	6.32
2019	89	12.23
2020	118	16.21
2021	229	31.46
2022	218	29.95

Utilities	121	16.62	
Total	**728**	**100.00**	

Total	**728**	**100.00**	

Region	***N***	***Percent***
APAC	374	51.37
Non-APAC	354	48.63
Total	**728**	**100.00**

Issuance	***N***	***Percent***
First	479	65.80
Recurring	249	34.20
Total	**728**	**100.00**

4. Results

4.1. Diagnostic Tests

Diagnostic tests were performed on the models to ensure that the OLS assumptions hold. This includes the heteroskedasticity test, multicollinearity, and skewness. In doing so, it ensures that the results will not be biased, inefficient, or inconsistent. Additionally it helps to see whether or not the model fits the data. Referring to **Appendix A,** in performing the heteroskedasticity test, the results are 0.0000 for most of the models, except for the models with ESG score as the dependent variable, indicating that the models are heteroskedastic. Additionally, most of the data is also skewed as the results are also 0.000. Therefore, each of the models will use cluster IssuerID to control for heteroskedasticity and skewness, thus giving more accurate standard errors for the model. Additionally, all the models do not have multicollinearity issues as the VIF value is less than or close to 10 but is a lot higher for models with the regional interaction term. From **Appendix B**, it can also be seen that there is no value that is close to 1 or -1 in all three tables, thus indicating no clear presence of high correlation between the included variables.

4.2. CARs Regression

Table 5 presents the results of the regression done on models with CARs (-10,10) as the dependent variable. From the table, we can see that there is a positive and statistically significant relationship between green bond issuance and short-term stock prices for all models except for the one with the first issuance interaction term. For the first model that does not use any fixed effects, green bond issuance is significant at 10% and 5% level. Next, for model (1), it is also statistically significant at 10% and 5% significance level. For this model, the coefficient 0.00247 implies that a 1% increase in the green bond issuance amount is associated with an increase of 0.00247 percentage points in the CARs, holding all other variables constant. For model (7), it is significant at 10% significance level. The coefficient indicates that a 1% increase in the green bond issuance amount is associated with a CARs value increase of 0.00280 percentage points. In comparison to the findings of Tang and Zhang (2020), this magnitude is smaller than their analyzed impact of conventional bonds, which is approximately 0.05% to 0.1%. Moreover, the effect is smaller than that of Flammer (2021), who found a 0.20% to 0.30% increase in CARs after green bond announcements.

Despite smaller effects being found, the relationships in the model are still statistically significant. However, the interaction terms are not significant in any of the models, which means that both the frequency of the issuance and the region of the issuing company does not determine how the green bond issuance affects the short-term stock price. The main relationship finding is in line with the findings of Suttichayapippat (2022), where the region does not affect the way in which green bond issuance affects short term abnormal returns. This could be the result of using companies that follow the ICMA principles and thus have a level of standardization, regardless of the issuing region. Additionally, whether it is a first or a recurring issuance is not significant, different from the finding of Tang and Zhang (2020), though this could be the result of only using the primary market and thus not having enough recurring issuances in the sample.

From the results, the adjusted R^2 value is highest for model (1), where no interaction terms are included in the model but uses industry and time fixed effects, increasing from 0.12, 0.015, to 0.019. Although considerably low, this is caused by the many factors that affect abnormal returns.This indicates that the variable that indicates the region and whether it is the first issuance does not increase the model fitness. For the control variables included, they are not statistically significant except for ROA in all the models. The results show a negative relationship, which is different from most findings but this could be due to the additional risks that a company is exposed to as they grow that decreases abnormal returns. Additionally, according to Zhang (2005), companies with a higher ROA implies stable returns and so only attracts conservative investors, thus not creating short term abnormal returns. With that, it can be concluded that there is a positive statistically significant relationship between green bonds and short-term CAR, in line with Hypothesis 1.

