# MARKET REACTION TO GREEN BOND ANNOUNCEMENTS

Evidence from The European markets

Lappeenranta–Lahti University of Technology LUT
Master's Programme in Strategic Finance and Business Analytics
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Ville Autio
Examiners: Associate Professor Azzurra Morreale
Post-doctoral Researcher Juha Soininen

ABSTRACT

Lappeenranta–Lahti University of Technology LUT
LUT School of Business and Management
Strategic Finance and Business Analytics

Ville Autio

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This master thesis examines the market reaction to the announcement of green bond issuance and determines if the announcement has value-enhancing effects on the company's shares. The feasibility of the value-enhancing effect is evaluated in the European markets between 2013 and 2020. The sample consists of 106 green bond announcements by publicly listed non-financial companies. This study applies the event study methodology to approximate abnormal returns during five different length event windows. The statistical significance of the abnormal returns is tested with a parametric and a non-parametric test. Additionally, green bond and company characteristics are used as determinants in regression analyses to determine if they affect the market reaction.

The findings of the event study suggest that the European markets react efficiently and positively to the announcements of a green bond. A significant cumulative average abnormal return of 0.207 percent is found for the whole sample. Additionally, a sample consisting only of first-time green bond announcements produced a significant cumulative average abnormal return of 0.249 percent. The results of the regression analysis support the findings of the event study, as the first-time announcement of a green bond and maturity of the green bond are found to affect the abnormal returns positively and are the only statistically significant determinants.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT
LUT-kauppakorkeakoulu
Strategic Finance and Business Analytics

Ville Autio

**Markkinoiden reaktio vihreiden joukkovelkakirjojen julkistamiseen**
**Todisteita Euroopan markkinoilta**

Pro gradu -tutkielma
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66 sivua, 5 kuvaa, 9 taulukkoa ja 4 liitettä
Tarkastajat: Apulaisprofessori Azzurra Morreale ja Tutkijatohtori Juha Soininen

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Tämä pro gradu -tutkielma tutkii markkinoiden reaktiota vihreiden joukkovelkakirjojen liikkeellelaskun julkistamiseen ja määrittää onko julkistamisella arvoa kohentavia vaikutuksia yhtiön osakkeisiin. Arvoa kohentavien vaikutuksien toteuttavuutta evaluoidaan Euroopan markkinoilla vuosina 2013–2020. Aineisto koostuu 106 julkisesti noteerattujen yhtiöiden vihreiden joukkovelkakirjojen julkistuksesta. Tämä tutkimus soveltaa tapahtumatutkimus metodologiaa epänormaalien tuottojen estimoinnissa viidelle eri mittaiselle tapahtumaperiodille. Epänormaalien tuottojen tilastollinen merkitsevyys testataan parametrisella ja ei-parametrisella testillä. Tapahtumatutkimuksen lisäksi, vihreiden joukkovelkakirjojen ja yrityksen tunnuslukujen vaikutusta markkinoiden reaktioon tutkitaan regressioanalyysien avulla.

Tapahtumatutkimuksen tulokset indikoivat, että Euroopan markkinat reagoivat tehokkaasti ja myönteisesti vihreiden joukkovelkakirjojen julkistuksiin. Koko otoksen estimoitu keskimääräinen kumulatiivinen epänormaali tuotto on 0,207 prosenttia. Lisäksi ensimmäisen vihreän joukkovelkakirjan julkistuksista koostuvalla otokselle estimoitu keskimääräinen kumulatiivinen epänormaalin tuotto on 0,249 prosenttia. Regressioanalyysin tulokset tukevat tapahtumatutkimuksen johtopäätöstä, sillä ensimmäisen vihreän joukkovelkakirjan julkistaminen ja vihreän joukkovelkakirjan maturiteetti vaikuttivat positiivisesti epänormaaleihin tuottoihin ja ovat ainoat tilastollisesti merkitsevät determinantit.

