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Do Issuers Benefit from Green Bonds Issuance: Cross-Region Analysis

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Abstract

Climate change represents one of the biggest collective problems faced by society, which necessitates a shift towards smart, low-carbon economies within the next 20 years. As a financial instrument aiding green development, proceeds raised from green bonds are used to finance climate- and environment-friendly projects. However, whether issuers actually benefit from this instrument remains debatable. This study applies the event study methodology and the difference-in-differences model to explore the stock market reaction to green bond issuance and its effect on firms' profitability. Our analysis was based on a global sample of corporate green bonds issued between 2013 and 2022. The empirical results highlight a negative stock market reaction around the announcement of green bond issuance. Additionally, post-issuance, green bond issuers record better profitability than their non-green counterparts. Overall, although green bond issuances signal unfavourable information about issuing firms, issuers still record better profitability than their non-green counterparts.

Keywords: green bonds, financial performance, event study, sustainability

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1. Introduction

With the rapid expansion of the global economy, environmental issues have become increasingly prominent, making economic growth and sustainable development a major topic of discussion (Crespo Cuaresma et al., 2013). As a result, research on sustainable development has increased significantly (Kudratova et al., 2018; Scholtens et al., 2008). Under the broad framework of sustainable development, the green economy and finance products have become key drivers of economic progress in the 21st century. As a crucial tool for transitioning from a carbon-intensive economy to a green economy, low-carbon green development has emerged as a central goal of global environmental governance, particularly since the 21st United Nations Climate Change Conference. Unlike traditional finance, green finance places greater emphasis on interdependence between the environment and human survival. Green finance evaluates the impact of firms' activities based on environmental protection and responsible resource utilization, encouraging economic enterprises to prioritize balanced environmental development. It advocates the harmonized growth of financial institutions, society, and the environment, with the ultimate goal of achieving sustainable societal development. Therefore, this study explores whether issuers benefit from issuing green bonds as financial instruments in the green finance sector.

While there is no universally accepted definition of green bonds, various organizations have been established to set guidelines and provide certifications for these bonds. ICMA defines green bonds as "loan instruments that enable capital raising and investments in new and/or existing projects, which promote environmental benefits." They were introduced in 2007 when a group of Swedish pension funds sought to invest in projects aimed at combating global warming, but were uncertain about how to raise the necessary funds (World Bank, 2019). In response, the World Bank developed an innovative financing tool with a significant environmental impact, which led to the issue of the world's first green bond. Initially, sovereign issuers such as the World Bank and the European Investment Bank dominated the green bond market. However, since the first corporate green bond issued in 2013, the market has evolved into a more diverse space, including asset-backed securities, corporate, financial and municipal bonds (Kochetygova & Jauhari, 2014). As of 2022, the total amount of issued green bonds surpassed $1 trillion and is expected to be $5 trillion annually as of 2025 (Climate Bonds Initiative, 2022).

The primary aim of green bonds is to raise funds to finance low-carbon projects and green technology. When companies adopt green practices by issuing green bonds, they gain economic advantage. Green bonds encourage firms to implement environmentally friendly practices across their operations, leading to three key outcomes: (1) a substantial decrease in energy costs, (2) enhanced operational efficiencies, and (3) increased tax incentives from the government (Lagas, 2015; Whelan & Fink, 2016). Long-term savings on costs and tax rebates directly boost profitability, whereas improved efficiencies result in maximizing output with minimal input. Thus, green bonds could indirectly impact corporate financial performance by encouraging companies to embrace sustainable practices, which eventually leads to higher profits and improved financial valuation (Zhou & Cui, 2019). Essentially, green bonds act as catalysts for the adoption of green practices, which in turn drive wealth creation.

This study uses listed firms worldwide that issued corporate green bonds as the research object to examine whether issuers actually benefit from this financial instrument. Specifically, we examine the impact of the announcement of green bond issuances on the stock prices of firms, as well as their impact on profitability. An event study methodology is used to study the stock market reaction, whereas a DID model is used to investigate the profitability of green bond issuers had they issued a regular bond. Although some studies have verified how issuers could potentially benefit from this instrument, the results remain mixed and we make the following contributions. First, we compare this relationship among the top three regions with the highest number of green bond issues, specifically, North America, Europe, and Asia. This helps us verify if the benefit issuers can obtain from this instrument differs according to the region in which they are domiciled. Second, we investigate whether specific issuer and issue characteristics, such as the underwriter's reputation, use of proceeds, and issuer type, could influence the stock market reaction to the announcement of green bonds. Finally, this study contributes to previous studies that examined the financial performance of green bond issuers using a larger dataset (Baulkaran, 2019; Flammer, 2018; Tang & Zhang, 2020).

