Lisbon School of Economics & Management
Universidade de Lisboa

MASTER IN MANAGEMENT (MIM)

MASTER´S FINAL WORK

DISSERTATION

Green Bonds: The issuance announcement effect on stock price

Francisco de Almeida Martins Pinto de Lima

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SUPERVISION:

Prof. Maryia Gubareva

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RESUMO

O nosso estudo tem como principal foco a reação do preço de a ação de uma empresa quando esta anuncia que vai emitir uma obrigação verde.

Nós avaliamos o retorno anormal proveniente do evento em estudo (anúncio da emissão de uma obrigação verde). Estes dados incluem todas as obrigações verdes desde a primeira emissão (2007) até junho de 2023, por parte de empresas publicas e as suas respetivas ações. Para analisar a reação do mercado ao anúncio de obrigações verdes, calculámos os retornos médios anormais acumulados para diferentes janelas de tempo ([-5d, +10d], [-10d, +10d], [-2d, +5d], [-10d, -2d], [0d, +5d], [+5d, +10d], and [+2d, +10d], e por último, preformamos os respetivos testes de significância..

Resultados indicam que o anúncio de uma emissão verde, em média, tem um efeito negativo na ação de uma empresa.

Também dividimos a nossa amostra em sub-amostras (setores, moedas, países, betas e outros testes cronológicos). Concluímos que as variáveis não cronológicas não têm intensidade e significância suficiente para desenhar conclusões concretas relativas ao efeito do anúncio de emissões verdes por parte de empresas. Além disso, também descobrimos que o efeito muda substancialmente ao longo do tempo (tanto em direção como intensidade).

Palavras-chave: Obrigações Verdes, Finanças Sustentáveis, Desempenho Financeiro, Mudanças Climáticas, Impacto de investimento, Sustentabilidade corporativa, Ambiente, Social, Governança

JEL CODES: G14; G32; Q56 ; M14.

ABSTRACT

Our study focuses on the reaction of the stock price movement when a company announces a Green Bond issuance. We assess the stock abnormal return resulted from the study event (announcement of green bond issuance). The data includes all green bonds issued by publicly listed companies since the first green bond issuance in 2007 till June of 2023 and their respective stock prices. To analyse the market reaction, we compute the average cumulative abnormal returns (CARs) for several short time windows ([-5d, +10d], [-10d, +10d], [-2d, +5d], [-10d, -2d], [0d, +5d], [+5d, +10d], and [+2d, +10d], and finally test the significance of the results.

Results indicate that the announcement of a green bond issuance, on average, has a negative impact on the stock price of a company.

We also split our data into sub-samples (sectors, currencies, countries, betas, and time splits). We conclude that the non-chronological variants are not strong enough to draw clear conclusions regarding the effect of green bond issuance announcement on the stock price. Moreover, we also figure that the effect substantially changes overtime (intensity and direction).

KEYWORDS: Green Bonds, Sustainable Finance, Financial Performance, Climate Change, Impact Investing, Corporate sustainability, Environmental, Social, Governance.

JEL CODES: G14; G32; Q56 ; M14.

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LIST OF ABBREVIATIONS

Av. Amount – Average amount

Av. Coupon – Average coupon

Av. Maturity – Average maturity

B – Billion

BICS – Bloomberg Industry Classification System

Bps – Basis points

BRL – Brazilian Real

CARs – Average cumulative abnormal returns

CBI – Climate Bond Initiative

CNY – Chinese Yuan

GBP – Green Bond Principles

ICMA – International Capital Market Association

M – Million

Rit – return of a stock on day t

Rmt – market return on day t

SDGs – Sustainable Development Goals

USD – United States Dollar

Utility-Elec- Eletrical Utility Sector

αi – Estimated alpha

βi – Estimated Beta

ε it – Residual

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1. INTRODUCTION

Green Bonds and Green Finance in general have been an emerging trend in the last decade and it is expected to keep growing exponentially in the following years (Ferrer, 2021). The first green bond was issued in 2007, so it is a kind of recent instrument. Consequently, there are lots of unknown aspects in this field. The primary concern in the Green Finance field focus on whether green investments are advantageous for the investors. Or, on the other hand, if by compromising with green investments they are abdicating on investment returns. With the exponential growing of number of green bond issuances year-by-year, and with the green washing matter, it is crucial to understand the effect of the announcement of a green bond issuance on the stock price of a company. Henceforth, it is also crucial to understand how the effect has changed overtime and the respective reasons.

Our motivation to study the relation between green investments and its returns comes from the fact of being a recent matter. Moreover, there are only a few studies about it and none of them have enormous samples. Which makes it more possible that the existing findings can change due to appearing factors. Henceforth, we believe it is vital to perform recurrent tests on the green finance ecossystem in the future.

There are a limited number of studies addressing the stock market reaction to green bond issuances. It's noteworthy that these studies solely incorporate data on green bonds up until 2019. Consequently, the existing research confines its analysis to the stock market impact resulting from green bond issuances, including exclusively bonds issued no later than 2019 (latest publication date was in 2021). The studies we find more relevant are of Flammer (2020), Cioli (2021) and Tang (2018). As we know stock market movers and trends are cyclical and change overtime (Cutler, 1988). Therefore, our study fills a significant temporal gap in the existing literature within this filed. Prior research in this area is limited to data collected up to 2019. In contrast, our study not only confine data up to 2019 but also extends the analysis to include the most recent data available, up to June 2023.