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On the 29th of May 2022 in Espoo

Ville Autio

ABBREVIATIONS

| | |
|---|---|
| AAR | Average Abnormal Return |
| AR | Abnormal Return |
| CAAR | Cumulative Average Abnormal Return |
| CAR | Cumulative Abnormal Return |
| CBI | Climate Bonds Initiative |
| CBS | Climate Bonds Standard |
| ESG | Environmental, Social and Governance |
| GBP | Green Bond Principles |
| ICB | Industry Classification Benchmark |
| ICMA | International Capital Market Association |
| OLS | Ordinary Least Squares |
| ROA | Returns on Assets |

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# 1. Introduction

The growth of the population and the constantly growing economic activities have caused negative externalities. One of the major challenges caused by the growth is climate change, which is a complex problem affecting nearly all industries and sectors across the globe. The effects of climate change are extensive to the point of making basic human functions unfeasible if the current tendency continues (Stern 2007). Consequently, the Authorities have taken regulatory actions to combat climate change and its consequences.

In 2015 the Paris Climate Agreement and later in 2019 the introduction of the European Green Deal have both addressed the threat of climate change by introducing new frameworks and laws to limit emissions, and ultimately achieve climate neutrality by 2050 (United Nations 2015, European Commission 2021). Corporates across the world, especially in Europe must accommodate these laws and frameworks into their operational activities as well as their reporting. The new requirements and standards for reporting have made the environmental, social and governance (ESG) impact of companies measurable. The development of ESG reporting is also reflected in information transparency as it gives an insight into the company's operations.

Investors have taken the rising trend of socially responsible as one of their criteria accompanied by the conventional financial criteria. Therefore, corporates that display positive environmental and social signals are more likely to be rewarded by investors (Berry and Junkus 2013). Concurrently, climate change created the need for sustainable and environmental focused financing. The concept of green financing was introduced, to increase financial flows to sustainable development priorities from the public, private and non-profit sectors (Bracking 2019).

To finance the prevention and the mitigation of climate change new innovative instruments have been issued to serve this purpose. One of the financial instruments introduced were green bonds. They are like conventional bonds, but they are labelled as green by the issuer with the purpose of allocating capital to beneficial climate and environmental projects (Flammer 2021). In 2007 the first green bond called climate awareness was issued by the European investment bank (2021). Only a year later World Bank issued its first green bond since then the green bond market has expanded significantly to the private and non-profit

sectors along with the public sector. Ultimately, reaching an all-time high issuance in 2020 of 290 billion US dollars (CBI 2021a).

Green bonds allow financing to be mobilized to projects with positive climate and environmental impact, in addition, the issuer having a possibility to enjoy a decreased cost of capital (Zhang, Li, and Liu 2021) In conjunction with the regulatory changes, green bonds have become one of the best choices for companies and investors to invest in green projects while minimizing financial risks along with non-financial risks (Dou and Qi 2019). As a result, green bonds have attracted significant interest, enabling the green bond market to see rapid growth globally, especially in Europe (CBI 2021a). The academic literature on green bonds trails behind the growth of the market, as there is a relatively low number of studies about the new financial instrument and its effects (Lebelle, Lajili and Sassi 2020; Wang, Chen, Li, Yu and Zhong 2020; Glavas 2020; Tang and Zhang 2020; Flammer 2021).

Extensive previous literature on green investments has shown empirical evidence of improved financial performance and increased market interest (Gupta and Jham 2021; Siedschlag and Yan 2021). Therefore, it can be concluded that the announcement of green bonds should increase interest in the company and as a result affect the share prices in the process.

## 1.1 Purpose of this study and research gap

This master's thesis aims to examine how does the market react to the announcement of green bond issuance. The market reaction is modelled through abnormal returns of the shares. This study focuses on the European market between 2013 and 2020. As the first corporate green bond was listed in 2013 hence this is a relatively new form of financial security on the market, consequently, studies focusing on the value-enhancing effects of green bond announcements are relatively scarce.

The previous existing literature has shown evidence that the announcement of sustainable and green investments influences company value and performance. The results have been mixed especially regarding green bonds, some studies found a significant positive reaction and others a negative reaction. (Glavas 2020; Tang and Zhang 2020; Flammer 2021) To examine the effect on company value previous literature has used the event study

methodology to examine the short-term effects of specific events; in this context, the event is the green bond announcement. This study follows the methodologies of the various previous academic literature.