This study provides evidence of a negative and significant stock market reaction around the announcement of green bond issuance. The negative reaction remains significant for financial issuers, bonds underwritten by low-reputable underwriters, bonds whose proceeds finance non-climate-related projects, and for companies domiciled in Europe. Additionally, comparing the profitability of green and non-green bond issuers, we find that green bond issuers record better profitability than their matched counterpart post-issuance. This relationship remains significant for firms domiciled in Europe and Asia but insignificant for firms domiciled in North America.

The remainder of this paper is organized as follows; Section 2 presents the literature review, and the data and research methodology are highlighted in Section 3. The results are presented in Section 4, and the concluding remarks are presented in Section 5.

2. Literature review

Researchers have long believed that investing in environmental protection seldom offer economic advantages to firms. However, as the economy has evolved, researchers have questioned this belief. For instance, previous studies document that corporate investments and financing decisions can lead to mutually beneficial outcomes for the environment and firm (Esty & Porter, 1998; Reinhardt, 1999). Examining current research on how firms might gain from green bonds reveal that these benefits can be described in multiple dimensions. For instance, they entail; the stock market reaction to the announcement of green bond issuance, the effect on profitability, and their ability to secure green finance at a cheaper price than regular bonds.

2.1 Stock market reaction

Regarding the stock market reaction, empirical results are missed, while most document that green bonds positively impact the stock returns of issuers, others do not arrive at this conclusion. The first study on this was conducted by (Tang & Zhang, 2020) based on firm-level data from 28 countries. Their results highlight a positive stock market reaction around the announcement of green bond issuance. Similarly, Karpf & Mandel (2018), using green bond data from Europe, Canada, the US, China, and Australia, document a positive abnormal return, which is reduced by a higher coupon rate. Kapraun et al., (2021), compared the stock market reactions of corporate green bonds and conventional bonds, and their results indicated a significant and positive reaction for all bond issuance announcements. However, the market reaction of bonds issued after the Paris Agreement was higher than that of conventional bonds. Furthermore, Flammer (2021) examined globally issued corporate green bonds and found a positive and significant market response to issuance announcements. Their result was more pronounced for first-time issuers and green bonds certified by independent third parties. Finally, Chen et al., (2022) analyzed the green bond stock market reaction issued in both mainland China and Hong Kong and document a positive and significant association.

Nevertheless, some studies document a negative stock market reaction around green bond announcements. Lebelle et al., (2020), finds an unfavorable market response to the announcement of green bond issuances. Their results remained significant for the first issues and for issuers domiciled in developed markets compared to subsequent ones and those domiciled in emerging markets. Additionally, Wang & Li (2020) find a negative market reaction to green bonds issued in China. Specifically, they highlight that in a short window the stock market had no obvious response to green bond issuance and a significantly weak negative reaction in a longer time window. Similarly, Mehmetcan & Yavuz (2024) document a negative stock market reaction. Amidst these diverse viewpoints, this study examines how the stock market reacts to green bond announcements.

2.2 Effect on profitability

Another strand of the literature analyzed the effect of green bond issuance on corporate profitability. Using propensity score matching and the DID methodology, Zhou & Cui (2019), examined the relationship between

green bond issuance and corporate performance, and highlight a significant positive relationship between the two variables. Additionally, based on the extended Fama-French model, Ley (2017) finds that issuing green bonds positively affects a firm's financial performance. Similarly, Flammer (2018) document that corporate green bonds are effective in enhancing firm performance, as measured by ROA and Tobin's Q. They further highlight that issuing green bonds in sectors in which environmental issues are financially significant leads to a more substantial improvement in financial performance. Building on this, Flammer (2020) incorporated bond certification as a dummy variable and found that green bond issuers perform better than their non-green counterparts in terms of profitability. Moreover, using a panel dataset of Chinese listed companies, Tan et al., (2022) highlight an increase in corporate performance with an overall effect of 1.65% post green bond issuance. Finally, Agliardi & Chechulin (2020) also document a positive link between bond issuance and corporate performance.

However, Zerbib (2019) documents that investors attracted by the "green" label do not significantly advance green bond development, suggesting that if issuers merely use the "green" label without enhancing financial performance, they can be considered a form of "greenwashing". Similarly, Maltais & Nykvist (2020) argued that green bonds are largely similar to regular bonds in terms of financial performance. Moreover, while examining corporate green bonds issued between 2015 and 2019, Yeow & Ng (2021) found that issuers do not enjoy any significant financial benefits post issuance. Similarly, a study by Wang & Li (2020) based on green bonds issued in China found no significant improvement in issuers' financial performance post issuance. Although some previous studies suggest that green bonds improve financial performance, more comprehensive evidence is required to confirm these findings. Hence, we examine the profitability of green bond issuers post issuance compared to that of non-green bond issuers.