Table 5: CARs Regression Results

	Dependent Variable: CARs (-10,10)			
		(1)	**(4)**	**(7)**
Green Bond	0.00240**	0.00247**	0.00230	0.00280*
	(0.00105)	(0.00113)	(0.00165)	(0.00164)
Size	-0.10300	-0.08450	-0.08710	-0.08240
	(0.09600)	(0.09680)	(0.09790)	(0.09570)
Leverage	0.00987	0.01040	0.01010	0.01360
	(0.02330)	(0.02690)	(0.02700)	(0.02700)
ROA	-0.01030***	-0.01240***	-0.01240***	-0.01250***
	(0.00321)	(0.00714)	(0.00471)	(0.00481)
Market to Book Ratio	0.00675	0.00456	0.00462	0.00398
	(0.00654)	(0.00714)	(0.00711)	(0.00719)
Coupon Rate	-0.00298	-0.00242	-0.00243	-0.00301

	(0.00234)	(0.00255)	(0.00255)	(0.00272)
First Issuance			-0.00640 (0.03520)	
First Interaction			0.00031 (0.00210)	
Region				-0.00122 (0.03680)
Region Interaction				-0.00026 (0.00223)
Industry	No	Yes	Yes	Yes
Number of Obs.	665	665	665	665
Adjusted R^2	0.015	0.019	0.012	0.013

Note(s): *This table reports the cross-sectional OLS regression results of green bond issuance on short-term CARs, together with other control variables including year and industry fixed effects. The dependent variable is green bond issuance size in EUR, while the independent variable is a (-10,10) daily-window CAR. The list of control variables includes firm size (Size), financial leverage (Leverage), operating profitability (ROA), valuation indicator (Market to Book Ratio), and the bond coupon size (Coupon Rate). An interaction term of whether it is a first or recurring issuance (First Issuance and First Interaction) and one for whether or not the issuing company is from APAC (Region and Region Interaction) was also included. Clustered standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.*

4.3. BHARs Regression

On the other hand, results of the BHARs (-6,6) regression show that the effect of green bonds on long-term stock prices are not statistically significant for any of the models that were tested. Results presented in **Table 6** show a negative relationship, which is different from the effect seen in short-term CARs, along with hypothesis 2. Although model fitness increases from 0.019 to 0.040 for the initial model to model (2), indicating that adding fixed effects makes a better model, results do not change in terms of significance and direction. Moreover, the interaction terms with whether it is a first issuance or not is and the issuing region was also not significant but has a positive and negative relationship, respectively. Although results cannot be interpreted due to ambiguity from the statistical insignificance, it can still be noted that these results indicate that for most of the models, in the long-run, the issuance of green bonds does not have any significant effects on abnormal returns. Different from the findings of Friede, Busch, and Bassen (2015) and Flammer (2021), the reasoning for this may be the shock that does not last in the long-run or skepticism of firms.

In terms of control variables, there is a statistically significant negative relationship with company size and leverage for all the models. Analysis found a negative relationship where the larger the firm size and the higher leverage, the lower the long term abnormal returns are. Different from

past studies, both analysts and investors are more critical of larger companies, leading to more efficient stock markets. With that, when announcement of new issuances take place, such as with green bonds, abnormal results are more prominents in larger companies. Whereas for smaller companies, it takes time for news on announcements to be known and have an effect on stock prices (Fama and French, 1992). Moreover, higher leverage indicates higher debt, which for investors can mean higher perceived risk. Therefore, stock prices can be affected negatively due to the debt level. Differently there is a positive relationship between coupon rate and BHARs, which means that higher coupon rates would increase long-term results. These findings are supported by Houweling, Mentink, and Vorst (2005) and Bae, Kang, and Wang (2011) that explains how investors seek for high returns to compensate for risk, thus having higher demand for bonds with higher coupon rates, affecting the market reaction.

Table 6: BHARs Regression Results

	Dependent Variable: BHARs (-6,6)			
		(2)	**(5)**	**(8)**
Green Bond	-0.00219 (0.00335)	-0.00072 (0.00342)	0.00328 (0.00425)	-0.00027 (0.00481)
Size	-.55200** (0.25100)	-0.43200* (0.25500)	-0.42200* (0.25500)	-0.43400* (0.25700)
Leverage	-0.02400 (0.08590)	-0.08580 (0.08940)	-0.08290 (0.09030)	-0.06420 (0.08930)
ROA	-0.02580* (0.01330)	-0.03820** (0.01600)	-0.03830** (0.01610)	-0.03790** (0.01620)
Market to Book Ratio	0.01190 (0.02740)	0.01570 (0.02450)	0.01550 (0.02440)	0.01260 (0.02520)
Coupon Rate	0.01410* (0.00820)	0.01720* (0.00916)	0.01760* (0.00937)	0.01300 (0.00965)
First Issuance			0.10100 (0.11200)	
First Interaction			-0.00600 (0.00672)	
Region				-0.07840 (0.12800)
Region Interaction				0.00277 (0.00769)
Industry	No	Yes	Yes	Yes

