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The announcement effect of green bond issuers on their listed share price

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Abstract

In a low carbon economy transition, Green bond market represents one of the main tools to switch towards an ESG investment approach. This study focuses its attention on the Green Bond market in Europe, in particular it studies the effect of the announcement of a green bond issuance by a listed company on its share price. In order to investigate this relationship and test the market efficiency hypothesis, I used MacKinley event study methodology, computing cumulative abnormal returns on a final sample of green and conventional bonds going from January 2013 to December 2019. After having obtained evidence of non negative relationship between green bond issuance and the relative company share price, I conducted robustness checks controlling for some firm characteristics and some specific geographical regions. This study shows that firms can contribute to the environment protection without suffering reductions in their value.

Key words

Green Bond, Green Bond Market, ESG, Event study

Responsibility for any remaining errors lies with the author alone.

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List of Abbreviations

AAR	Average abnormal return
AR	Abnormal return
CAAR	Cumulative average abnormal return
CAR	Cumulative abnormal return
CBI	Climate Bonds Initative
EBIT	Earning before interest and taxes
ESG	Enviromental, Social and Governance
GBP	Green Bond Principles
ICMA	International Capital Markets Association
ROA	Return on assets
SSA	Sovereign and Supranational Agency
SIC	Standard Industrial Classifications

1. Introduction

Two of the main challenges Europe and the rest of the world are asked to overcome are climate change and environmental degradation. In order to face such important threats and make the European economy sustainable, European Union adopted the Paris Agreement in 2015 and published an historic agreement on the *European Green Deal in 2019.* It highlighted the importance of long-term signals to direct financial and capital flow towards green and sustainable investments. In this framework, green bond market represent one of the main tools to switch towards an ESG investment approach. According to what was reported by Climate Bond Initiative[1], the third quarter of 2020 was the most plentiful ever recorded in terms of green bond issues: at the end of October, the global value of the green bond market reached $ 194.6 billion, recording an increase of 9% if compared to the same period of the previous year.

Green bonds are fixed-income instruments used to finance environmental and sustainable development projects. Green bonds differ from conventional bonds because of several characteristics. First, the "green" nature of the projects; another main difference is that corporate bonds are usually issued for general purposes, while proceeds from green bond issuance have to be tracked to ensure funds are invested in green projects (ICMA[2], 2014). In fact, after having issued the bond, companies are asked to submit post-issuance reports in order to guarantee that funds are addressed to proper sustainable investments. Green Bond market has experienced an important evolution through years, not only in terms of amount of bonds issued but also of types of issuers. In the beginning, from 2007 to 2013, green bond issuers were mainly Sovereign Supranational and Agency issuers (SSA[3]); starting from 2013, financial and corporate firms drew their attention to this type of assets and its market.

Given the importance that ESG investments are assuming in the financial market scenario, it appears interesting to study the reaction of the stock market when there is the announcement of an imminent green bond issuance, in order to better investigate whether

[1] Climate Bond Initiative: international, investor-focused not-for-profit organization.
[2] ICMA: International Capital Market Association
[3] SSA: international institutions that have differing funding requirements, such as development banks, infrastructure developers, export creditors, shipping entities, etc. (BSIC, 2020)

issuing green bonds can impact on firm value. Previous studies, such as Flammer (2020), Tang&Zhang (2018) and Glavas (2020), analysed several probable reasons behind the relationship between green bond issuance by listed companies and stock market reaction. In line with these authors, one hypothesis about the effect of green bond issuance on companies share price could be found in the signalling theory: since green bond issuance implies more information if compared to conventional bond issuance, it is a way of reducing information asymmetry. Another possible reason lies in the increasing visibility of the firm: green bond issuance is an event usually highlighted by media, therefore it attracts investors attention.

The study is conducted by analysing listed companies share prices through the event study methodology proposed by MacKinlay (1997), considering all public European companies which issued green bonds in the period going from January 2013 to December 2020 and considering an event window given by 5 days before and 5 days after the announcement. An event study is an empirical investigation of the relationship between security prices and economic events (Strong, 1992). In particular, in order to study the effect of the green bond announcements I computed stock abnormal returns (AR), cumulative abnormal return (CAR) and cumulative average abnormal return (CAAR). Also conducting a comparison analysis between green bond issuances companies and conventional bond issuances might help in understanding how an ESG approach – in particular the issuance of green bonds – could influence the corporate financial performance.

For the European market, I find a CAAR equals to 0.05%, which confirms a positive reaction to the announcement. I computed CAAR also for conventional bonds issued in the same period and I obtained a negative value, indicating a green bond premium. In order to conduct some robustness checks, I computed different regressions which confirmed the results obtained in the event study . I inserted some control variables in the regression regarding some firms specific characteristics, such as ROA and Size. Also, since France results as the main green bond issuer country, I run two regressions comparing green bonds issued by French companies and those issued by companies in the Rest of Europe. Also in this case I obtain a positive result, which increases when controlling for firm variables.