2.3 Pricing advantage

Another way issuers can benefit from issuing green bonds is through their ability to secure cheaper financing. Since the inception of the green bond market, there have been discussions regarding the pricing gap between green bonds and their traditional counterparts, since previous studies have produced mixed results. Zerbib (2019) examines green bond pricing in the secondary market by pairing each green bond with an identical non-green bond from the same issuer and concludes that, on average, green bonds are priced 2bps higher than their non-green counterparts. Ehlers & Packer (2017), compared the spreads of green and non-green bonds in the primary market and found an average spread difference of 18 bps. Similarly, Preclaw & Bakshi (2015) find a yield differential of 20 bps in the secondary market. Moreover, Gianfrate & Peri (2019) employed the PSM methodology to evaluate the issuance return of green bonds against non-green bonds issued in Europe. They highlight that investors are willing to pay a premium of 18.5 bps, which is more pronounced for corporate firms than financial firms. Furthermore, Baker et al., (2018) analysed the pricing of US municipal bonds and discovered that green bonds offer lower yields of approximately 6 bps compared to conventional bonds.

Contrary to the aforementioned studies, Bachelet et al., (2019) examine a diverse sample comprising both certified and non-certified corporate and government bonds and find a higher yield for corporate green bonds. Additionally, Hachenberg & Schiereck (2018) highlight that green bonds trade slightly tighter than their non-green counterparts. Moreover, Karpf & Mandel (2018) examine the yield differential of US municipal green and

non-green bonds in the secondary market and find no premium. Furthermore, Kapraun et al., (2021) document significantly lower yields for green bonds in the primary market, ranging between 20 and 30 bps. In summary, the research findings present a wide range of outcomes regarding the pricing advantage. However, owing to difficulties collecting this data, this part will not be analyzed in this paper.

3. Data and research methodology

3.1 Data

To construct the data set, we collected information on green bonds from Refinitiv Eikon between January 2013, the year in which the first corporate green bond was issued and December 2022. This database is among the best providers of information on the primary bond market, and all its information on green bonds comes from the Climate Bond Initiative database. It provides detailed information on bond characteristics, including but not limited to the issuer type, announcement date, coupon rate and third-party certification. The data collected resulted in 3,995 corporate green bonds issued by private and public firms. Since we could not access the information of private firms, we further narrowed our sample size to 1,194 green bonds issued by public firms. Some firms had missing information on important data, which reduced the sample to 1,133 corporate bonds, of which 762 were unique firm-year observations (some firms issue several green bonds in a year).

We further collected stock and market index prices. In the second part of the analysis, we compare the profitability of green bond issuers (treated group) and non-green bond issuers (control group). Thus, we downloaded the yearly financial information of these issuers spanning from 2011 till 2022. The main information downloaded include; ROA. ROE, leverage, size, environmental score, social score and governance score. The control group consists of firms that have access to debt securities markets, but have not issued a green bond until the end of our sample selection. For ease of comparison, all amounts were collected in US dollars.

3.2 Research design

As mentioned, we examine whether issuers benefit from green bond issuance. The analysis is conducted in twofold, in the first part we analyze the stock market reaction to the issuance of green bonds and in the second part we look at the effect on profitability.

Event study model

An event study is a useful approach for assessing how specific events impact various financial variables. Such events may include announcements about stock splits, dividends, mergers and acquisitions. This article focuses on the first announcement date of green bonds, collected from Refinitiv Eikon. The estimation window spans from [-281, 30], equivalent to 252 trading days, which represents the expected or normal return of the security, assuming that the event had not occurred. The event windows selected were a 21-day window [-10,10], an 11-day window [5,5], and a 3-day window [-1,1]. Additionally, a pre- [-10, -1] and post- [10,20] event window is used to assess any potential leakage before the announcement or any delay in the market response, respectively (Brooks, 2019).

Several advanced event study methods have been developed to enhance the robustness of the results. We employ the statistical market model, a widely recognized method used to estimate abnormal returns (Baulkaran, 2019;

Lebelle et al., 2020). The market model estimates expected (or normal) returns through a one-factor ordinary least squares regression. For security i, the market model is expressed as follow;

$$R_{it} = \alpha_i + \beta_i * R_{mt} + \varepsilon_{it} \quad (1)$$

Where α_i and βi are the parameters of the market model, R_{it} and R_{mt} are the returns of security i and the market portfolio m at time t, and the error term is ε_{it}. The primary stock market index for each country under examination is used in the analysis.