Number of Obs.	553	553	553	553
R^2	0.019	0.040	0.037	0.039

Note(s): *This table reports the cross-sectional OLS regression results of green bond issuance on long-term BHARs, together with other control variables including year and industry fixed effects. The dependent variable is green bond issuance size in EUR, while the independent variable is a (-6,6) monthly-window BHAR. The list of control variables includes firm size (Size), financial leverage (Leverage), operating profitability (ROA), valuation indicator (Market to Book Ratio), and the bond coupon size (Coupon Rate). An interaction term of whether it is a first or recurring issuance (First Issuance and First Interaction) and one for whether or not the issuing company is from APAC (Region and Region Interaction) was also included. Clustered standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.*

4.4. ESG Score Regression

Similar to the findings on BHARs (-6,6), **Table 7** presents a negative relationship between green bond issuance and the issuer's ESG score that is not statistically significant. This ambiguous result indicates that there is a weak relationship between the two main variables that cannot be concluded with the provided models. However, the negative relationship means that an increase in the issuance amount lowers the ESG score. The statistical insignificance means that there is no strong evidence that shows the effect of the issuance on ESG score. It was explained that a positive and significant result is hypothesized due to the required ICMA principles and commitment towards keeping a good reputation. Hoang et al. (2022) finds a positive relationship with an underlying requirement to internalize externalities that motivate issuers to improve ESG scores. The ambiguous results either indicate that it requires more time for the impact on ESG scores to materialize or that issuing firms do not necessarily adopt more sustainable practices after the issuance.

Once again, both interaction terms are not statistically significant. The effect towards ESG score of whether it is a first issuance or from the APAC region is also ambiguous. Therefore, for all the cases, there is not an evident relationship between issuing green bonds and green initiatives taken by the company. Results may indicate signs of greenwashing as issuing companies don't necessarily make efforts to increase their ESG score after the issuance. Differently, constants are now significant which means that more variables could be added to the model for better fit but limited data poses difficulties. In terms of the fitness of the model, it is the highest for model (6) and (9) at 0.040 in comparison to the other models, which means that the model explains approximately 4% of the relationship.The lower score can be a result of many variables that can affect the other components of the ESG score.

Table 7: ESG Score Regression Results

	Dependent Variable: ESG Score

		(3)	(6)	(9)
Green Bond	-0.20900 (0.32900)	-0.21800 (0.34900)	0.20400 (0.53800)	-0.48600 (0.46500)
Size	-2.73500 (14.38000)	-1.06500 (15.3900)	1.56100 (15.8600)	-3.18500 (15.8100)
Leverage	-9.15200 (6.19100)	-10.2700 (7.36300)	-10.4000 (7.32000)	-9.71800 (7.50200)
ROA	-0.24300 (0.72300)	0.41300 (0.91600)	0.26900 (0.93000)	0.60400 (0.93800)
Market to Book Ratio	1.59700 (1.25100)	1.41400 (1.32700)	1.40500 (1.32600)	1.50300 (1.38700)
Coupon Rate	0.60500 (0.81200)	0.32800 (0.93100)	0.36700 (0.92500)	0.12200 (0.99100)
First Issuance			11.94000 (8.93700)	
First Interaction			-0.67000 (0.56100)	
Region				-14.08000 (11.90000)
Region Interaction				0.80900 (0.71200)
Fixed Effects	No	Yes	Yes	Yes
Number of Obs.	506	506	506	506
R^2	0.011	0.038	0.041	0.041

Note(s): *This table reports the cross-sectional OLS regression results of green bond issuance on ESG score, together with other control variables including year and industry fixed effects. The dependent variable is green bond issuance size in EUR, while the independent variable is the Refinitiv ESG score. The list of control variables includes firm size (Size), financial leverage (Leverage), operating profitability (ROA), valuation indicator (Market to Book Ratio), and the bond coupon size (Coupon Rate). An interaction term of whether it is a first or recurring issuance (First Issuance and First Interaction) and one for whether or not the issuing company is from APAC (Region and Region Interaction) was also included. Clustered standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.*