The structure of the thesis is the following: Chapter 2 provides a brief presentation of the Green Bond Market, focusing on the European case, and an overview of the existing literature on this topic. Then Chapter 3 describes the process I followed when collecting data useful for the study. Chapter 4 presents the methodology applied and the results obtained, while Chapter 5 provides a final conclusion on my work.

2. Literature Review

Either Green Bond Principle (GBP) and Climate Bond Initiative (CBI) provided some standards for a bond to be considered as green. As it is stated in the relative ICMA document, 'GBP are voluntary process guidelines that recommend transparency and disclosure and promote integrity in the development of the Green Bond market'. Although we might encounter several ways of defining what a green bond is, Green Bond Principles define it as any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects (ICMA, 2014) and which are aligned with the four core components of the GBP (Use of proceeds, Process for Project Evaluation and Selection, Management of proceeds and reporting). There exist four different types of green bonds in the market : standard green use of proceeds bond, green revenue bond, green project bond and green securitised bond (ICMA, 2018), as shown in Table 1.

Table 1 : Four types of green bonds (ICMA, 2018)

Categories	Description
Green use of proceeds bond	Standard debt obligation aligned with GBP
Green Revenue Bond	Obligation aligned with the GBP - credit exposure is to the pledged cash flows of the revenue streams, fees, taxes etc., and whose use of proceeds go to related or unrelated Green Project(s).
Green Project Bond	A project bond for a single or multiple Green Project(s) for which the investor has direct exposure to the risk of the project(s), aligned with the GBP.
Green Securitised Bond	Bond collateralized by one or more specific Green Project(s). The first source of repayment is generally the cash flows of the assets.

The first green bond was issued in 2007 by European Investment Bank and World Bank, then in 2013 also public corporations started entering the green bond market, as Eletricite de France which issued its first green bond in November 2013. In the recent years, this market experienced an exponential and rapid growth: in early December 2020 it reached a global value of USD 1 trillion in cumulative issuance since its market inception. Although the growth is evident, this market still represented only the 2% of the whole bond market according to Refinitiv (2019).

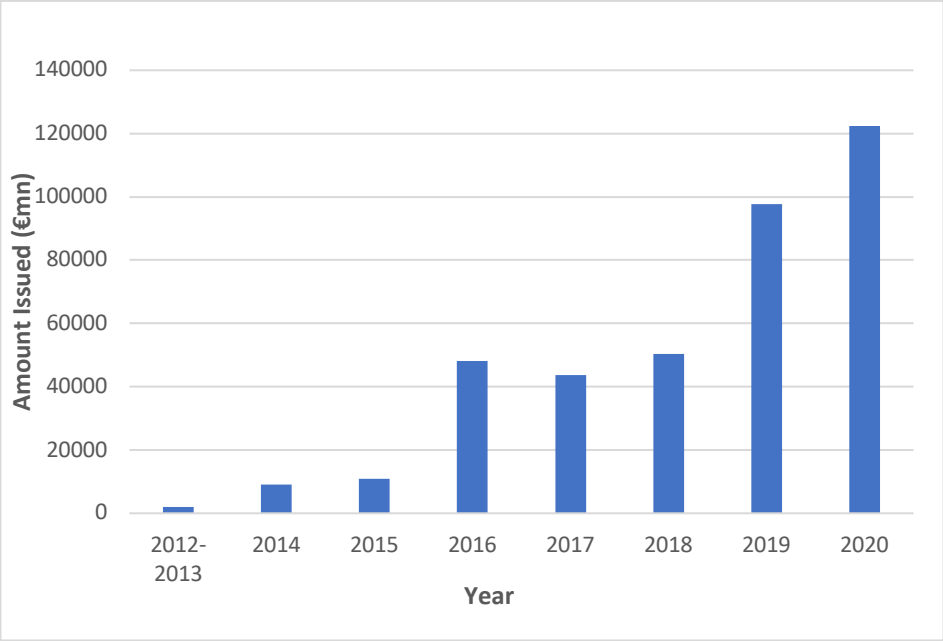

Figure 1: Growth of European Green Bonds from 2012 to 2020

In order to provide a valid insight of the green bond market, looking at the different type of issuers in the Issuer Count (see Figure 2) it is evident that main of the issuances in the European green bond market comes from Non-Financial Issuers over the years, followed by Sovereign issuers and Government-backed entities. It is therefore interesting to focus the attention on corporate green bonds issued by public traders.