This study contributes to the increasing pool of information regarding corporate green bonds. First, we think that the empirical data collected in this study may confirm or refute the theory that the announcement of corporate green bonds causes the stock markets to respond favourably because investors are more concerned with the environment and the long term, and because they are aware that green projects can boost business performance, or in contrast prove the opposite. Second, our research is based on a bigger database of bond issuance over a longer period of time than the previous literature, and with more recent data (bonds) allowing us to go deeper into investors' reactions.

The main results show that the announcement of a green bond issuance has a negative impact on the stock price of a company on average. Moreover, it also indicates that the impact changes over time. Till 2021 the effect used to be positive (positive average cumulative abnormal returns), that when was the turning point that influenced our results (the point when the average cumulative abnormal returns started to be negative on a yearly basis).

The rest of the dissertation is organized as follows. Chapter 2 presents a literature review with the history of green bonds, relation to Sustainable Development Goals (SDGs), and the findings already done on the subject. Chapter 3 describes the Hypothesis Development. Chapter 4 illustrates the data and methodology. Chapter 5 demonstrates the results followed by the respective discussions and implications (Chapter 6). Finally, Chapter 7 concludes.

2. LITERATURE REVIEW

In the context of the research on green bonds, green finance, and more specifically on the impact of the announcement of the issuance of green bonds on the stock price, this literature review considers certain theoretical facts. We begin

by explaining why green instruments are so important. Then, we present the history of green bonds since the first issuance in 2007, followed by their definitions and the findings from previous studies focused on green bonds.

2.1 The Importance of Green Finance

The constant acceleration of climate change has been impacting ecosystems and human life for decades, and thus has become one of the most important issues of our time. The high average temperatures, the rising sea levels and the retreat of ice glaciers, and the increasing of floods all express a changing climate (Baker, 2018). In addition, climate change poses a significant overall risk to the financial system and the economy. Investment patterns need to be drastically altered in order to meet the 1.5° C target (McCollum, 2018). Therefore, the instruments of financial economics, created for valuing and controlling dangerous future events, can assist society in evaluating and responding to the risk of climate change (Litterman, 2020). It is mandatory to act to reduce greenhouse emissions and for this to be possible it is required to mobilize a sizeable amount of money, something that traditional public intervention (taxes, subsidies, and regulation) cannot do alone (Faticaa, 2019). One of the main means of reducing and hedging climate risk is the financial markets. As we move toward an environmentally sustainable economy, financial markets help to reduce climate risk by enabling the flow of capital investment toward green projects. Financial innovation in green bonds and an increase in climate-aware mutual funds are two examples of the role financial markets play in reducing climate risk (Giglio, 2021).

Finance has a key role to play here, and green bonds can be one of the most promising solutions to fight climate change (Baker, 2018).

2.2 History of Green bonds

Green bonds are a recently created financial instrument. The first green bond was issued in 2007 by The European Investment Bank (EIB) with the name "climate awareness bond" (Yongjun, 2018). Since 2007, the green bond ecosystem has become one of the international market segments that have grown the most. From 2007 to 2019 has been issued a total volume of around 800 billion United States Dollars (USD) (Ferrer, 2021). The amount issued only in 2019 was USD 259 billion which is a growth of 51% compared to 2018 (Ferrer, 2021). This data just shows how exponentially this market is expanding. Morgan Stanley refers to this as the "green bond boom" (Ferrer, 2021). Moreover, it is segment expected to continue growing. This aligns with what is required/needed for the transition to a decarbonized global energy system imposed by the 2015 Paris Agreement (around 110 trillion in investments for the energy sector) (Ferrer, 2021). Additionally it resonates with the financial commitments required to meet the Sustainable Development Goals (around 7 trillion) (Tolliver, 2019). It is not only the total volume of issuances that has been changing. Also the number of countries issuing green bonds and different types of green bonds. China became the largest issuer of green bonds in the world in 2015 after entering the market. In 2016 and 2017, China issued $34 billion and $31 billion in green bonds, respectively (Y Ning, 2023). In 2016 Poland became the first country to issue a green sovereign bond. The world's first green Islamic bonds were launched for Malaysia in June 2017. Fannie Mae, a government-sponsored enterprise in the US, has issued the largest green MBS worth 24.9 billion USD. Furthermore, issuer types are also enlarging, including supranational organizations, development banks, commercial banks, non-bank financial institutions, and corporations (Yongjun, 2018). In 2018 the total amount of green bonds issued by nation, showed that China, Sweden, France, and Japan made up the majority of issuances (Wang, 2017). Green bonds got more common and well-liked in environmental finance across nations in the post-COVID-19 period. The worldwide green bond issuance value in 2020 reached a

record of US$305.3 billion, according to Bloomberg New Energy Finance, representing an increase of 13% year over year (X Tan, 2022).

2.3 Green bond definitions

There isn't yet a widely accepted definition for recognizing green assets. Green finance has different definitions around the world. For instance, whereas clean coal is not supported by green bonds in Europe, it is recognized as a green product in China. One of the reasons is that industrialized and developing countries have different priorities when establishing green finance standards, and that short-term policy is probably driven by more immediate financial considerations. The Chinese government's priorities, nevertheless, include a variety of environmental concerns, such as air, water, and soil pollution, in addition to the reduction of carbon emissions. Some of these problems are currently not as significant a problem in Europe (D Gilchrist, 2021).

On the other hand, the definitions of green bonds vary across Thomas Reuters, Climate Bonds Initiative (CBI), and Bloomberg. Although we find that all have some key points in common. For Yonjun (2018) green bonds are “fixed income securities issued by capital raising entities to fund their environmentally friendly projects, such as renewable energy, sustainable water management, pollution prevention, climate change adaptation and so on”. Ferrer (2021) describes green bonds as “a category of fixed-income securities whose only difference from regular bonds is that the proceeds of green bonds are committed to financing projects that have positive environmental effects”. Flammer (2020) defines green bonds as “bonds whose proceeds are committed to financing environmental and climate-friendly projects, such as renewable energy, green buildings, or resource conservation”. So, in our point of view green bonds are fixed-income instruments whose proceeds are used for environmental and climate linked purposes.