Despite the European green bond market having the most growth in the past years, studies exclusively focusing on Europe have not been conducted. This paper aims to contribute to the existing green bond literature, by filling the gap by answering the following research question:

*Does the market react positively to the announcement of green bonds?*

This main research question focuses on whether the announcement can create shareholder value by estimating the cumulative abnormal returns of the shares and seeks to confirm the previous literature's positive results. If the abnormal returns are negative or insignificant, which indicates that green projects may not be valued higher than non-green projects and therefore will not impact the share prices positively or at all. In addition, to the market reaction, market efficiency and determinants of the reaction are examined, by answering the following supporting research questions:

*Does the market react efficiently to the green bond announcements?*

*Does the first-time green bond announcement enhance the positive market reaction?*

*Do company-specific and bond-specific determinants influence the market reaction?*

By answering the main and supporting research questions, this thesis sheds light on how the announcements are priced on the European markets, and if shareholders benefit from the issuance of green bonds. The market reaction will be examined from the viewpoint of how efficiently it reacts to new information, by determining how the share prices reflect the new information and if the reaction is significant. Additionally, ascertain the determinants that may affect the reaction of the market will be examined. Determinants that will be examined are company-specific and green bond-specific characteristics like return on assets, first-time issuance and ESG score, the full list of determinants will be presented later in the thesis. The research questions are approached with the event study methodology and regression

analyses, which follow the methods of previous academic literature that studied the effects of green bond announcements on company valuation. This thesis differentiates from other studies like Glavas (2020), Tang and Zhang (2020) and Flammer 2021), by focusing on the green bond announcements in Europe and by applying the regression analysis on top of the event study to determine possible factors affecting the market reaction.

## 1.2 Structure of the thesis

The rest of this thesis is structured the following way. The second section focuses on defining green bonds and the relevant concepts. After that, the theoretical background is defined, which includes the significant underlying theories and previous academic literature regarding the market reaction to conventional bond and green bond announcements. The following section describes the data and methodology used in this study, followed by the empirical results and a discussion of the results. Finally, section six concludes the thesis.

# 2. Green bonds

The trend of green financing has been on the rise due to the changing political situation which led to the transition towards a more sustainable economy, notably Europe has been leading the trend as a result of the Paris Climate Agreement that aims to reduce greenhouse gas emissions by the year 2030 and more recently with the green deal that aims to make Europe climate-neutral by 2050 (United Nations 2015; European Commission 2021). Policymakers and investors have become more aware of the probable connection between the risks of climate change and financial risks. Therefore, investors are shifting towards investment strategies that not only focus on profit maximization but to strategies that create financial value along with environmental and social value (Schoenmaker 2017). By adopting, and anticipating current as well as upcoming sustainability and environmental frameworks, investors can reduce their exposure to climate and environmental risks and limit the possible capital losses due to the risks (Weber 2018, 12). Investors have developed an increased appetite for the new innovative financial instruments that can limit their exposure to environmental risks. Green bonds meet the investors' and policymakers' demands and expectations as a financial instrument. In addition, green bonds allow companies to show their commitment toward climate and the environment.

## 2.1 Defining green bonds

Green bonds are defined as any form of bond instruments of which the return or equivalent amount is completely allocated to the financing or refinancing of green projects (ICMA 2021a). The definition of a green bond is not consistent in the financial literature or the financial markets. The various definitions of green bonds have the common characteristic of allocating at least part of the funds to environmentally friendly or green projects, especially to projects with a focus on mitigation and adaptation of climate change (Barua and Chiesa 2019; Karpf and Mandel 2018; Maltais and Nykvist 2020; World Bank 2015).

The main difference between a conventional bond and a green bond is the use of the proceeds. The green bond proceeds are earmarked for green projects, most of them focusing on environmental, climate or social benefits (Flammer 2021). A Green bond is similar in its

risk and return profile to any other bond on the fixed-income market. The pricing of the bonds and the yield to maturity are comparable. Furthermore, the key element along with the green label is the similar yield to maturity, which can boost investor interest in green bonds. (Banga 2019)

As with conventional bonds, green bonds keep a similar loan structure in terms of risk and recourse in the event that the issuer defaults. Similarly, to conventional bonds, green bonds can be split into different types based on their legal aspects, these four types are listed in the table below. Most of the green bonds are use of proceeds green bonds like mentioned in the previous paragraph the proceeds are marked as green projects that are on the issuer's balance sheet. The project bond's proceeds like the name suggest are earmarked to a specific project in the issuer's balance sheet. The revenue bond offers collateral, so the credit exposure of the investor is limited in case of a default. The securitized bond is collateralized by a single green project or several, and the revenue from the projects is used to repay the bond. (Banga 2019; ICMA 2021a)