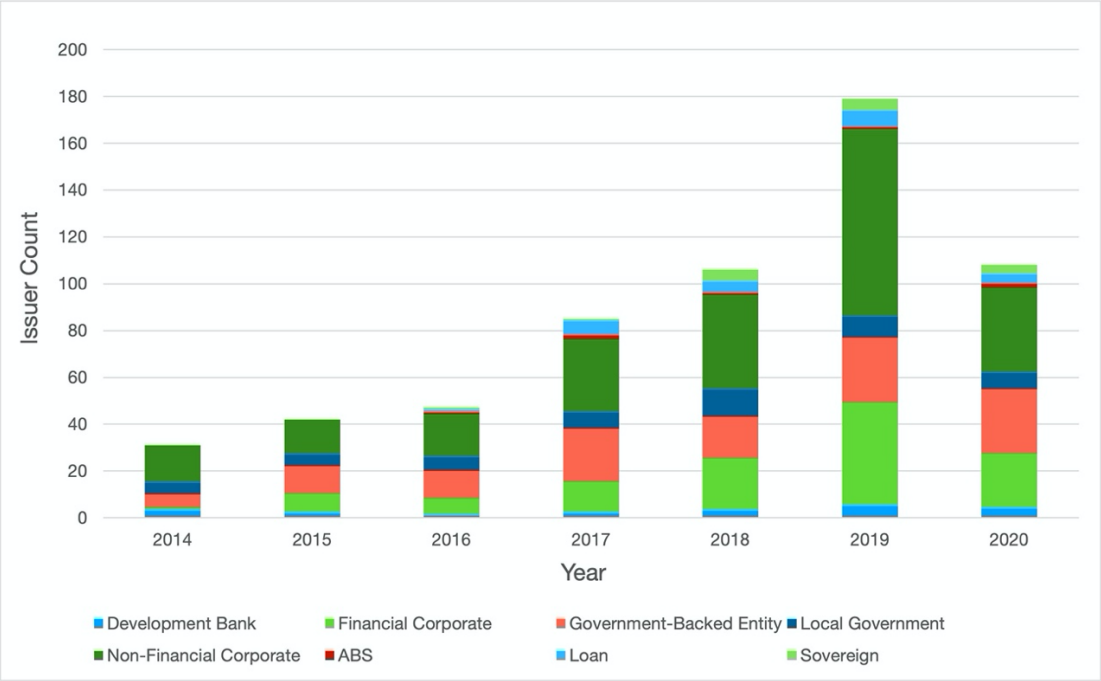

Figure 2: Issuer type by issuer count in Europe from 2014 to 2020

Analysing a first strand of existing literature focusing on the investors, Baulkaran (2018) reported that in the secondary market only a small part of green bonds is traded: most of the investors consist in main institutions. Since impact investing and in particular green bonds are very actual and leading themes, looking at literature we can find several works related to these topics, most of them focusing on the existence of a market premium of green bonds (Bachelet et al, 2019) – also called 'Greenium' (Larcker et al, 2019). Many works analysed this 'green premium', while just some works dealt with the effect of green bond issuance announcement on markets and firm performance – as Flammer (2020) and Tang & Zhang (2018) - which is the main goal of this thesis. In 2017, Zerbib conducted a comparison analysis between green and conventional bonds, from which he found a 0.08% green bond discount in average.

Several authors mentioned above found different probable reasons behind the relation between green bond issuance and stock market reaction. Tang & Zhang (2018) investigated whether shareholders of green bond issuer companies could benefit from the issuance. The authors identify three possible explanations to this relation: "financing cost", according to

which green bond is a valid tool to boost ESG performance and get a consequent lower cost of debt for green bond issuers. Second, firm's attention to green topics could add value in the long term and lastly, green bond issuance could increase firm's visibility and therefore attract investors. This last hypothesis is confirmed by Grullon et al. (2004), who point out that the visibility of a firm causes consequences on the stock market. Flammer (2020) finds that signaling could be one of the main drivers of green bond issuance, through which firms can improve both their financial and environmental results. In his study, Glavas (2020) expects that information coming from the debt market could impact investors perception on main themes such as future value creation since green bonds contain information about firm value.

From this study, I also find a better stock market reaction to green bond announcements in Europe, if compared to conventional bond announcements. One possible reason behind this fact might be a lower cost of capital in case of green bonds. I also find evidence for geographical differences in the equity market reaction to green bonds, in that the European market provides on average a positive stock market reaction than the global average. Focusing on green bonds certified by the authorities, some studies as the one by Hyun, Park, and Tian (2018) found out that a universal green bond standard will provide an improvement to the system of pricing of green bonds and the relative market development.

Corporate green bond market appears to be younger than the others, therefore there is not a consistent number of studies focused on this topic. The first to investigate this topic was Flammer (2020), considering a global sample going from 2013 to 2017. While in his study the analysis was conducted on a global scale, this study focus its attention on the European green bond market. Evidence of positive stock market reaction to green bond issuance announcements can be found also in Tang & Zhang (2018), who conducted an analysis of the global market considering the sample period going from 2008 to 2017. They studied also the difference between first and subsequent green bond announcements, concluding that the cumulative average abnormal returns are significant only in case of first-time announcements.