4.5. Robustness Test

The robustness test is performed to test whether the results highlighted above are robust and consistent, despite changes in the models. To test the short-term CARs, the results presented in **Table 8 and Appendix C** show the regression between green bond issuance with a 11-day event window. Similar to the findings in **Table 5**, there are positive and statistically significant results between the

green bond and short-term stock price. Model (1) is significant at 10% level, while model (7) is significant at 10% and 5% significance level. The interpretation of model (1) is that a 1% increase in the green bond issuance amount is associated with an increase of 0.00126 percentage points in the CARs, while model (7) shows that it is associated with an increase of 0.00228 units in the CARs. The difference is that with this model, there is a significant positive relationship for the region variable and a negative relationship with the regional interaction term at 10% and 5% significance level. The results indicate that if the issuing company is from the APAC region, it has higher CARs. However, the coefficient of the interaction term shows that with a 1% increase in green bond issuance amount, the short-term CARs decrease by 0.00298 units more for issuing firms in APAC countries compared to non-APAC firms. This shows that the immediate reaction may be slightly different from the 21-day window results, though the relationship stays robust.

Table 8: Summarized Robustness Test for Short-Term CARs Results

	Dependent Variable: CARs (-5,5)			
		(1)	**(4)**	**(7)**
Green Bond	0.00104 (0.00066)	0.00126* (0.00069)	0.00103 (0.00124)	0.00229** (0.00092)
First Issuance			-0.00230 (0.02540)	
First Interaction			0.00034 (0.00148)	
Region				0.04970** (0.02170)
Region Interaction				-0.00295** (0.00131)
Fixed Effects	No	Yes	Yes	Yes

Note(s): T*his table reports the cross-sectional OLS regression results of green bond issuance on short-term CARs, together with other control variables including year and industry fixed effects. The dependent variable is green bond issuance size in EUR, while the independent variable is a (-5,5) daily-window CAR. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; Standard errors are presented in the parentheses.*

For the robustness test done on the long-term BHARs using the 19-month window, results show that the initial findings are robust and consistent. **Table 9** and **Appendix D** shows that there is a statistically insignificant and negative relationship between the green bonds and long-term abnormal returns. A longer BHARs window is chosen for the robustness test to see if the insignificance in the prior BHARs regression was due to the window that was not long enough. However, the findings here confirm and prove that there is not enough evidence to conclude hypothesis 2 is accepted and that

there is also a positive and significant effect to abnormal returns in the long run, as for the short-term CARs. However, there is a higher model fitness for model (2) as it has the highest adjusted R^2 value of 0.055. This value can still be considered as low, but many things outside of controlled firm and bond characteristics also affect abnormal returns. The coupon rate and ROA is still significant for all the models, which emphasizes the preference investors have for bonds with higher coupon rates. The results indicate that a 1% increase in coupon rate and firm ROA increases the BHAR by approximately 0.033 percentage points and 0.06 percentage points, respectively. Although insignificant, the second column shows weak evidence that a 1% increase in green bond issuance decreases the BHAR by approximately 0.00704 percentage points.

Table 9: Summarized Robustness Test for Long-Term BHARs Results

	Dependent Variable: BHARs (-9,9)			
		(2)	**(5)**	**(8)**
Green Bond	-0.00758 (0.00773)	-0.00701 (0.00779)	-0.00812 (0.01630)	-0.01210 (0.01160)
First Issuance			-0.06210 (0.34900)	
First Interaction			0.00172 (0.01970)	
Region				-0.16500 (0.31500)
Region Interaction				0.01100 (0.01840)
Fixed Effects	No	Yes	yes	Yes
Adjusted R^2	0.025	0.055	0.051	0.051

Note(s): *This table reports the cross-sectional OLS regression results of green bond issuance on long-term BHARs, together with other control variables including year and industry fixed effects. The dependent variable is green bond issuance size in EUR, while the independent variable is a (-9,9) monthly-window BHAR. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; Standard errors are presented in the parentheses.*

Lastly, for the ESG robustness test, the value is logged. This is done because based on the descriptive statistics, there is a higher range of values for the ESG score. In changing the form of the variable, the initial results found are also robust. **Table 10** and **Appendix E** shows that for green bond issuances, there is still a negative statistically insignificant relationship with ESG score, despite the log transformation. The coefficient is also close for both the main regression and the robustness test,

wherein with a 1% increase in the green bond issuance amount, there is a 0.005 to 0.007 percentage point decrease in the ESG score. Moreover, the constant is still statistically significant at 10%, 5%, and 1% significance level. With that, the conclusion that not enough control variables are included for the ESG analysis. Therefore, these findings go against hypothesis 3 where there is a positive and statistically significant relationship with the ESG score.