Additionally, the estimated market model parameters were used to forecast the expected stock returns ($\hat{R}_{it}$) for each day t within the event window, as shown below:

$$\hat{R}_{it} = \hat{\alpha}_{it} - \hat{\beta}_{it} * \hat{R}_{mt} \quad (2)$$

Next, the daily abnormal return is calculated by subtracting the estimated return from the actual return for each day t within the event window:

$$AR_{it} - R_{it} - \hat{R}_{it} \quad (3)$$

DID model

A DID model is often used to assess the net effect of a policy intervention by comparing the outcomes of treated and control groups before and after the intervention (Abadie et al., 2015; Heckman & Robb, 1985). Prior to conducting the DID regression, we matched each green bond with an identical non-green bond to ensure that they face similar conditions before any green bond issue. Matched companies operate in a similar country, have identical years, and belong to a similar industry sector as the green bond issuer. From the outstanding potential firms, the closest neighbor is selected based on six firm-level attributes: size, ROA, leverage, environmental score, social score and governance score. Each characteristic is evaluated using data from the year before the green bond issue (t-1) and the "pre-trend" (i.e., the change from t-2 to t-1), which resulted in a total of 12 matching variables. The closest neighbor is defined as the firm with the smallest Mahalanobis distance to the treated firm.

Table 1 presents the average values and t-tests of the matched variables. Levels (e.g Size) are measured one year prior to the issue of green bonds, whereas pre-trends, (e.g dSize) are assessed within the two-year period before the green bond issue. The mean and median values of the treated and matched firms and their corresponding P-values are presented in Table 1. Out of 762 green bond year observations, 488 found matched non-green bonds. In general, most of the matched variables do not exhibit significant differences between the mean and median values (P-Mean and P-Med).

After matching both green and non-green bond issuers, we further established a panel dataset spanning from 2010 to 2022 and estimated the following DID regression following the study of (Tan et al., 2022; Zhou & Cui, 2019);

$$ROA_{it} = \alpha_i + \alpha_c * \alpha_t + \alpha_s * \alpha_t + \beta * Greenbond_{it} + \gamma * x_{it} + \varepsilon_{it} \quad (4)$$

$$ROE_{it} = \alpha_i + \alpha_c * \alpha_t + \alpha_s * \alpha_t + \beta * Greenbond_{it} + \gamma * x_{it} + \varepsilon_{it} \quad (5)$$

where i denotes firms, t denotes years, c represents countries, and s represents industries. α_i represents the firm fixed effects, $\alpha_c * \alpha_t$ the country by year fixed effects, $\alpha_s * \alpha_t$ the industry by year fixed effects, and the error term is ε_{it}. Our dependent variables, ROA_{it} and ROE_{it}, are widely used metrics in previous studies to measure profitability (Yeow & Ng, 2021; Zhou & Cui, 2019). The dependent variable is $Greenbond_{it}$, a dummy

variable. In the treatment group, the year in which a firm issues a green bond and the following years are coded 1, while all other years are coded 0. All years had a value of 0 in the control group. The coefficient of interest, denoted as β, quantifies the difference-in-differences in the dependent variable among the treated firms and matched control firms. Essentially, β captures the variation in the dependent variable subsequent to the issuance of green bonds while adjusting for simultaneous changes in similar firms that do not issue green bonds. x_{it} entails a predetermined array of control variables, precisely those used in the matching process (size, leverage, Escore, Gscore, Sscore). To address the potential impact of any differences in the regression results, we incorporate one-year lags for these variables. To address the impact of extreme values, all variables were winsorized to the 1st and 99th percentiles of their respective empirical distributions. We clustered standard errors at the industry level.

Table 1: Comparison of treated and matched control firms

		Obs	Mean	Median	St.dev.	P-Mean	P-Med
Panel A: Variables used in matching							
Size	Treated firms	488	24.73	24.44	2.08	0.27	0.21
	Control firms	488	24.88	24.87	2.28		
ROA	Treated firms	488	3.49	2.33	4.26	0.96	0.77
	Control firms	488	3.48	2.58	3.92		
Leverage	Treated firms	488	28.34	27.65	15.78	0.94	0.82
	Control firms	488	28.41	30.26	15.83		
Escore	Treated firms	488	70.52	73.75	18.98	0.01	0.01
	Control firms	488	66.86	69.26	19.17		
Sscore	Treated firms	488	69.64	72.99	17.99	0.10	0.08
	Control firms	488	67.72	71.46	18.20		
Gscore	Treated firms	488	65.57	69.43	19.82	0.05	0.03
	Control firms	488	63.16	65.94	18.82		
dSize	Treated firms	488	0.087	0.07	0.14	0.01	0.02
	Control firms	488	0.063	0.05	0.09		
dROA	Treated firms	488	-0.15	-0.03	4.46	0.46	0.56
	Control firms	488	0.017	0.01	2.66		
dLeverage	Treated firms	488	0.079	-0.05	4.08	0.84	0.36
	Control firms	488	0.034	0.08	3.20		
dEscore	Treated firms	488	2.23	0.79	7.53	0.82	0.79
	Control firms	488	2.33	1.11	7.26		
dSscore	Treated firms	488	2.28	0.54	7.34	0.62	0.79
	Control firms	488	2.06	0.65	6.23		
dGscore	Treated firms	488	2.01	1.44	11.93	0.34	0.39
	Control firms	488	2.72	2.06	10.98		