Table 1. The four types of green bonds

| Green bond type | Description |
|---|---|
| Standard Green Use of Proceeds Bond | Proceeds are reserved for the issuer's green projects in the issuers balance sheet. Exposure limited to the balancesheet. |
| Green Revenue Bond | Proceeds are reserved for the issuer's green projects in the issuer's balance sheet, with limited credit exposure. |
| Green Project Bond | Proceeds are reserved for a spefied project or projects in the issuer's balance sheet. Exposure limited to the specified projects. |
| Green Securitised Bond | Proceeds are used to repay the bond, the exposure is limited to specific projects. |

Currently, there are no unified regulations or frameworks for green bonds. The issuer of the bond defines the use of proceeds, meaning that the bonds are self-labelled without any external review or assessment. Therefore, determining if the bond is truly green can be difficult.

There are voluntary frameworks that issuers may use, but others decide to define their bond green on their terms. The list of eligible projects for green bond financing is multifarious and includes but is not limited to investments in sustainable housing, sustainable public transport renewable energy, waste management and water infrastructure (ICMA 2021a). With the lack of legislation, greenwashing is made possible. (Bachelet, Becchetti and Manfredonia 2019) In the following chapter, the existing regulations and certifications for green bonds are reviewed and their availability to issuers is also examined.

## 2.2 Regulation and standards

As mentioned before in the previous chapter there is not a unified framework or legislation for the international green bond market. The existing voluntary guidelines have provided soft legislation and a framework for green bonds. With multiple overlapping frameworks and taxonomies are making the label of a green bond deviate regionally and depended on the used framework if any. Without harmonization of the standards investors must carry an extra risk if there is uncertainty about the greenness of the bond, therefore creating universal standards has become a priority to further develop the green market (Ehlers and Packer 2017).

Unlike the international green bond market, the People's Republic of China has implemented official regulations for green bonds. The regulations are mostly consistent with the voluntary legislation used in the international green bond market. (Huang and Yue 2020) The European Commission (2022) has begun to form a proposal for a European green bond standard, once adopted the regulation will set a clear framework for green bonds in Europe. Until the official green bond standards are formed investors and issuers have to rely on the voluntary frameworks.

The International Capital Market Association (ICMA 2021a) introduced the first voluntary guidelines for the issuance of green bonds in 2014. These process guidelines provide issuers

with the key principles of green bonds and guidance on the issuance process of the bond. The green bonds principles (GBP) are: process for project evaluation and selection, use of proceeds, management of proceeds and reporting. In addition to guiding the issuer, these four principles aim to increase transparency, integrity, and accuracy of the information disclosed and reported to the stakeholders through key recommendations and core components. (ICMA 2021a)

As another important regulatory pillar of the green bond market, Climate Bonds Standard (CBS) established by the Climate Bonds Initiative has provided a second channel to certify green bonds. The certification is given to eligible projects or assets that are in line with the CBS. For issuers, the certification acts as a voluntary initiative if their bond meets the standards and definition of a green bond, it will be eligible for the certification. Investors use the certifications as screening tools to avoid greenwashing. CBS is complementary to GBP and other green bond standards, like the upcoming European green bond standards. The CBS is more detailed compared to the GBP and it consists of pre-issuance and post-issuance requirements, which include criteria for climate-resilient and low carbon projects also the four principles of GBP. There are other aspects of green bonds for instance the environmental and social aspects that are not reflected in the CBS because the standard only considers the climate aspect. Another crucial aspect of the CBS is the requirement of a third-party verification that determines if the green bond meets the requirements for the certification. (CBI 2019)

External review of green bonds is not part of the GBP but there is a recommendation for an external review before the issuance of the green bond or after the issuance. The recommendation is used for the pre-issuance review to evaluate if the framework, bond programme and issuance are aligned with the GBP. The post-issuance review assesses that management and use of proceeds are confirmed by an external auditor or a third party to ensure that the funds are allocated to eligible projects. (ICMA 2021a) A variety of options exist for issuers to obtain external input into their green, social, and sustainability linked bonds processes, as well as numerous levels and types of reviews for the green bond that can be offered to the market as certification of the green aspect.