2.4 SDGs

The two main initiatives created to address the economic growth-environmental stewardship conflict are the Paris Agreement and the Sustainable Development Goals (SDGs). The first has the purpose to keep global temperatures rising at 2-celsius degrees and to finance low-carbon, the latter apart from that also aims to eliminate poverty and hunger and encourage peace, human rights, and justice. Of the 17 SDGs, only 3 are aligned with the climate-focused commitments of the Paris Agreement, SDG 6 is allied to clean water and sanitization, SDG 7 is aimed at next-generation energy, and lastly, SDG 9 is for infrastructure and industrialization. Green bonds are extremely related to both agendas, as the fact that they are designed to finance projects with the scope of 15 SDGs and are similarly connected to the Paris Agreement (Tolliver, 2019).

2.5 Green bond Issuance and Standards

Green bonds have unique characteristics that set them apart from traditional bonds, and these characteristics come at a cost to businesses.

The most distinctive feature of green bonds that separate it from conventional bonds is the need to track the bond proceeds to make sure that the funds are being used for green initiatives (ICMA, 2014). Despite the fact that the International Capital Market Association (ICMA) has published the green bonds principles, the actual standard systems differ. Bond issuers can freely join the green bond market and set their own commitments thanks to the bottom-up voluntary structure. The top-down guidance structure, however, imposes a number of conditions on issuers (X Tan, 2022). In order to ensure accurate allocation of funds, companies must

give post-issuance reports (ICMA, 2014) and full green taxonomies by sector (Yongjun, 2018).

To issue a green bond, companies need to develop a framework for their green bond issuance, making sure they follow the criteria for eligible green projects. After that, companies may decide to obtain verification by a third party which make sure that the proceeds are funding projects that generate environmental benefits aligned with the green bond objectives. This verification implies administrative and compliance costs (Flammer, 2020). The primary standards for green bond verification are the Green Bond Principles (GBP). The GBP is a voluntary guideline defined in 2014 by a few investment banks (like Bank of America, Citi, Crédit Agricole, JPMorgan Chase, BNP Paribas, among others), and it is composed of 4 elements: (i) use of proceeds, (ii) process of project valuation and selection, (iii) management of proceeds and (iv) reporting (Baker, 2018), and the Climate Bond Initiative (CBI) that certifies green bonds by providing an eligible criterion

There's no universal and consensual green bond standard, and the enforcement of the law is limited which makes it difficult to compare the environmental impact of different green bonds and the exact allocation of the funds (Flammer, 2020).

2.6 Recent studies on Green bonds pricing

Despite being a relatively recent financial instrument, we were able to find some studies regarding the pricing of green bonds, and their correlation with other asset classes.

According to numerous studies, in the short term conventional financial and energy markets are most connected to the global market. Green bonds are closely related to Treasury and investment-grade corporate bonds in terms of return and volatility, demonstrating that they do not belong to a separate asset class and can

be an effective tool in the fight against global warming without reducing returns from conventional bonds (Ferrer, 2021). Furthermore, it has been established that institutional investors hold the majority of green bonds. These investors typically follow long-term investing strategies such as "buy and hold," which can reduce the volatility of this asset during periods of strong risk aversion (Ferrer, 2021). Moreover, is consistent with another argument, that by issuing a green bond a company credibly signals its commitment to the environment, rejecting the hypothesis that institutions use green bonds for greenwashing (Flammer, 2020). Based on a sample of over 2,000 municipal and corporate green bonds issued from 2010 till 2016, Baker et al. (2018) find that green bonds have lower yields than bonds without the green label but with similar attributes. Quantitatively, the bonds in question have after-tax rates that are around 6 basis points lower than the yields on comparable non-green bonds.

Regarding the added costs incurred in the issuance and verification of green bonds in comparison to ordinary bonds, investors speculate whether the former are priced at a premium to offset the additional costs. Although it is proven that only green bonds issued by supranational institutions and non-financial corporations sell for a premium compared to brown bonds (Serena Fatica, 2019). Moreover, certified green bonds sell for a larger premium compared with the ones that are not certified by third parties (Baker, 2018), but only for private issuers, institutional reputation is enough (Bachelet, 2019).

Our thesis enhances studies of Yonjun (2019), Flammer (2020), and Violi (2020). All of themfind evidence that green bond issuance by a company has a positive effect on the stock price of that same company in 2 different time windows, 10 days before the announcement and 10 days after [-10, 10] and 5 days before and 5 days after [-5, 10]. Moreover, the effect is stronger for first-time green bond issuers. After the announcement also stock liquidity improves in terms of bid-ask spreads, a result of increased media attention that attracts more investors and institutional ownership causing more trades on the stock market.