Glavas (2020) studied the different stock market reaction to green bond announcements before and after the Paris Agreement occurred in 2015, but in his study he uses a sample which includes all corporate green bonds issued from 2013-2018 in the global green bond market. The results show that the stock price reaction to green bond announcements grew after the Paris Agreement, suggesting a change of equity investor behaviour after said agreement. Also in this study he finds out that that green bonds are considered as value-enhancing by markets in Europe as well.

Previous studies as Dasgrupta et al. (2001) find that negative news about sustainability and environment lead to a negative stock market reaction. From the results obtained in this study, we can state that in case of positive environmental news a positive stock market reaction is expected. Also, analyzing previous literature it is evident that companies firms which adopt high environmental standards record larger firm value.

3. Data

The goal of this chapter is to describe the process I followed when collecting data useful for my analysis. In the first part I provide a description of the dataset I used to conduct the event study, which is composed by bond, market index and stock data. The second part is composed by an explanation of the financial data I used to conduct the regression, while the last part shows several descriptive statistics.

3.1 Bonds

In order to conduct my study I obtained data regarding green bonds from Thomson Reuters – Datastream. In particular, I extracted the complete list of all corporate green bonds issued among 2010 and 2020, their relative issue announcement date and information about issuer, maturity, primary market, credit rating, coupon rate, industry and amount issued. I chose Euro as main currency. Furthermore, I excluded from the sample all green bonds issued by banks and financial institutions, following the criterium adopted in previous studies (Glavas-2020). In fact, financial companies do not issue green bond in order to make direct investments in eco-friendly projects, but their goal is to make loans to other firms and borrowers to finance their projects (Fatica, Panzica, & Rancan, 2019). This choice makes the sample reduce a lot, since I consider only public companies identified and labelled as "Corporate" by Thomson Reuters Datastream.

For what concerns the event study, I restrict the sample including green bonds issued only by publicly traded firms: in fact detailed corporate information and stock returns are only available for public firms. Initially, I use the feature of Datastream to identify whether the issuer is a public or private company. Filtering data according to the primary market in which corporate green bonds were issued, we can notice that Asian (Honk Kong, Japan, China, Philippines, Singapore, Taiwan) and NZ markets recorded the highest number of issues, 313, while 253 green bonds were issued in International Market (Eurobonds), 189 in European markets (Belgium, Germany, Denmark, Spain, France, Italy, Norway, Sweden and Switzerland), 65 in the US market and finally 51 in South American markets (Argentina, Brazil and Chile).

Finally, I remove all firms that have confounding events within the window of [− 5] to [+ 5] days around the announcement date. In regards to confounding events, I checked for M&As, stock repurchases, earnings announcements and changes in top management or credit rating.

3.2 Stock Prices

In this study stock prices are used in order to compute daily stock returns. Dataset containing daily stock prices for all the public firms included in the sample is also extracted from Datastream library. When cleaning the dataset, I excluded from the sample all the stocks having missing trading days in the event window. Following these criteria, I obtained a final sample made of 51 green bond issuances and 34 companies. (see appendix A.2).

3.3 Indices

Stock market index is used to obtain daily market return. Dataset containing daily stock market index is collected from Datastream library. For each company, the relative proxy for the market is given by its leading local stock market index, following the examples of Brounen & Derwall (2010). The dataset is therefore composed by 12 different countries, corresponding to 12 stock market indices.

3.4 Control Variables

In order to control the regression for some specific variables, I collected financial data for each public firm from Reuters Datastream library. All the amounts are expressed in Euro, in order to compare across different countries. Following the example of Bradshaw, Richardson & Sloan (2006), I focused on the following firm-specific characteristics, which are considered as potential factors influencing the stock market reaction to the announcement of bond issuances.

First, I considered total assets in order to derive the Size of the company: this is a variable which provides the total amount of assets owned by a company. Then I obtained the EBIT-to-interest expense ratio: the interest coverage measures a company's ability to pay financial commitments on debt in terms of interest expense - the higher the ratio, the higher the ability. Therefore, I calculated the Return on Assets (ROA) for each company and the operating cash

flow. ROA is given by EBIT[4] divided by Total Assets: it is a measure of profitability on investment in total assets in terms of EBIT. Operating cash flow is an efficiency measure through which investors can see whether company's operation are successful.

In case of companies issuing multiple bonds on the same trading day, I considered them as a single bond having an amount equal to the cumulative amount of the bonds, following what was done in previous studies (Flammer, 2020).

3.5 Descriptive statistics

In this section, I provide some information about the European Green Bond Market. First, I show the descriptive statistics regarding all the green bonds included in the initial sample before applying some adjustment criteria. Therefore, I report a table contraining data regarding bonds used in the final sample.

3.5.1 Bonds

The initial sample contains the total of all green bonds issued in Europe between January 2013 and December 2020, labelled as "corporate" in Datastream library. The dataset is comprised of 630 green bonds, with an average size of 552.564507 mn€, an average coupon rate equal to 1.3189343 and a median credit rating from S&P equal to Aaa.