Table 10: Summarized Robustness Test for ESG Score

	Dependent Variable: ESG Score			
		(2)	**(5)**	**(8)**
Green Bond	-0.00593 (0.00710)	-0.00499 (0.00747)	0.00042 (0.01630)	-0.00797 (0.01160)
First Issuance			0.16400 (0.19200)	
First Interaction			-0.00874 (0.01250)	
Region				-0.18200 (0.25100)
Region Interaction				0.01000 (0.01510)
Fixed Effects	No	Yes	Yes	Yes
Adjusted R^2	-0.002	-0.014	-0.016	-0.017

Note(s): *This table reports the cross-sectional OLS regression results of green bond issuance on ESG score, together with other control variables including year and industry fixed effects. The dependent variable is green bond issuance size in EUR, while the independent variable is the Refinitiv ESG score. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; Standard errors are presented in the parentheses.*

5. Conclusion and Recommendations

5.1. Conclusion

There has been an evident increase in the issuance of green financial tools, green bonds being of the most prominent one, due to worsening climate issues. This raises awareness towards the need to implement sustainable practices and the urgency to undergo green projects. Many papers have discussed the benefit that an investor may get by investing in green bonds. However, there is still a research gap in the benefits for issuers in terms of firm performance, separate from the projects the bonds are allocated towards. Not only is the sustainability of the issuer tested, but also the market reaction that should affect stock price. Therefore, this study aims to answer the research question of "How does the issuance of green bonds affect ESG score, along with short-term and long-term stock

prices of publicly listed issuing companies?" The study looked into both immediate short-term reactions and prolonged long-term reactions to the issuances.

The study used a cross-sectional dataset of publicly listed companies that issue green bonds in line with the ICMA principles from the year 2013 to 2022. A cross-sectional OLS regression for baseline models, models with a frequency interaction term, and models with a regional interaction term were analyzed with industry and year fixed effects to test for the 5 hypotheses. It can be concluded that the H_1 was fulfilled as the regression done between the issuance and (-10,10) CARs showed a positive and statistically significant relationship between green bonds and short-term stock prices for most of the models. The results were further confirmed by the robustness test done with the (-5,5) CARs value that found the same results. As the issuance value increases, there is also an increase in the short-term abnormal returns. However, the model fitness is still considerably low, though results are still significant for the one with the highest value.

Next, results proved that there is not enough evidence to conclude that H_2 is true. In regressing the green bond issuance on the long-term BHARs, results show a statistically insignificant negative relationship between the two variables. Results of the robustness test brough the same results, wherein it indicates that an increase in green bond issuance would instead decrease the BHARs value. However, this cannot be concluded as it is not significant though the hypothesis is rejected. H_3 was also rejected as results showed statistically insignificant negative results. Although it may seem intuitive that ESG score would increase as green bonds are used for the issuers to undergo green projects, the results may be due to lags in the realization of the project or even greenwashing practices that may come from fully optimizing sustainable practices within the firm.

Lastly, H_4 and H_5 were also rejected as there were no significant results shown for the interaction term. Results show that both the frequency of the issuance and the region of the issuer does not impact the way green bond issuance affects short-term CARs, long-term BHARs, and ESG scores. This may be a result of the small sample of recurring green bond issuers or the standards of the green bond and issuers that follow the ICMA principles instead of focusing on regional regulations, respectively. Therefore, it can be concluded that green bond issuances have an effect on short-term stock prices, but lacks evidence on its effect towards long-term stock prices and ESG score.