Numerous variables, including regulatory statements, macroeconomic conditions, and corporate control announcements, might affect stock prices (Cutler, 1988). Green bond announcements can be categorized under the "announcements about corporate control" Cutler referred to in 1988, but the announcement of the green bond itself can have a variety of effects on the stock price. First, a key point is the investor demand for environmentally responsible investments at the time of the announcement, naturally, if the demand is higher the announcement will have a bigger impact on the stock price (Cuervo-Cazurra, 2020). Furthermore, the environmental performance of the issuing company is also a central factor, if the company has better environmental performance, it shows more environmental credibility and commitment to investors regarding the company's capacity to achieve its goals and be better positioned for long-term sustainability, and by consequence, if the company have stronger environmental performance, also the bigger is the stock price movement (Choi, 2020). Henceforth, if the market's perception of green bonds at the time of the announcement is favorable, the stock price may benefit more (Callen, 2020). The green bond characteristics such as their size (issuance amount) and the particular environmental projects they are funding, play a significant role in determining the impact on stock price. Larger green bond issuances can have a stronger positive impact because it shows a bigger commitment by the issuing company toward the environment. Moreover, if the green bonds are designed to fund high-impact environmental projects, the green bond issuance may also result in a more sizeable positive stock price movement (He and Sun, 2019). Lastly, the regulatory environment adjacent to green bonds and environmentally responsible investing has an impact on the different way of how stock prices react (Chen, 2021). Government incentives and subsidies for green bonds issuers may indicate a bigger commitment by local governments through environmental responsibility and can improve demand for green bonds, which result in a greater positive impact on the stock price (Callen, 2020). Following the previous sub-section we realize that there are multiple factors (bond characteristics, market/government moment and issuer

related) that can influence the stock price of a company when issuing a green bond. Taking this into account we form the Hypotheses of our study in the next chapter.

3. HYPOTHESIS DEVELOPMENT

In the chapter 3 we present our study Hypothesis based on our literature review and in what we think is more relevant to understand on the area (Green Finance).

We propose the following hypothesis:

Hypothesis 1: Stock prices have a positive reaction to the announcement of green bond issuances.

The cumulative abnormal returns (CAR) associated with the announcement date are expected to, on average, be significantly different from zero (Flammer, 2020).

Considering seasoned bond issuance, we think the positive impact on stock prices decreases since investors already know the company's position on environmental projects and the advantages of eco-friendly behavior are "priced" in.

Hypothesis 2: The impact of the issuance announcement vanishes over time.

Cutler et al. (1988) states that there are several factors that move stock prices. Authors also affirm that stock movers change over time, it is a matter of market momentum, trends and market perception.

Taking into account our more extensive sample (from 2007 till June of 2023) compared to other studies done that have in maximum data up to 2019, we think it is possible to verify softer positive CARs or even negative. In addition, there have been some significant events in the world in recent years. Covid-19 and the war in

Ukraine are the most important of them, followed by the rising interest rates we have been experiencing. No previous infectious disease outbreak (including the Spanish flu) has affected the stock market as much as the pandemic COVID -19 (Baker, 2020).

4. DATA AND METHODOLOGY

In this chapter, we present the methods employed to collect the data and to analyze the research results. First, we explain in detail how we extract the data from the Bloomberg terminal (bond data, stock data, betas and alphas) and present some stylized facts about the green bond ecosystem. Then, we define the average cumulative abnormal returns (CARs) and present the approach used in the CARs calculation.

4.1. Data

We collect all corporate bonds from Bloomberg's fixed income database that are defined as "green bonds" (more specifically, bonds for which the field "Green bond indicator" is "Yes") in order to create a database of corporate green bonds.

We included in our search all green bonds issued since the first green bond in 2007 until June 2023, without any additional filters.

The above criteria yield a total of 8509 green bonds. For each bond, we add columns to the table we export to Excel (from the Bloomberg Terminal function “SRCH”) referring to the amount, ISIN, issue date, announcement date, country, currency, issuer industry, maturity, coupon, and credit rating. We convert all issuance amounts to US dollars for the sake of a facility of comparison. Below we present some stylised facts based on these statistics (amount issued, average

amount issued, average coupon and average maturity) that can be easily checked in Table I..

From the initial sample the amount issued is around 3.53 trillion dollars with an average coupon of 3.10, and an average maturity of 8 years. We exclude bonds whose issuer's BICS (Bloomberg Industry Classification System) is "Government", which results in 6815 corporate green bonds (80%), meaning that the government green bonds are 1694 (20%) (Table I). The amount issued of government green bonds is around 1.5 trillion dollars, with an average coupon of 2.68 and average maturity of 7 years (Table I).

The corporate green bonds in general represent an issued amount of 2.03 trillion dollars, with an average coupon of 3.20 and average maturity of 8 years (Table I).

After that, we exclude all bonds which the mother company is not publicly listed (no stock price to check). This results in a final sample of 3761 green bonds, issued from September 2010 till June 2023. So, we can tell that since the first green bond ever issued, around 55% of the issuers are publicly listed companies (45% are private firms). This percentage represents a total amount issued of $1.12T. The average maturity is 8 years and the average coupon is 3.25 (Table I). The average Bloomberg Composite Rating is BBB+.

From the data, we can conclude that green bond issuers tend to be more corporate than governments, but the governments, on average, issue bonds with larger amounts and smaller coupons. The maturity on average is almost the same.

Looking at the differences between corporate green bonds, we observe that green bonds issued from private firms are a less in terms of the number of issues (3054 versus 3761), with higher average coupons (3.30 versus 3.13) (Table I).

Table I. Green bonds overtime (2007 till June 2023).

BICS	$ Amount(B)	$Av. amount(M)	Av.Coupon (years)	Av. Maturity (years)
All (8509)	3530	414,85	3,1	8
Gov. (1694)	1500	885,48	2,68	7
Corp. (6815)	2030	297,87	3,2	8
Publ. comp. (3761)	1120	297,79	3,13	8
Priv. comp. (3054)	910	297,97	3,3	8

Notes: This table reports the total Issue amount of green bonds from 2007 till June 2023 as also the average amount per issue, average coupon and average maturity. The data is also separated by government ("Gov.") and corporate green bonds ("Corp"). Lastly, we also distinguish public companies ("Public. comp.") from private companies ("Priv. comp."). ***Source***: Bloomberg and Author´s calculations.