The external reviews can be divided into four groups: second-party opinion, verification, certification and scoring or rating. The difference between the second-party opinion (SPO) and verification is that the scope of the second-party opinion is a comprehensive assessment

of the issuer's green, sustainability and social-related processes related to the bond. SPO is more focused on the bond issuance as well as the alignment with their strategy, policies and sustainability processes or goals. Verification is conducted on the bond issuance and aligning it with the GBP or required standards. (ICMA 2021b) As mentioned before the CBS is an example of a certification, which is characterized by its continuous alignment with the requirements to keep the certification. An issuer can have their bond rated based on the key features like the use of proceeds or other key indicators of their bond. (CBS 2022)

## 2.3 Issuance of a certified green bond

Issuing a certified green bond requires three major market players to be included in the process, the issuer, an external reviewer, and an underwriter. The figure below illustrates the process of issuing a green bond. The issuance process starts with the issuer setting up the green project and estimating the possible positive impact on the environment, climate, or other eligible targets. To determine if the project is truly green the project is evaluated by an external reviewer with the intention to avoid any possible underestimations or overestimations of the positive impact. The assessment of the project is conducted by an environmental specialist who carries out a qualitative and quantitative evaluation of the project to determine if the project is in line with the four key components of GBP presented in the previous chapter. Failure to meet the requirements could mean excluding the green bond from the certified green market. (Banga 2019)

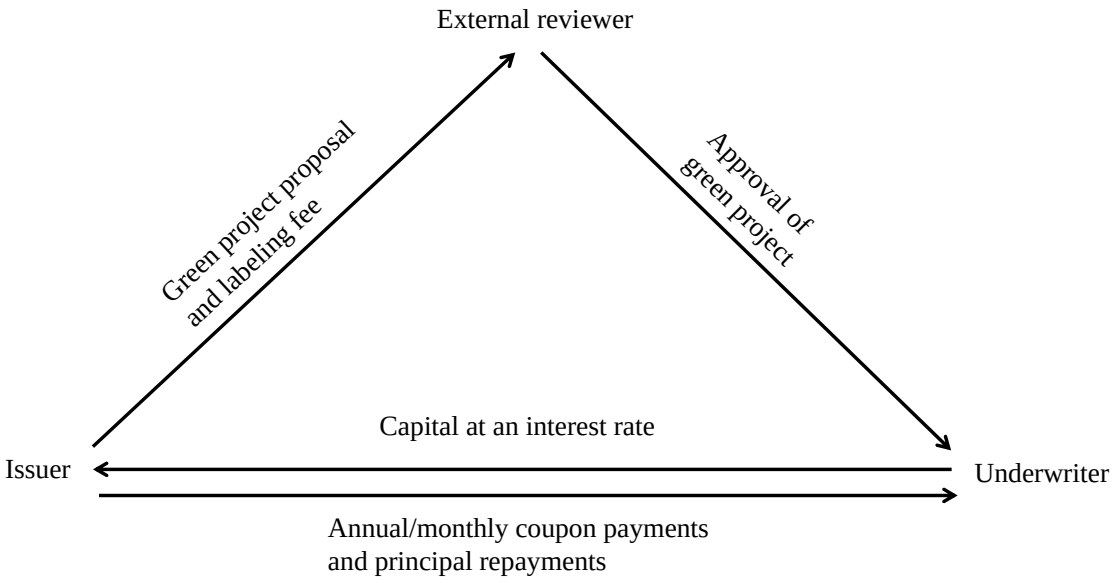


Figure 1. The issuance process of a certified green bond (adapted by Banga 2019)

After the review of an external party, the underwriter provides capital for a predetermined period at a variable or at a fixed interest rate to the issuer of the bond. The process could include transaction significant costs. This is a simplification of the issuance process, and it varies from issuer to issuer, also depending on the market. After the certification of the issuance process, the bond can be issued, which is usually preceded by the announcement of the green bond. The announcement provides extensive information about the project it used to finance and possible future investments or outlooks of the project. (ICMA 2021a)