[4] EBIT: earning before interest and taxes

Table 2 : Green Bond Market in Europe

Table 2 provides a summary for all corporate green bonds issued by European companies in the sample period from January 2013 to December 2020. *Green Bond* is the number of green bond issuances. *Amount issued* is stated in €, Coupon is the coupon rate and it is presented in percentage and *Fixed-rate bond* is a dummy variable equal to one if the bond is straight – it has fixed coupon payments, while *Credit Rating* describes the bond rating from Standard& Poor's. The sample mean is presented for each characteristic and the standard deviation is in parenthesis, except for *Credit Rating* which shows the median.

VARIABLES	All
Green Bond (#)	630
Amount(mn€)	552.564507 (1,470.54335)
Fixed-rate bond(1/0)	0.872224 (0.335218)
Coupon(%)	1.3189343 (1.51957574)
Credit Rating S&P Rating (Median)	Aaa

In the following table I present the descriptive statistics of the Bonds in the sample, divided in Conventional Bonds and Green Bonds. In particular, we can notice that there is a larger amount of conventional bonds issued in the sample period with respect to the green bonds. The average amount issued is not particularly different in the two cases, but in the case of green bond the minimum amount issued is noticeably lower if compared to the conventional bond case. Analysing statistics regarding coupon rate, expressed in percentage terms, green bonds as an higher average coupon rate of 0.7% and a higher maximum value equal to 9.

Table 3 : Descriprive Statistics of Bonds in the sample

Table 3 describes the number of observations, mean, median, standard deviation, minimum and maximum of the issuances in the sample period going from January 2013 to December 2020. Amount issued is stated in €, Coupon is presented in percentage and Fixed-rate bond is a dummy variable equal to one if the bond is straight – it has fixed coupon payments.

Variable	Obs	Mean	Std. Dev.	Min	Max
Conventional Bonds					
Amount issued	152	578923.84	351910.13	25000	1500000
Coupon	152	1.647	1.321	0	6.25
Fixed-rate bond	152	0.868	0.339	0	1
Green Bonds					
Amount issued	56	563303.57	317526.71	3200	1300000
Coupon	56	2.362	1.981	0	9
Fixed-rate bond	56	0.946	.227	0	1

3.5.2 Control Variables

As previously said, I used multiple control variables in the regression. Since some companies issued more than one bond, the observations correspond were reduced to 113 firm-year observations.

Table 4 : Descriprive Statistics of Control Variables in the sample

Table 4 describes the number of observations, mean, standard deviation, minimum and maximum of the control variables in the sample period going from January 2013 to December 2020. Size is the logarithm of total assets, ROA is computed as the ratio between net income and total assets, EBIT-to-interest is the ratio between EBIT and interest expenses and operating cash flow (expressed in €) is the difference between total revenues and operating expenses.

Variable	Obs	Mean	Std. Dev.	Min	Max
Size	113	7.4	0.872	4.758	8.709
ROA	113	0.041	0.035	-0.083	0.257
EBIT-to-interest	113	7.295	8.084	-3.869	42.243
Operating Cash flow	113	5182890.8	7686662.4	-1274000	39047000

Looking at the descriptive statistics reported in table 4, Size has an average value equal to 7.4 and a minimum value equal to 4.758. Return on Assets (ROA) mean records a value equal to 0.041, while its maximum is equal to 0.257. EBIT-to-interest has a mean equal to 7.295, which means that on average companies in the sample generate sufficient revenues to cover their interest expenses. Operating cash flow records a positive mean value equal to 5.182890 mn€, which indicates that on average companies are financially successful in their core business activities.

4. Empirical analysis

In the following chapter, I show the analysis I conducted on the green bond market. First, I present the methodologies used in my study, then I show the results of my analysis. In particular, first I describe the event study methodology and its results, second I introduce the regression analysis and its results.

4.1 Event study

This section 4.1.1 starts consists of a brief introduction on the event study method, followed by the presentation of the results I obtained in section 4.1.2.

4.1.1 Event study methodology

The event study methodology was introduced by Fama et al. in 1969 and has become the standard method of measuring security price changes in event announcements. It helps in examining stock return behavior for a given sample of companies which experience a particular event – in our case: green bond issuance announcement. In this case, the event takes place at different points in calendar time for each security. The estimation window is the interval between T0 and T1. It is used to determine the normal behaviour of the stock market. The interval between T1 and T2 is the event window. With 0 we identify the event date, in case of green bond issuance the announcement is made at time 0. From T2 to T3 we have the post-event window: it is used to investigate long-term company performance following the events.