4.2. Methodology

The stock price reaction following the announcement of an event is examined by the event study methodology (Flammer, 2020). We apply this methodology to determine how the stock market reacts when the issuance of corporate green bonds is announced. The announcement date, or the day the company announced it would be issuing the green bond, is a useful component of Bloomberg's database, and as we already mention in the section 4.1 "Data", we add it to our initial data. Since it records the day when the information is made available to the market, the announcement date—as opposed to the issue date—is the appropriate date for the event research. On the other hand, no fresh information is released to the market on the day of issuance.

We use the announcement date as the event date (day 0) for conducting the event study. In accordance with Krueger (2015), we consider the chance that some

guidance may have been known to the public before the announcement date by embracing the five days prior to the announcement and the following ten week days, so the baseline event window is [-5d, 10d]. We also take into account the time window [-10, -2] before, and the time periods [5, 10] and [2, 10] after the event window to see whether there is any up movement in stock prices before and after the event window. For the time window [-10, -2], our objective is to assess potential leakages preceding the announcement (on the short-term, within 10 days). Additionally, we aim to analyze previous out-performances on the short-term related the study event. Subsequent to the announcement date (d=0), we decided to perform the same test [-10, -2], but on the opposite side ([2, 10]). This allows us to check if there was any out-performance after the event, excluding the main event (announcement of the issuance). In the case of milder effect, this emphasizes the significance of the main event of the study (d=0). Moreover, It's essential to note that all time windows focus exclusively on the short-term, limiting the analysis to a maximum of 10 days before and after the issuance announcement date in both directions.

We examine the stock price reaction to the green bond issuance following the event study methodology developed by Brown & Warner (1985) and Mackinlay (1997).

We estimate the cumulative abnormal returns using the market model. We use the market model to calculate the abnormal returns for each firm *i*. The coefficients αi and βi of the market model are estimated by ordinary least squares method (OLS). Specially, the estimation utilizes data from 200 trading days prior to the event window (i.e., the 210 trading days we use in the estimation correspond to the interval [–220, –11]) using daily returns.

I estimate:

(1) $Rit = \alpha i + \beta i \times Rmt + \varepsilon it,$ ($Rmt =$ return country main stock Index)

Where *Rit* is the return on the stock of company *i* on day *t*, *Rmt* is the daily

market return, and εit is the residual. Market returns correspond to the country main Index.

The estimated return on the stock of firm *i* on day *t* is then given by

(2) $\hat{R}it = \hat{\alpha}i + \hat{\beta}i \times Rmt,$ ($Rmt =$ return country main stock Index)

I then calculate the abnormal daily return (AR) of firm *i* on day *t* as follows:

(3) $ARit = Rit - \hat{R}it$

Finally, we compute the average cumulative abnormal return (CARs) for each time interval by summing up the abnormal returns within the specific time window and report CARs for the time intervals, [–10, 10], [-2, 5], [-10, -2], [0, 5], [2, 10], along with the event window [-5, 10].

The stock market data are obtained also from the Bloomberg Terminal. The first step is to build a formula that return the Stock ticker of the mother company of each bond picking the bond ISIN using Bloomberg Query Language (BQL). Then with the stock tickers, we are able to get the respective main Index for each stock. The following steps are to get the % daily returns for the time windows specified above, as well as the Beta and Alpha for each company. Lastly, we calculated the daily abnormal returns for each firm, followed by the average abnormal returns and for the average cumulative abnormal returns (CAR) for the different time windows.

At first instance we pick the sample of 3761 green bonds (after excluding government bonds and bonds issued by private firms), for the companies that issued more than one green bond on the same day we kept only one of them. This resulted in a sample of 2913 green bonds.

The findings of the event investigation are presented in Table II. There are 2913 issuer-day observations total in the sample. We provide the average and median

CAR as a percentage for each event window along with the corresponding T statistics and with the matching standard error (Std. Err) and number of samples (N). To perform the significance test (T statistic), I follow Brown et al. (1980).

5. EVENT STUDY RESULTS

5.1 CARs

To examine the CARs, the market model is used (Flammer, 2020). This allows also to perform tests on small samples (sub-samples), varying according to bond and issuer features, and different chronological seasons. We start by presenting the results on the main question of the paper (the reaction of the stock market to the announcement of corporate green bond issuance), followed by the bond and issuer features related tests (sector, currency, country and beta). Lastly, I show the results on a few chronological tests (before and after 2020, and year by year test, starting in 2019 till 2023).

In contrast to our Hypothesis 1 and to the findings of Flammer (2020), and Cioli (2021), we find that the green bond issuance announcement has a negative effect on the stock prices. As it is shown (Table II), the average CARs in the event windows [-5, 10], [0, 5], and [-2, 5] are -0.22%, -0.15%, and -0.20% at the 5% significance level. The period [-10, 10] also present negative effects, although only at 10% significance.

Table II. Reaction of the stock market to the announcement of corporate green bond issuance.

Event time	***CAR***	***Std. Err.***
[-10, 10]	-0,226 **	0,15
[-5, 10]	-0,216 ***	0,13
[-2, 5]	-0,199 ***	0,09
[-10, -2]	0,036	0,10
[0, 5]	-0,152 ***	0,07

[2, 10]	-0,01 *	0,01

Notes: The average cumulative abnormal return (CAR) is shown in this table for various time frames following the announcement of green bond issues. *, **, ***, **** indicates significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

The results presented in Table II are not influenced by unrelated trends around the event date, as shown by the small and insignificant CARs for all other intervals before and after this event window. The negative CARs imply that the issue of green bonds has a negative impact on the stock prices. We ascribe this observation to a change in market perspective regarding the issuance of green bonds. It is true that by splitting the data by the date of the issuances (before 2020), I get similar returns compared to the previous studies done (Table VII).