## 2.4 Green bond market

The global green bond market has seen exponential growth ever since the first corporate green bond was issued in 2013. Only two years later (2015) the green bond market reached yearly issuance of 44.7 billion USD and in 2020 the issuances reached a total of 290 billion USD, with an average annual growth of 60 percent throughout the 7-year period. The figure below graphically displays the exponential growth of the green bond market. Despite the Covid19 pandemic bringing uncertainty into the green bond market at the start of 2020, the market bounced back in the second half continuing the yearly growth. (CBI 2021b)

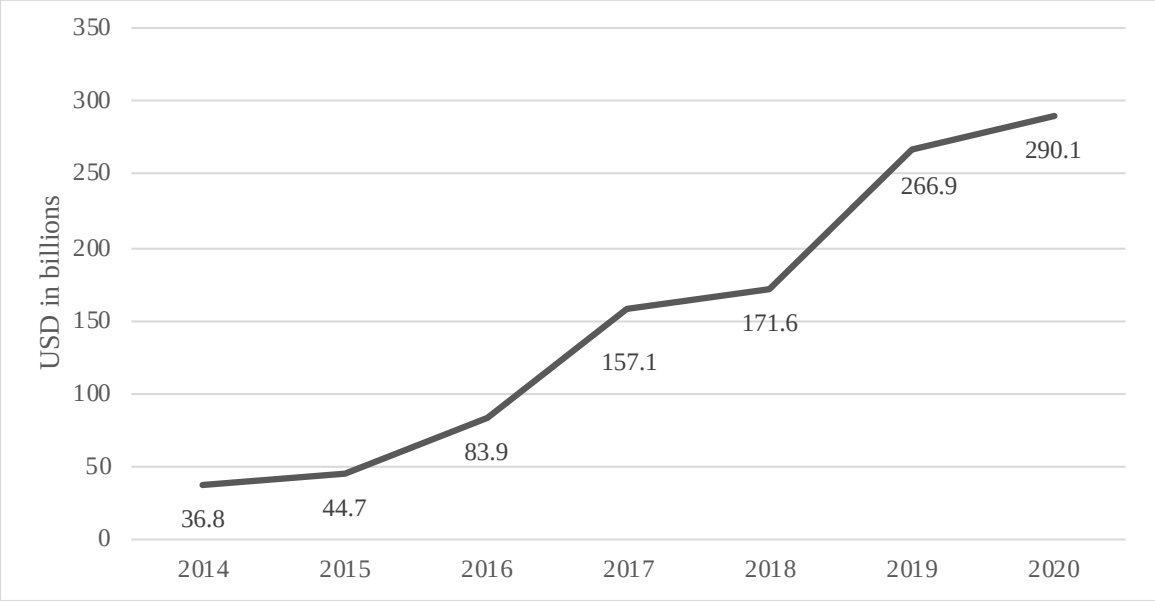


Figure 2. The annual value of the global green bond market in USD from 2014 until 2020

Europe accounted for the largest share of green financing in 2020 as it has been in previous years followed by North America and Asia-Pacific. Figure 3 shows the cumulative issuance of green bonds in USD per region. (CBI 2021b)

In 2020 the largest green bond issuer was government-backed entities followed by non-financial corporates which remained the largest source of green bonds among the private sector with a total issuance of 65 billion USD. Two-thirds of the non-financial corporate green bonds originated from Europe. Indicating that the private sector in Europe has accommodated the new financial instrument as a possible source of financing. The private sector is estimated to grow its share of the market next year, as more new issuers issue their first green bonds. (CBI 2021b)