4. Empirical results

4.1 Descriptive statistics

Table 2 presents the summary statistics at the bond level. It is common for a single firm to issue multiple green bonds on the same day. The 3,955 bonds represent 3,087 unique issuer-days and 2,221 unique issuer-years,

issued by 1,511 distinct issuers. It has an average maturity of 8.85 years and about 67% are certified by a third party. Distinguishing between bonds issued by private and public firms as shown in column (2) and (3), 2,761 bonds were issued by private firms (from 967 unique issuers) whereas 1,194 bonds were issued by public firms (from 544 unique issuers). Public firms tend to issue larger bonds with longer maturities, and their bonds are more certified than those of private firms. The analysis of this paper as mentioned above will focus on green bonds issued by public firms due to the availability of detailed firm-level data.

Table 2: summary statistic at bond level

	All	**Private**	**Public**
	(1)	(2)	(3)
# Green bonds	3955	2761	1194
# Green bond issuer-days	3087	2082	1005
# Green bond issuer-years	2221	1376	845
# Green bond issuer	1511	967	544
Amount (in $M)	274.0 (348.0)	229.0 (314.0)	363.0 (403.0)
Certified (1/0)	0.67 (0.47)	0.65 (0.48)	0.71 (0.45)
Maturity (years)	8.85 (42.16)	7.50 (20.50)	10.34 (57.85)

Table 3 presents the summary statistics at the firm level for treated and matched firms. Between 2011 and 2022, selected firms issued an average of 0.13 green bonds. The mean values of green bonds may seem low, but this can be explained as follows: first, around 50% of the observations are control firms, and they all take the value of 0. Second, green bond issuers, also take a value of 0 until the year they issue their first green bond. The financial indicators precisely ROA and ROE disclose an average value of 4.17 and 13.12 during our selected period.

Table 3: Summary statistic at firm level

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Greenbond	6240	0.13	0.34	0	1
ROA	6240	4.17	5.05	-9.68	24.21
ROE	6240	13.12	14.11	-49.37	62.39
Escore	6240	56.96	26.64	5.52	97.48
Sscore	6240	56.15	25.55	2.75	96.42
Gscore	6240	54.84	24.93	3.48	98.87
Size	6240	24.30	2.28	19.87	30.46
Leverage	6240	28.07	16.76	0.52	71.97

4.2 Event study results

The results for different event windows are presented in Table 4. We obtained negative CARs across different event windows, implying that the market reacts negatively to the announcement of green bonds. The negative and statistically significant event windows are those around the twenty-day event window [-10, 10], ten-day event window [-5, 5] and the event window prior to the time intervals [-10, -1]. This finding is similar to that of (Baulkaran, 2019; Lebelle et al., 2020; Mehmetcan & Yavuz, 2024), who document an unfavorable stock market reaction to green bond announcements. However, this contradicts that of (Flammer, 2021; Tang & Zhang, 2020), who document a positive stock market reaction.

For robustness check, we employ multi-factor models to calculate abnormal returns, specifically, Fama and French 3-factor and 5-factor models (Fama & French 1993, Fama & French 2015). The results obtained using these two models are quite similar to those of the market model, only the event windows [-10;-1], [-10;10] and [-5;5] are negative and significant at the 5 percent level whereas the other event windows lack statistical significance.

Table 4: Stock market reaction

Panel A: Market Model				
Event Time	# of events	CAAR	T-Statistics	T-Sign
[-10;-1]	1133	-0.0040**	-2.0795	-1.9131
[-10;10]	1133	-0.0080**	-2.7795	-2.1508
[-5;5]	1133	-0.0040**	-1.9813	-2.0914
[-1;1]	1133	-0.0016	-1.4972	-1.3187
[10;20]	1133	-0.0015	-0.7213	-1.5628
Panel B: Fama and French 3 -Factor Model				
[-10;-1]	1133	-0.0110**	-2.3761	-2.7044
[-10;10]	1133	-0.0227**	-1.9594	-2.4073
[-5;5]	1133	-0.0115**	-2.2145	-1.6347
[-1;1]	1133	-0.0041	-1.5164	-1.4073
[10;20]	1133	-0.0123	-1.5568	-1.4667
Panel C: Fama and French 5 - Factor Model				
[-10;-1]	1133	-0.0105**	-2.1477	-2.8900
[-10;10]	1133	-0.0215**	-2.7233	-2.2957
[-5;5]	1133	-0.0112**	-2.1152	-1.7071
[-1;1]	1133	-0.0038	-1.6676	-1.2957
[10;20]	1133	-0.0108	-1.5435	-1.6089

Notes: a *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

b Values in parentheses indicates the robust standard errors.