By performing the same analysis described previously in Table II, but this time only for green bonds issued before 2020 we get positive CARs for the base study time windows [-5, 10] and [-10, 10] of around +40 basis points. On the other way picking the sample of green bonds issued after 2020 the CARs are of around -45 basis points (Table VII).

After checking Table VII results, we decide that it is our task to test and understand when was the turning point of the stock market reaction to the event study, and the reason. But before that I present the rest of our analysis and results for the data set as the whole.

5.2 Sectors

As we mention previously in this work in the section 4.1 "Data", while extracting the bond data from the Bloomberg Terminal, we include several relevant bonds´ and Issuers´ characteristics. We use the following filters to test any tendency that might exist: *(i)* the country where the bond was issued, *(ii)* the Bloomberg Sector of the issuer, *(iii)* the currency in which the bond was issued, *(iv)* Beta of the company and *(v)* some chronological tests. The next Table (III)

presents the results for the sectoial analysis.

Table III. Reaction of the stock market to the announcement of corporate green bond issuance by issuer sector.

Sector	N	CAR [-5, 10]	Std. Err.
BANK	947	0,208 **	0,16
FINANCIAL	789	-0,254 *	0,24
INDUSTRIAL	608	-0,476 **	0,34
SPECIAL PURPOSE	109	-0,903 **	0,58
UTILITY- ELEC	379	-0,400 *	0,40

Notes: This table provides the average CAR [-5, 10] for a different sub-sample (by issuer Sector) from Table 1. *, **, ***, **** indicates significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

Regarding the issuer Sector, our final sample of 2913 green bonds comprehend 10 different sectors. We only consider 5 different sectors ("Bank", "Financial", "Industrial", "Special Purpose" and "Utility – Elec") because only those had enough bonds (more than 50) to make it possible to draw accurate conclusions. The "Bank" sector represents 947 green bonds in our data set, and it is the only Sector with positive CARs (10% significance level). The cumulative average abnormal returns for stocks of the Bank sector are +21 basis points for the time window [-5, 10]. The sector that is more affected by the issuance of green bonds is the one that Bloomberg denominates as "Special Purpose", with a CAR of -90 bps, followed by the Industrial Sector with a CAR of -47 bps. The electrical utility sector ("Utility – Elec") result in a CAR of -40 basis points, and lastly, the Financial Industry with a CAR of -0.25%, but only ate 25% level of significance which is not strong enough to draw accurate conclusions.

5.3 Currencies

Our following analysis is regarding the issuance currency. The data pool contains 22 different currencies across all green bonds, and we only consider 13 of them for motives of insufficient sample size for the other 12.

Table IV. Reaction of the stock market to the announcement of corporate green bond issuance by bond currency.

Currency	N	CAR [-5, 10]	Std. Err.
AUD	41	-0,742 *	0,94
BRL	41	0,972 ***	0,58
CHF	61	0,672 *	0,63
CNY	325	-0,225	0,46
EUR	833	-0,185*	0,22
GBP	34	1,335 *	1,48
HKD	54	-0,79 *	0,84
JPY	255	-0,193	0,33
KRW	104	-0,548 *	0,78
NOK	74	-1,088 **	0,72
SEK	190	0,231	0,51
TWD	50	-1,11 *	0,89
USD	615	-0,499 **	0,33

Notes: This table provides the average CAR [-5, 10] for a different sub-sample (by currency of the bond issuance) from Table 1. *, **, ***, **** indicates significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

As could be seen from Table IV, only the Brazilian Real issuances have a positive effect on the Stock price of the company (0.97% at 5% significance level). On the other side the bond currencies that affect the most the stock price are the NOK and the USD with CARs of -1.09% and -0,50% (10% significance level). Moreover, from the three most frequent currencies in green bond issuance (Euro, United States Dollar, and Chinese Yuan), we are only able to draw conclusions with significance for the USD.

5.4 Countries

Thereafter, we perform the same evaluation for the different countries where green bonds have been issued from our data set, and we found some logical evidence if we consider the last step (currency). The results are presented in Table V below. From the 30 countries of our data, we exclude 7 of them due to only having been issued there less than 30 corporate green bonds by public companies.

Table V. Reaction of the stock market to the announcement of corporate green bond issuance by country where the bond was issued.

Country	N	CAR [-5, 10]	Std. Err.
AUSTRALIA	24	0,500	0,77
AUSTRIA	51	0,286	0,76
BRAZIL	30	0,280	0,87
BRITAIN	44	1,746 ***	0,89

BRITISH VIRGIN	36	-2,868 ****	1,16
CANADA	30	1,063 ***	0,53
CAYMAN ISLANDS	61	-1,871 ****	0,72
CHINA	334	-0,451 *	0,44
DENMARK	35	0,352	0,98
FRANCE	305	-0,344 *	0,33
GERMANY	166	0,385	0,61
HONG KONG	76	0,329	0,71
ITALY	61	-0,353	1,11
JAPAN	272	-0,005	0,32
NETHERLANDS	91	-0,358	0,64
NORWAY	114	-0,816 **	0,58
SOUTH KOREA	141	-0,75 *	0,64
SPAIN	112	-0,226	0,68
SWEDEN	181	0,014	0,54
SWITZERLAND	49	1,119 **	0,80
TAIWAN	42	-0,740	0,85
UNITED STATES	250	-0,68 **	0,53

Notes: This table provides the average CAR [-5, 10] for a different sub-sample (by country where the bond was issued) from Table 1. *, **, ***, **** indicates significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

As could be concluded from the Table V above, Britain, Switzerland and Canada appear as the countries with the biggest CAR (+1.74% at 5% significance, +1.12% at 10% significance and 1,06% at significance level of 5%). Moreover, the Canadian Dollar (CAD) is one of the currencies excluded in the last analysis, but it had a positive CAR of +77 basis points. On the negative stock market effect side, we have the Exotic Islands of Cayman and British Virgin with negative CARs of -2.86% and 1.87% (at 1% level of significance.