Since the aim of this work is to study how the company share price is influenced by the announcement of green bond issuance, such analysis can be conducted through an event study and a comparison considering corporates which issue green bond and corporates which do not, in the period Jan 2013 – Dec 2020. Looking at existing literature, Brown & Warner (1975) investigated how daily stock returns affect event study methodologies. In order to conduct this analysis, a valid tool can be an event study which measures the abnormal returns in correspondence of the announcement. In the event window, we consider *t* as the announcement date (and not the issuance date since it is irrelevant (Flammer, 2020)), t-5 as

five trading days before (denoted with T1) and t + 5 as five trading days after (denoted with T2), while in the estimation window we consider a prior period, going from t-206 to t-6, in order to have a reference point for our analysis. In order to have an estimate of the normal performance of corporation, a useful tool is given by the market model (Stapleton et al, 1983) OLS regression

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

where the dependent variable is the return of the i company at time t, α and β are the parameters we want to estimate and R_{mt} represents the market return. Then, after having defined the abnormal returns as the difference between the effective return and the predicted one estimated through the market model, in formula:

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

We can use stock market index as proxy for expected return. It is therefore interesting to examine whether mean abnormal returns for periods around the event (i.e. the event window) are equal to zero. The cumulative abnormal return (CAR) of a security is the sum of the related daily abnormal returns over the horizon of the study and it is used as an abnormal performance measure. Therefore the formula of the CAR is given by:

$$CAR(T_1, T_2) = \sum_{t=T_1}^{T_2} AR_t \quad (3)$$

For a given performance measure, such as the CAR, a parametric cross sectional test is usually perfomed; t-statistic is typically computed and compared to its assumed distribution under the null hypothesis that mean abnormal performance equals zero. The null hypothesis is rejected if the test statistic exceeds a critical value, typically corresponding to the 5% or 1% tail region (i.e., the test level or size of the test is 0.05 or 0.01). The test statistic is a random variable because abnormal returns are measured with error. Two factors contribute to this error. Firstly, predictions about the securities' unconditional expected returns are not precise. Second, individual firms' realized returns at the time of an event are affected by

other factors unrelated to the event, and this component of the abnormal return does not average to literally zero in the cross-section.

In the cross-sectional test, the AR_{it} and CAR_i are considered as aggregated through the events. The test statistics I used in this study CAR_i in case of the null hypothesis H0 : $CAR_i=0$ is defined in the following equation 5 :

$$t_{CAR} = \frac{CAR_i}{S_{CAR}} \quad (5)$$

Where S_{CAR} is the standard deviation of the cumulative abnormal returns in the estimation window.

4.1.2 Results of the event study

In this section of the thesis, I present the results obtained from conducting the event study described above. First, I consider the main sample in order to compare the green bond announcement effect and the conventional bond effect on the market. Therefore, since France is the European country who records the largest amount of green bonds issued – equal to 105 €bn in the sample period we are considering – it is interesting to conduct a geographical analysis comparing bonds issued by French firms and bonds issued by other European countries in the sample.

Stock Market Reaction to Green Bond issuance announcements

The table below presents the cumulative average abnormal returns around the bond issuance announcement in the sample, considering a period going from January 2013 to December 2020. The results obtained show that announcements of green bond issues correspond to positive abnormal returns.

Table 5 : AR and CAR around announcement date

The following table presents the values of the CAR respectively for the green bond announcements and conventional bond announcements. The parametric t-test is conducted in order to test whether the cumulative abnormal returns are significantly different from zero. Skewness and kurtosis of data are also included.

	Green Bonds	*Conventional bonds*
Event window	[-5,5]	[-5,5]
CAAR	0.0429	-1.1716*
t-test	(0.9552)	(-1.6747)
Confidence intervals (95%)	[-1.2302,1.3160]	[-2.3398;-0.0034]
Skewness	(-0.8995)	(-2.5415)
Kurtosis	(5.0398)	(7.2434)

*** Significance for a 2-tailed test at 1% level
** Significance for a 2-tailed test at 5% level
* Significance for a 2-tailed test at 10% level

In order to test for statistical significance, after having computer AR, CAR and CAAR for both green and conventional bonds, I apply the parametric t-test as previously shown in section 4.1.1.The event window I consider is [-5,5]; in this case, only conventional bonds are significant and negative, while green bonds present positive CAAR. This confirms that green bond issuances have a positive impact on the stock market returns.

The event window goes from five days prior to the announcements to dive days after in order to better capture possible leakage of information. The results obtained are in line with previous studies, but the explanations to this effect are different across authors (Flammer, 2020 , Glavas, 2020). Tang & Zhang (2018) identify one of the possible reasons in the reduction of information asymmetry since, as opposed to conventional bonds, in the case of green bonds the issuers have to explicitly communicate their perspectives in term of use of proceeds.

According to Flammer (2020), the announcement of green bond issuances from a public company captures the attention of the market investor, therefore it increases the company's visibility on the market. Also, Reboredo (2018) states that issuing green bonds is an appropriate way of attracting the attention of investors whose aim is to improve their ESG effort and score.

From a review of previous literature, it is evident that in Europe firms record average lower AR if compared to the rest of the world. One possible reason has been identified by the Global Sustainable Investment Alliance, which suggests that investors may react less with respect to the rest of the world because the European Green bond market is considered as more mature than others.