Issue characteristics and stock market reaction

We further investigate how the negative stock market reaction differs based on various green bond issues and issuer characteristics, while focusing on the CAR calculated over the ten-day event window [-5, 5]. In Panel A of Table 5, we distinguish between the first and subsequent issues. A similar comparison was carried out by (Flammer, 2021; Lebelle et al., 2020; Tang & Zhang, 2020), who documented that green bond issuers do not benefit from the label effect after their initial issue. The rationale is that once a firm has label a bond as green and disclose it to all investors, there should be no positive effect on subsequent issues. From the results in panel A, the CARs of first-time issues are significant and larger than those of subsequent issues, suggesting that investors place more importance on initial green bond issues than later ones. We further investigate how the stock market reacts to different types of green bond issuers, specifically corporate and financial issuers. Following studies conducted by (Lebelle et al., 2020; Tang & Zhang, 2020), this comparison is made because issuers use proceeds from green bonds differently. While corporate firms use proceeds to finance their personal green projects, financial issuers lend proceeds to other firms. The result shows that the stock market reaction to green bonds issued by corporate firms is negative but insignificant, whereas that of financial institutions is significant at the 5 percent level. This finding is similar to that of Lebelle et al., (2020), who finds a negative and significant equity reaction for financial issuers compared to corporate issuers.

Panel C examines how the stock market reacts to certified and non-certified green bonds. For a green bond to be classified as certified, issuers need to undergo a third-party verification which is quite costly. Hence, certified green bonds serve as a stronger signal of a firm's dedication to addressing environmental issues. The CAR values of certified green bonds lack statistical significance, whereas those of non-certified green bonds are larger and significant at the 5 percent level. Panel D further partitions the dataset into green bonds for which proceeds were used for climate-related projects and those used for non-climate-related projects. The CAR value is negative but insignificant for climate-related projects, whereas it doubles and becomes significant for non-climate-related projects. Panel E further differentiates between green bonds underwritten by underwriters with high- and low-reputation. Following Chen et al., (2019), the underwriter's reputation is measured based on the proportion of underwriting volume relative to the total bond issuance volume in a given year. An underwriter has a high reputation when its median value is above that of all underwriters, otherwise, a low reputation. To the best of our knowledge, no study has yet investigated what signal investors infer when reputable underwriters agree to put their name on line. From the results, the market reacts negatively to bonds underwritten by low reputable underwriters significant at the 5 percent level, whereas those underwritten by highly reputable underwriters have an insignificant reaction.

Stock market reaction per regions

We further investigate the stock market reaction across the three regions with the highest volume of green bond issue, specifically, North America, Europe, and Asia. From the results presented in Table 6, the stock market has a positive but insignificant reaction to green bonds issued in North America. This positive market reaction could be influenced by the number of observations, as a smaller number of firms are domiciled in North America than in other regions. The market reaction to green bonds issued in Europe is negative and significant at the 10 and 5 percent levels, depending on the model utilized. One possible explanation is investor skepticism regarding the

legitimacy of green bonds issued in this region. Investors may doubt that issuers use the proceeds as intended, probably because of the voluntary nature of various standards. Lebelle et al., (2020), examining the stock market reaction to green bonds issued in developed and emerging markets, found a negative and significant reaction in developed markets and an insignificant reaction in emerging markets. Our finding on green bonds issued in Europe is similar to theirs since Europe is a developed market. Finally, Asian firms disclose an insignificant negative reaction.