5.2. Limitations and Recommendations

With the results of the study, there are still limitations that need to be considered that can be used for improvements in further studies. First would be that this study only uses green bond data from the Bloomberg terminal. The Bloomberg portal has data on green bonds issued from 2010 onwards, meanwhile CBI has data from 2007 when the first green bond was issued. Although this was intentional as the ICMA green bond principle was only published and imposed from 2013, data from earlier years may also provide important insights as it still required a certified third party to verify the issuance and use of proceeds. Additionally, in exploring more markets beyond the primary market,

more bonds with reissuances can be collected. With a larger data sample, a more sophisticated regression model can be used with the panel data, such as the difference-in-difference, and fixed effect regression. However current constraints in data availability still make cross-sectional the best option for the study that was done. Moreover, a study including the American and Canadian market can also be done as it can bring insights, although this study did not include it due to the difference in market maturity and data availability in the WRDS system.

Next, there is also a smaller sample for the ESG score as many companies still do not publish their ESG score and it is difficult to extract only the environmental dimension of the score. With more data and the breakdowns of the dimensions or pillars, it would help to better see whether the insignificant result is due to the environmental component or others. Similarly, there is also less data availability for long-term BHARs. Due to the longer window used for the study, the WRDS dataset was used as it has the most adequate amount of data for an event study. However, the data is not fully updated, thus resulting in more recent issuances to not have the BHARs data as the system does not have a record of the recent stock prices. Lastly, more firm and bond specific control variables would improve the fitness of the models, however data availability is always a problem and results in many missing data for companies.

Therefore, the first recommendation is to explore more datasets and to be more open to merging various datasets to get the most complete list of issuances. One of the main options would be to explore CBI and include data from earlier years and from the American and Canadian region. Second, looking into sources that also measure ESG score other than Refinitiv can be used to see if there are discrepancies in the scores and to derive the individual pillar value. Third, manually calculating the BHAR value seems ineffective but can be an option, though using a lower cutoff point can also be done considering that more recent issuances are included for further studies. Additionally, it would be interesting for further studies to analyze the effect of green bonds towards stock price and ESG score with lags in the model as this does not only look at the signaling and announcement effect, but the actual effect of projects funded by the green bonds.

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Appendices

Appendix A: *Diagnostic Test Results*

Test	**(1)**	**(2)**	**(3)**	**(4)**
Breusch-Pagan Prob > Chi2	0.0002	0.0000	0.8945	0.0003
VIF Mean	1.19	1.18	1.17	8.58
Skewness Test Pr(Skewness)	0.0000	0.0000	0.0000	0.0000

Test	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Breusch-Pagan Prob > Chi2	0.0000	0.8260	0.0002	0.0000	0.6033
VIF Mean	8.40	8.63	10.80	11.00	10.80
Skewness Test Pr(Skewness)	0.0000	0.0000	0.4833	0.0000	0.0000

Appendix B: Pairwise Correlation Test

B.1. CARs5 Correlation Test

Variable	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**
CARs10	1.0000						
GreenBond	0.0791	1.0000					
Size	-0.0708	-0.0717	1.0000				
Leverage	0.0277	0.0990	-0.2564	1.0000			
FirmROA	-0.0977	0.1271	-0.1286	0.1994	1.0000		
MarketBook	-0.0073	0.1205	0.1271	0.2488	0.4288	1.0000	
Coupon	0.0295	0.1284	-0.1402	-0.0012	0.1122	0.1123	1.0000

B.2. BHARs6 Correlation Test

Variable	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**
BHARs6	1.0000						
GreenBond	-0.0398	1.0000					
Size	-0.1210	-0.0717	1.0000				
Leverage	-0.0173	0.0990	-0.2564	1.0000			
FirmROA	-0.0759	0.1271	-0.1286	0.1994	1.0000		
MarketBook	-0.0650	0.1205	0.1271	0.2488	0.4288	1.0000	
Coupon	0.0497	0.1284	-0.1402	-0.0012	0.1122	0.1123	1.0000

B.3. ESG Score Correlation Test

Variable	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**
ESG	1.0000						
GreenBond	-0.0142	1.0000					
Size	0.0218	-0.0717	1.0000				
Leverage	-0.0716	0.0990	-0.2564	1.0000			
FirmROA	-0.0013	0.1271	-0.1286	0.1994	1.0000		
MarketBook	0.0364	0.1205	0.1271	0.2488	0.4288	1.0000	
Coupon	0.0457	0.1284	-0.1402	-0.0012	0.1122	0.1123	1.0000