4.2 Regression

In this part of the thesis I inserted a regression analysis in order to provide a robustness check for the event study presented above. In this study, the regression allows to control for a set of variables that can be considered as potential factors influencing the reaction of the stock market to the announcement of corporate green bond issuances. In section 4.2.1, I provide an introduction of the regression methodology and variables used in my study, then in section 4.2.2. I show the results I obtained applying the regression to this case.

4.2.1 Methodology

From a brief literature review of previous years studies, a regression analysis on the CARs may be considered an appropriate robustness check for the event study. Indeed many studies -such as Bradshaw, Richardson & Sloan, 2006 – focused their attention on the relation between stock markets and bond issuances, identifying some typical firm characteristics as potential factors affecting the equity market reaction to the announcements of green bonds. Therefore, I performed a regression analysis on the cumulative abnormal returns in order to study the effect of "green label" on the stock returns, controlling for relevant firm characteristics.

The first control variable is given by the logarithm of Total Assets which provides the Size of the firm, since previous studies such as Bradwhan, Richardson & Sloan (2006) consider it as one of the main factors that may have effect of the market to bond announcements. Then, I added as control variables some factors related to risk: EBIT- to interest expense ratio, which measures the number of times a company could make the interest payments on its debt with its EBIT, and the cash flow from operating activity, which highlights whether a firm can generate sufficient positive cash flow in order to maintain and grow its operating activities. Lastly, in order to consider a company's financial performance, I consider Return on Assets as another control variable in the regression (Goedlewski,2018).

The regression I used in the study is shown in the following equation:

$$CAR_{ij} = \alpha_i + \beta_{ij} \times Green + Controls_{ij} \quad (6)$$

In the above regression, the dependent variable is given by cumulative abnormal returns of the event window [-5,+5]. Alpha and beta are the parameters we want to estimate through the regression. Green is a dummy variable, which assumes value equal to one in case of green bond and zero otherwise. Under *Controls* all the control variables mentioned above are included, given a firm I and an announcement j. The error terms have an expected value equal to zero and variance equal to $\sigma_\varepsilon{}^2$.

The main goal of running this regression is obtaining the value of the β-coefficient: indeed a positive value of this parameter would show a positive relation between the green characteristic of a bond and the reaction of the stock returns.

4.2.2 Regression results

In this section results of the regression are presented. In order to consider it as a robustness check for the study, the subsamples are the same of the set used for the event study.

Green Bonds and Conventional Bonds

Using results obtained in the event study, the dependent variable of the following regression is given by CAR of the event window [-5,5], since it is the variable which most highlights and captures the reaction of the stock market to announcements. The independent variables used to control for firm charectistics are explained in section 3.4. The results of the regression analysis are shown in table 5 below.

Table 6 : Regression results – Green Bonds and Conventional Bonds

This table shows the results of the regression with robust standard errors, considering a sample period going from January 2013 to December 2020. For both the regressions the dependent variable is CAR (cumulative abnormal return). In model (1), I performed a regression analysis considering only *Green* as independent variable, which is a dummy variable equal to 1 when the bond is green and 0 otherwise.

	(1)	(2)
VARIABLES	CAR	CAR
Green	1.284	1.751
	(1.042)	(1.099)
EBIT-to-interest expense		-4.13e-09
		(1.17e-08)
Operating cash flow		0.142
		(0.0941)
Return On Assets		1.05e-07
		(1.42e-07)
Size		0.136
		(0.746)
Constant	-1.172*	-2.885**
	(0.700)	(1.245)
Observations	113	110
R-squared	0.013	0.061

Robust standard errors in parentheses
*** Significance for a 2-tailed test at 1% level
** Significance for a 2-tailed test at 5% level
* Significance for a 2-tailed test at 10% level

In the first regression (1) I show the result excluding the control variables, while in the second regression (2) I include the control variables. All the results are obtained assuming robust standard errors. The coefficient related to the variable Green is positive in both the estimations: after controlling for firm specific characteristics, this coefficient shows an higher value if compared to the first regression.

A potential source of endogeneity may be simultaneity bias. In this case it can be excluded as a potential risk , since the issuer is not able to control the stock price reaction after the bond is issued (Glavas, 2020).

France and Rest of Europe

As a further robustness check, I conduct a regression analysis on the geographical difference between France and the rest of the Europe. Since France is the European country that records the largest amount of green bond issued across years, with a complessive amount of 103 €bn, it is interesting to perform a regression analysis controlling for the same variables as in the previous section and adding two dummy variables: France and Rest of Europe, then combined with the dummy variable Green.

Table 7 : Regression results – France and rest of Europe

This table shows the results of the regression with robust standard errors, considering a sample period going from January 2013 to December 2020. For both the regressions the dependent variable is CAR (cumulative abnormal return). In model (1), I performed a regression analysis considering only *Green*France* as independent variable, which is a dummy variable equal to 1 when the bond is green and issued by French companies and 0 otherwise, *Green*Rest of Europe* which is equal to 1 in case the issuer company is not French and the bond is green. In model (2) I control for variables used in the previous section.