Table 5: Issue/Issuer characteristics and stock market reaction

Panel A: First-Time Vs Subsequent Issues						
	First-Time Issues			Subsequent Issues		
	CAAR	T-Statistics	T-Sign	CAAR	T-Statistics	T-Sign
Market Model	-0.0054**	-1.7185	-1.9184	-0.0025	-0.9440	-0.9313
FF3 model	-0.0044***	-2.2750	-2.4719	-0.0169	-0.8884	-0.3449
FF5 model	-0.0047**	-1.8839	-1.9013	-0.0161	-1.6307	-1.7000
Observations	501	501	501	632	632	632
Panel B: Corporates Vs Financials						
	Corporates			Financials		
	CAAR	T-Statistics	T-Sign	CAAR	T-Statistics	T-Sign
Market Model	-0.0076	-1.4493	-1.5982	-0.0018**	-2.0072	-2.3508
FF3 model	-0.0093	-1.6651	0.0628	-0.0140**	-2.4074	-2.4388
FF5 model	-0.0098	-1.5338	0.2229	-0.0127**	-2.9794	-1.8402
Observations	598	598	598	535	535	535
Panel C: Certify Vs Non-Certify						
	Certify			Non-Certify		
	CAAR	T-Statistics	T-Sign	CAAR	T-Statistics	T-Sign
Market Model	-0.0028	-1.1427	-1.2262	-0.0069*	-1.9464	-1.9532
FF3 model	-0.0069	-1.5464	-1.3532	-0.0152**	-2.0882	-1.9305
FF5 model	-0.0096	-0.5457	-0.0994	-0.0151**	-2.0726	-1.8826
Observations	798	798	798	335	335	335
Panel D: Climate vs Non-Climate						
	Climate			Non-Climate		
	CAAR	T-Statistics	T-Sign	CAAR	T-Statistics	T-Sign
Market Model	-0.0043	-0.6856	-0.9372	-0.0035**	-2.0689	-1.9267

FF3 model	-0.0115	-1.2990	-0.9750	-0.0115*	-2.0232	-1.797
FF5 model	-0.011	-1.167	-0.438	-0.0112**	-2.0043	-2.2235
Observations	690	690	690	443	443	443

Panel D: High Underwriter vs Low Underwriter

	High Underwriter			Low Underwriter		
	CAAR	T-Statistics	T-Sign	CAAR	T-Statistics	T-Sign
Market Model	-0.0051	-1.6255	-0.6290	-0.0090**	-2.1241	-2.4870
FF3 model	-0.0099	-0.8505	-0.1339	-0.0139***	-2.7282	-2.2833
FF5 model	-0.0103	-0.9635	-0.1658	-0.0132**	-2.438	-1.915
Observations	533	533	533	600	600	600

Notes: a *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

b Values in parentheses indicates the robust standard errors.

Table 6: Stock market reaction in different region

	North America			Europe			Asia		
	CAAR	T-Stat	T-Sign	CAAR	T-Stat	T-Sign	CAAR	T-Stat	T-Sign
Market Model	0.002	0.244	-0.115	-0.005*	-1.835	-1.826	-0.003	-0.767	-0.701
FF3 model	0.007	0.982	0.493	-0.015**	-2.295	-1.757	-0.009	-1.202	-0.826
FF5 model	0.003	0.504	0.819	-0.014**	-2.864	-2.718	-0.010	-1.332	-1.075
Observations	141	141	141	656	656	656	336	336	336

Notes: a *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

b Values in parentheses indicates the robust standard errors.

4.3 Effect on profitability

Table 7 presents the results of equation (4) and (5) examining green bond issuance effect on the profitability of green bond issuers, as measured by ROA and ROE, compared to that of non-green bond issuers. Columns (1) and (2) maintains ROA as the dependent variable, whereas column (3) and (4) maintains ROE as the dependent variable. In columns (1) and (3), $Greenbond_{it}$ is positive and significant at the 5 percent level. This means that, post issuance, green bond issuers disclose better profitability than their matched counterparts. These results are similar to that of (Flammer, 2018; Tan et al., 2022; Zhou & Cui, 2019), who found that green bond issuers outperform their matched conventional counterparts. However, this contradicts the findings of (Maltais & Nykvist, 2020; Sachs et al., 2019; Wang & Li, 2020), who documented no significant relationship between the two variables.

Columns (2) and (4) defines additional dummy variables to track the short- and long-term impact of green bond issuance on profitability. $Greenbond_{it-1}$ (pre-issue year) equals 1, the year prior to the green bond issue, otherwise

0. $Greenbond_{it+1}$ (short-term, one year) equals 1, the year following the issuance of green bonds, otherwise 0. Lastly, $Greenbond_{it+2}$ (long-term, 2+ years) equals 1 two years post green bond issuance, otherwise 0. All the short-term dummy variables are insignificant, and only the long-term dummy variable is significant at the 1 and 5 percent levels. Hence, we can deduce that it takes several years for green bonds to have any significant effect on the profitability of firms.

Table 7: Financial Performance of green bond issuers

	ROA_{it}		ROE_{it}	
	(1)	(2)	(3)	(4)
$Greenbond_{it}$	0.366**		1.290**	
	(0.113)		(0.442)	
$Greenbond_{it-1}$		-0.399		-1.380
		(0.321)		(1.161)
$Greenbond_{it+1}$		0.648		1.903
		(0.416)		(1.212)
$Greenbond_{it+2}$		0.655***		1.739**
		(0.225)		(0.678)
Firm Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Ctry_Year FE	YES	YES	YES	YES
Ind_Year FE	YES	YES	YES	YES
Observations	6,240	6,240	6,240	6,240
R-squared	0.763	0.814	0.626	0.651

Notes: a *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

b Values in parentheses indicates the robust standard errors.