***Appendix C**: Complete Robustness Test for Short-Term CARs Results*

	Dependent Variable: CARs (-5,5)			
		(1)	**(4)**	**(7)**
Green Bond	0.00104 (0.00066)	0.00126* (0.00069)	0.00103 (0.00124)	0.00229** (0.00092)
Size	0.01950 (0.04190)	0.02600 (0.04340)	0.03040 (0.04490)	0.03420 (0.04320)
Leverage	0.01430 (0.01310)	0.00815 (0.01400)	0.00866 (0.01420)	0.00752 (0.01450)
ROA	-0.00114 (0.00183)	-0.00109 (0.00255)	-0.00106 (0.00256)	-0.00182 (0.00261)
Market to Book Ratio	-0.00106 (0.00344)	-0.00130 (0.00348)	-0.00144 (0.00350)	-0.00174 (0.00348)
Coupon Rate	-0.00101 (0.00130)	-0.00172 (0.00133)	-0.00179 (0.00134)	-0.00112 (0.00144)
First Issuance			-0.00230 (0.02540)	
First Interaction			0.00034 (0.00148)	
Region				0.04970** (0.02170)
Region Interaction				-0.00295** (0.00131)
Fixed Effects	No	Yes	Yes	Yes
Number of Obs.	655	655	655	655
Adjusted R^2	0.002	0.007	0.009	0.004

***Note(s):** *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; Standard errors are presented in the parentheses.*

***Appendix D**: Robustness Test for Long-Term BHARs Results*

	Dependent Variable: BHARs (-9,9)			
		(2)	**(5)**	**(8)**
Green Bond	-0.00758 (0.00773)	-0.00701 (0.00779)	-0.00812 (0.01630)	-0.01210 (0.01160)
Size	-0.72900* (0.41100)	-0.39600 (0.40400)	-0.41600 (0.40400)	-0.43000 (0.41100)
Leverage	-0.07200 (0.14200)	-0.16400 (0.15800)	-0.16800 (0.15800)	0.17500 (0.15400)
ROA	-0.04600** (0.02340)	-0.06090** (0.03040)	-0.06100** (0.03040)	-0.05880 (0.03170)
Market to Book Ratio	0.06640 (0.04560)	0.06700 (0.04150)	0.06760 (0.04130)	0.07120* (0.04250)
Coupon Rate	0.03150** (0.01410)	0.03340** (0.01690)	0.03380** (0.01710)	0.03280* (0.01820)
First Issuance			-0.06210 (0.34900)	
First Interaction			0.00172 (0.01970)	
Region				-0.16500 (0.31500)
Region Interaction				0.01100 (0.01840)
Fixed Effects	No	Yes	yes	Yes
Number of Obs.	389	389	389	389
Adjusted R^2	0.025	0.055	0.051	0.051

***Note(s):** *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; Standard errors are presented in the parentheses.*

***Appendix E**: Robustness Test for ESG Score Results*

	Dependent Variable: ESG Score			
		(2)	**(5)**	**(8)**
Green Bond	-0.00593 (0.00710)	-0.00499 (0.00747)	0.00042 (0.01630)	-0.00797 (0.01160)
Size	-0.12000 (0.33200)	-0.08420 (0.35900)	-0.04060 (0.37300)	-0.10500 (0.35800)
Leverage	-0.14300 (0.14000)	-0.22700 (0.16600)	-0.23000 (0.16500)	-0.21400 (0.16700)
ROA	-0.02070 (0.02490)	-0.05760 (0.04400)	-0.06080 (0.04470)	-0.05140 (0.04480)
ROE	0.02730 (0.03360)	0.06980 (0.04910)	0.07130 (0.04990)	0.06490 (0.04850)
Market to Book Ratio	0.02570 (0.02590)	0.014600 (0.02930)	0.01420 (0.02940)	0.01570 (0.03010)
Coupon Rate	0.02110 (0.02250)	0.01580 (0.02630)	0.01610 (0.02570)	0.012700 (0.02810)
First Issuance			0.16400 (0.19200)	
First Interaction			-0.00874 (0.01250)	
Region				-0.18200 (0.25100)
Region Interaction				0.01000 (0.01510)
Fixed Effects	No	Yes	yes	Yes
Number of Obs.	506	506	506	506
Adjusted R^2	-0.002	-0.014	-0.016	-0.017

***Note(s):** *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; Standard errors are presented in the parentheses.*