	(1)	(2)
VARIABLES	CAR	CAR
Green*France	0.190*	0.281*
	(2.304)	(2.413)
Green*Rest of Europe	1.591	2.503*
	(1.171)	(1.343)
France	-0.481	-1.246
	(1.713)	(1.619)
Size		2.076
		(1.500)
Operating Cash Flow		-4.70e-08
		(7.74e-08)
ROA		8.658
		(13.87)
EBIT-to-interest		0.0177
		(0.0506)
Constant	-1.065	-16.82
	(0.798)	(11.19)
Observations	113	113
R-squared	0.023	0.100

Robust standard errors in parentheses
p<0.05, * p<0.1

After controlling for firm characteristics, there is an increase of the CAR to 0.28%, while in the first model I obtained 0.19%. As expected, green bonds issued in France cause a positive stock market reaction, although green bond issuances in France are more frequent than other countries and the market is more mature, therefore the we could expect a less positive effect.

5. Conclusion

This thesis studies the reaction of the stock to green bond issuance announcements by public firms on European Stock exchanges considering a sample period going from January 2013 to December 2019. I applied the MacKinley event study , finding evidence that green bond issuance announcements do not have a negative impact on the stock market returns and the firm value.

In the main event window [-5,5] surrounding the green bond announcement date, I find a CAAR of 0.04%, while Conventional bond announcements present negative values in the same event window, confirming the presence of a green bond premium as stated in previous studies. If compared to global market, the European one is different in terms of transparency and law and green bond signaling effects. Therefore, I study whether there may be regional difference within the European continent, finding a positive CAAR of 0.24% for public firms listed in France.

As robustness check, I conduct a regression analysis considering as control variables that might impact the stock market reaction. Green label of the bond has a significant positive impact on firm value, in line with findings from the event study. Furthermore, I investigate whether there are regional differences among France and the rest of the Europe

The findings suggest that green bond announcements are positively related to equity value in the European market. Furthermore, we contribute to the literature by providing evidence of regional differences within the continent. The results imply that France can be considered as one of the main drivers of the positive stock market reaction in Europe. This finding is especially interesting, as it indicates that even though green bonds are more widespread and has many repeat issuers in France, it is still considered as more value-enhancing in this region than the rest of Europe. Also, this study wants to draw attention on the role that financial markets could play in the fight against climate change and environmental degradation. This study shows that issuing green bonds does not cause a reduction in the firm value, but exactly the opposite. Indeed, firms can contribute to the environment protection withouth suffering reductions in their value.

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Appendix A.1: SIC Classification

Table A.1: SIC classification

This table presents a list of the SIC codes, as provided by the SEC (2019)

SIC Codes	Sector
0100-0999	A: Agriculture, Forestry and Fishing
1000-1499	B: Mining
1500-1799	C: Construction
2000-3999	D: Manufacturing
4000-4999	E: Transportation, Communications, Electric, Gas and Sanitary service
5000-5199	F: Wholesale Trade
5200-5999	G: Retail Trade
6000-6799	H: Finance, Insurance and Real Estate
7000-899	I: Services
9100-9729	J: Public Administration
9900-9999	K: Not classified

Appendix A.2: Companies in the sample

Table A.2 Companies in the sample

This table presents a list of the companies in the event study sample considering the period going from January 2013 to December 2020. *Company* displays the name of the company, *Index* displays the market index used in the analysis and *Country* is the borrower country of origin.

Company	Country	Index
A2A	Italy	FTSEMIB
ACS Servicios	Spain	IBEX35
Advanced Soltech	Sweden	OMX Stockolm
Alerion Clean Power	Italy	FTSEMIB
Audax Renovables	Spain	IBEX35
BASF	Germany	DAX30
Baywa	Germany	DAX30
Daimler	Germany	DAX30
Energias de Portugal	Portugal	PSI20
ENBW	Germany	DAX30
Ence Energia	Italy	FTSEMIB
Engie	France	CAC40
ERG	Italy	FTSEMIB
Falck Renewables	Germany	DAX30
Getlink	France	CAC40
Greenalia	Spain	IBEX35
Grenenergy	Spain	IBEX35
Hera	Italy	FTSEMIB
Neoen	France	CAC40

Nordex	Germany	DAX30
Orsted	Denmark	OMX Copenhagen
PostNL	Netherlands	AEX
Schneider	France	CAC40
SNAM	Italy	FTSEMIB
Stora Enso	Finland	OMX Helsinki
Telia	Sweden	OMX Stockolm
Terna Rete Elettrica Nazionale	Italy	FTSEMIB
Upm-Kymmene	Finland	OMX Helsinki
Verbund	Austria	ATX
Vestas Wind	Denmark	OMX Copenhagen
Vinci SA	France	CAC40
Volvo	Sweden	OMX Stockolm