Effect of profitability in different regions

We further partition the dataset according to the three regions with the highest number of green bond issues; North America, Europe and Asia. This enables us to determine whether the profitability of green bond issuers differs according to their domiciled region. Table 8, maintains ROA as the dependent variable. Columns (1) and (2) present the results for issuers based in North America, and as seen, there is no significant difference in the profitability of both green and non-green bond issuers. Columns (3) and (4) present the results for issuers domiciled in Europe, and the green bond indicator is positive and significant at the 5 percent level. This means that, post-issuance, green bond issuers domiciled in Europe record better profitability than their non-green counterparts. Similarly, issuers based in Asia record better profitability post-issuance as seen in Columns (5) and (6).

In Table 9, ROE is maintained as the dependent variable. Similarly, as shown in Table 7, only issuers based in Europe and Asia significantly improve their profitability post-issuance compared to their matched non-green counterparts. Overall, issuing green bonds has no statistical effect on the profitability of firms based in North America since the result only remains significant for firms based in Europe and Asia.

Table 8: Effect of ROA in different regions

Dependent Variable: ROA_{it}						
	North America		Europe		Asia	
	(1)	(2)	(3)	(4)	(5)	(6)
$Greenbond_{it}$	-0.830		1.367**		1.212**	
	(0.622)		(0.511)		(0.450)	
$Greenbond_{it-1}$		-1.005		-0.286		-0.589
		(0.718)		(0.259)		(1.201)
$Greenbond_{it+1}$		-0.833		-0.578		-0.671
		(0.766)		(0.504)		(0.649)
$Greenbond_{it+2}$		-1.102		0.988**		1.154***
		(0.742)		(0.216)		(0.374)
Firm Controls	Yes	Yes	Yes	Yes	Yes	
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Ctry_Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind_Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	972	972	2,892	2,892	2,160	2,160
R-squared	0.089	0.093	0.057	0.076	0.060	0.066

Notes: a *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

b Values in parentheses indicates the robust standard errors.

Table 9: Effect of ROE in different regions

Dependent Variable: ROE_{it}						
	North America		Europe		Asia	
	(1)	(2)	(3)	(4)	(5)	(6)
$Greenbond_{it}$	-1.265		1.372**		3.130**	
	(1.844)		(0.508)		(1.117)	
$Greenbond_{it-1}$		-0.851		-0.772		4.607
		(2.495)		(1.058)		(4.138)
$Greenbond_{it+1}$		-1.089		1.463		2.036
		(3.026)		(1.576)		(1.508)
$Greenbond_{it+2}$		-2.763		1.857**		3.766***
		(2.545)		(0.632)		(0.811)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
CountryYear FE	Yes	Yes	Yes	Yes	Yes	Yes
IndustryYear FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	972	972	2,892	2,892	2,160	2,160

R-squared	0.028	0.030	0.035	0.029	0.024	0.033

Notes: a *, ** and *** indicate significance at 10%, 5% and 1% level, respectively.

b Values in parentheses indicates the robust standard errors.

5. Conclusion

This study explored the increasing popularity of green bonds as a financial instrument and analyzed how issuers could benefit from this instrument. Specifically, we analyzed the effect of the announcement of green bonds on firms' stock prices and the impact of green bond issuance on the profitability of green bond issuers compared to non-green bond issuers. An international dataset of corporate green bonds issued by public firms between 2013 and 2022 and a panel dataset of both green and non-green bond issuers from 2011 to 2022 were utilized. Based on the results of the event study analysis, we find a significant negative reaction around the announcements of green bonds. The relationship remains significant for first-time issues, financial issuers, bonds underwritten by underwriters with low reputation, and those domiciled in Europe. The results of the second part of the analysis, based on a matching methodology and a DID model, reveal an enhancement in the profitability of green bond issuers compared to that of non-green bond issuers, as measured by ROA and ROE. Comparing this result among the three regions with the highest green bond issues, it remained significant for firms domiciled in Europe and Asia, and insignificant for firms based in North America.

These findings are important for firms, researchers, and policymakers, as understanding whether issuers' benefits from green bonds could accelerate market growth, as the total issuance amount remains low compared to the conventional bond market. Although this study offers insight into the benefits that issuers could enjoy, future studies could also look at other mechanism through which this instrument could be beneficial to issuers, such as pricing advantage. It is also important to examine how investors and other market participants, such as underwriters, could benefit from this instrument. Finally, future studies can analyze a larger dataset by including private firms, which was not possible in our case due to data limitations.

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