5.5 Betas

We perform a test separating the data into 6 classes of betas ([-1.0, 0], [0, 0.25], [0.25, 0.50], [0.50, 0.75], [0.75, 1.0], [1.0, 1.5] and [1.5, 3.0]) as presented in Table VI below.

Table VI. Reaction of the stock market to the announcement of corporate green bond issuance by issuer estimated Beta

Beta range	**N**	**CAR [-5, 10]**	**Std. Err.**
[-1,0; 0]	27	-3,303 ***	1,71
[0; 0,25]	186	-0,443 **	0,33
[0,25; 0,50]	359	-0,687 ***	0,35
[0,50; 0,75]	575	-0,404 **	0,26
[0,75; 1,0]	662	-0,227 *	0,26
[1,0; 1,5]	927	0,286 **	0,21
[1,5; 3,0]	176	-0,541 *	0,73

Notes: This table provides the average CAR [-5, 10] for a different sub-sample (by estimated Beta of the bond issuer on the time of the announcement) from Table 1. *, **, ***, **** indicates

significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

Table VI shows that the greater the Beta (till [1.0, 1.5], after that the CAR gets negative), the less negative is the impact on the stock market. Moreover Table VI evidences that the CARs increase class by class and the class of Betas [1.0, 1.5] is +0.29% (the only positive CAR) at 10% level of significance.

5.6 Before and after 2020

Naturally over time trends, and stock market movers change, and alternate intensity. That is the reason why we decide to perform chronological tests on our data to find some correlations. The results are summarized in Table VII below.

Table VII. Reaction of the stock market to the announcement of corporate green bond issuance before and after 2020.

Time	N	CAR [-5, 10]	Std. Err.
Before 2020	803	0,402 ***	0,20
After 2020	2110	-0,451 ****	0,16

Notes: This table provides the average CAR [-5, 10] for a different sub-sample (green bonds issued before 2020 and after 2020) from Table 1. *, **, ***, **** indicates significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

As could be seen in Table VII, our results reveal that before 2020 the average CAR is 0.40% (5% level of significance) while after 2020 till June 2023 (later issuance on our data) is -0.45% (1% level of significance). Therefore, we conclude that green bond issuance announcement effect on stock price changes overtime, meaning that our hypotheses 2 is confirmed.

5.7 Yearly tests

To understand the turning on the stock market perspective wee test the average CARs year by year starting in 2019 (later year of previous studies done regarding green bond announcement effect on stock price).

Table VIII. Reaction of the stock market to the announcement of corporate green bond issuance year by year (2019-2023).

Year	N	CAR [-5, 10]	Std. Err.
2019	293	0,92 ****	0,34
2020	348	0,503 **	0,38
2021	703	-0,746 ****	0,30
2022	683	-0,702 ****	0,28
2023 (Jan - Jun)	376	-0,334 *	0,31

Notes: This table provides the average CAR [-5, 10] for a different sub-sample (green bonds issues year by year, from 2019 to 2023) from Table 1. *, **, ***, **** indicates significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

The results presented in Table VIII above show that the average CARs in 2019 are 0.92% at 1% significance level (the strongest year ever), 0.49% in 2020 (10% significance level), -75 basis points in 2021 and -0.70% in 2022 significant at the 1% level. In 2023 so far the CAR is -0,33% but with no relevant significance level. Meaning that the turning point was in 2021, the biggest ongoing event in 2021 was the pandemic (Covid-19) that started in February 2020.

5.8 Year 2020

Following the previous results from the test presented in Table VIII we decide to also test the year of the other big event in the previous years, Covid-19 (2020). The first rumors of COVID-19 in China started at the end of 2019, but it only arrived on the Occident side of the world at the beginning of 2020. Therefore, we decide to perform the average CARs for the first half of 2020, and the second half of 2020 (vaccine-uncertainty).

Table IX. Reaction of the stock market to the announcement of corporate green bond issuance in the first and second half of 2020.

Time	N	CAR [-5, 10]	Std. Err.
First half 2020	102	-0,115	0,92
Second half 2020	246	0,741 ***	0,44

Notes: This table provides the average CAR [-5, 10] for a different sub-sample (green bonds issued in the first half of 2020 and second half of 2020) from Table 1. *, **, ***, **** indicates significance at the 25%, 10%, 5% and 1% level, respectively. ***Source***: Bloomberg and Author's calculations.

We find that in the first 6 months of 2020, the average CARs are negative (-0.12%) with no level of significance, while in the second half are +0.74% with significance at 5% level (see Table IX above).

6. DISCUSSIONS AND IMPLICATIONS

When we started developing this paper, we were expecting to find a positive effect of green bond issuance announcement on the stock market (like Flammer and Cioli concluded), but we end up finding the opposite. For the time window [-5, 10] we end up with a CAR of -0,22% significant at 5% level. Therefore, we reject our first hypotheses and confirmed that second one. One reason that can explain the non-positive CAR, can be due the fact that the effect is positively bigger for first-time green bond issuers (Flammer, 2020), and naturally overtime the number of public companies that issue the first green bond decreases. Even so, the previous argument does not explain the negative effect only the "less strong positive effect". Consequently, we perform other tests in order to try to find clear evidence. First step is to perform non-chronological tests, which show to be even less explicative and significant.

Looking to the test by Issuer Sector/Industry the Banks are the only sector with a positive CAR. The worst Sector is the Bloomberg denominated as "Special Purpose" (-0,90% at 10% significance level). Special purpose companies are formed to finance and participate in companies and enterprises. Those companies are formed with the purpose of issuing debt securities to repay existing credit facilities, refinance indebtedness, and for acquisition purposes.

Similarly, also the Currency test result in logical conclusions. The Brazilian Real is the only currency from Latin America in the Table III, meaning that the positive CAR (0,97% significant at 5% level) can be related to the surprise factor for being a more "recent" financial instrument on South America emerging markets. On the other hand, bonds in USD are very common.

Looking at the Country analyses, the Exotic Islands of the Caribbean Sea (British Virgin and Cayman Islands) have strong evidence (1% significance) of negative effect on the stock price (-2,87% and -1,87% respectively). Both are categorized by the US State department as countries/jurisdictions of primary concern in respect of Money Laundering and Financial Crimes. Consequently, green bonds issued there are leaded to Greenwashing. Inversely, Britain and

Canada result in positive CARs at significance level of 5% (1,75% and 1,06%). It seems that the reduced amount of green bond issuances in Britain can be an explanation, the GBP also have a positive CAR (but not significant because lots of the issues in GBP are out of Britain, which deviated the significance).

A securities or portfolio's volatility, or systematic risk, as contrasted to the market as a whole (for example the S&P 500), is measured by its beta. On average, stocks with betas greater than 1.0 are deemed to be more volatile than their benchmark. Leveraged beta is affected by debt in that a company's levered beta increase in value as its overall debt increases.

The results from Table 5 mean that the maximum value creation in the sense of abnormal returns from green bond issuance occurs for slightly levered firms (Beta from 1 to 1.5). For heavily leveraged firms the impact is weaker, as they should have already a lot of debt outstanding and green bonds do not make a big difference. With diminishing beta from 1 towards zero, the average abnormal returns are negative and diminishing.

Moving on to the Chronological tests (where we are able to perform clearer evidence and conclusions), we conclude that at some time in history the positive CARs that other authors computed turned into negative. The CAR for green bond issued before 2020 (Table 6) is 0,40% (5% level) and after -0,45% (1% level), one reason can be due to the disappearance of the surprise/recent instrument (also an exponentially growing number of green bond issuances every year). Moreover, recently we have been listening more about discovers on greenwashing and fraudulent debt issues. Looking at the data year by year, 2019 is the biggest CAR for a single year (0,92% with significance level of 1%). In 2019 there was a boost in green bonds from non-financial corporates (issuance almost doubled from 2018). Additionally, it was the year that the Certified green issuance surged the most (86%), and by the end of 2019, cumulative Certified Issuance under the Climate Bonds Standard reached USD 101.4 B, indicating a significant landmark for the international assurance scheme settled by the Climate Bonds Initiative in

2011. Henceforth, the CAR for 2020 (Covid-19 starting year) is 0,50% only at significance level of 10%. By breaking 2020 into two semesters, we find out that it was not an equal distributed year. The first half correspondent to the start of Covid-19 and to the first confinements around the world have a non-significant CAR, specially caused by a high standard error, meaning that there is a big dispersion on the individual data around the population mean. The second half (vaccine-uncertainty) was the pandemic point which confinements started to permit people to go out, economy started to reopen and started to appear credible rumours about the arrive of a vaccine. It was time that economy, markets and trends started to gaining traction again. For the second half of 2020 the CAR is 0,74% at significance level of 5%. Lastly, the turning point for the positive CARs (2021). The year of 2021 seems to be the year that the shareholders lost fade and traction to the issuances of green bonds. For 2021 and 2022 the CARs are -0,75% and -0,70% both with significance level of 1%. The following years after 2020 (turning point) coincide with the biggest world events in the past decade (Covid- 19 pandemic and the ongoing geopolitical uncertainty resulted from the Russian Invasion of Ukraine). Moreover, we are also witnessing the fastest and the biggest rising in the interest rates over the past 20 years related to the inflation higher than the 2% Federal Reserve target since 2021(Source: Bloomberg terminal). Higher interest rates are harmful for green transition investments, since those kinds of projects typically have big upfront capital costs, despite that they cause operational savings in the long term (Flammer, 2020).

7. CONCLUSION

This research explores how the stock market perceives green bond issuances and examines the factors that explain the effect of green bond issuances on stock prices. Moreover, we also test how the average cumulative abnormal stock market returns around the announcement of green bond issuances evolve over time. We

prove that the announcement of the issuance of green bonds has, on average, a negative impact on the stock market, meaning that on average is not beneficial for the shareholders. Henceforth, it refutes our hypothesis 1 (positive impact on the stock price). Moreover, we show that the negative CARs start in 2021 only and that they are different every year (confirming the hypothesis 2). We ascribe this result to the Covid-19 pandemic. We posit that the Russia-Ukraine conflict and the high interest rate environment also contribute to negative CARs from 2021 onwards.

Our study contributes substantially to the Green bond field. Our more extended sample (from 2007 till June 2023) compared to the previous studies allowed us to be the first study to prove negative average abnormal cumulative returns. Moreover, we proved that some bond/issuer characteristics (sector, currency, country, and beta) are not relevant to the study.

Future research is needed to explore additional temporal factors or refine the existing model. We think that two years and a half (2021, 2022, and 6 months of 2023) of negative CARs is short to assume its prolonged persistence.

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