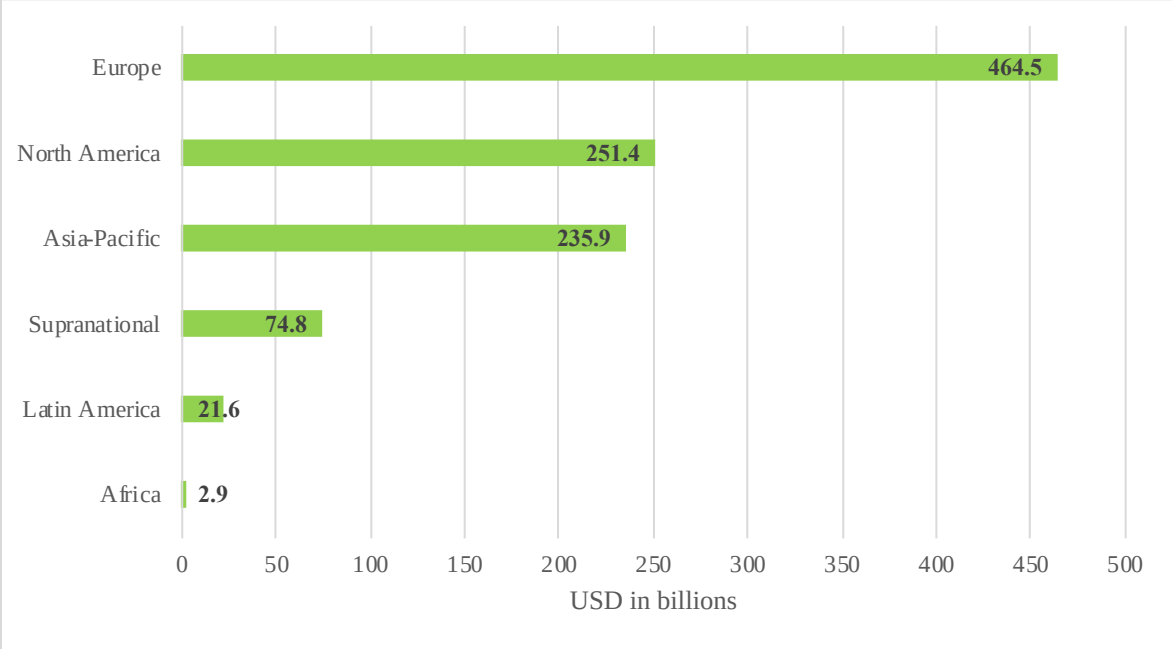


Figure 3. Cumulative issuance of green bonds per region until 2020

The three largest industries in 2020 that issued the most according to the CBI (2021b) were energy, construction, and transportation. The top three industries have seen a green transition over the past years, which explains the popularity of green bonds for the three industries. Over 89 percent of the green bonds issued were reviewed by external reviewers improving the transparency of the green bond market from the previous year's external review percentage of 82. Indicating that most of the bonds are certified regardless of the voluntary nature of the process.

# 3. Theoretical background

This chapter of the thesis focuses on the relevant theoretical framework and previous academic literature. At the beginning of the chapter, the relevant theories for this study are presented, and afterwards, the previous studies about the market reaction to green bond announcements are presented.

## 3.1 Efficient market hypothesis

Malkiel (1996) expressed the essence of the efficient market in just three words, "Money attracts brains", as new information becomes available rational participants react to it trying to achieve profits, subsequently, the information is incorporated into the asset prices. Therefore, it is assumed that information travels freely on the market among rational investors.

According to the efficient market hypothesis, there are no undervalued or overvalued assets on the market since the prices reflect all available information, hence asset's value is equivalent to its intrinsic value. Making excess risk-adjusted returns unattainable from the market as investors cannot possess information that is not incorporated into the prices. (Fama 1970) In the real-world limitations like asymmetric information and costs exist that make the market not fully efficient, which leads to the asset's value deviating from the intrinsic value. Consequently, making excess returns obtainable. (Grossman and Stiglitz 1980)

The efficient market hypothesis introduced by Eugene Fama (1970) presents three forms of market efficiency based on the information affecting asset pricing. These three forms of efficiency are: weak form, semi-strong form, and strong form. The weak form efficiency suggests that today's prices reflect all the historical information, therefore using technical analysis as a tool to achieve abnormal profits is useless. (Fama 1970)

In the semi-strong form of market efficiency, prices reflect all available public information, like earnings announcements and news. Using technical or fundamental analysis will not produce excess returns. The semi-strong form of efficiency is described to be closest the form to the real market efficiency. (Fama 1970)

Finally, the strong form of efficiency includes all the previous forms of efficiency so past and public information, and in addition, private information, hence all possible information is reflected in the prices. When all information is included in the prices no one can achieve excess returns. (Fama 1970)

The Efficient market theory has been criticized on multiple occasions as the prices on the market have not reflected all available information. The burst of the internet-technology bubble from the 1990s until the 2000s is an example of a long period of irrationality on the market. (Malkiel 2005) The conditions of efficiency like transparent information and investor rationality are rarely fulfilled on the market, as a result, excess returns can be achieved on the market at least occasionally. On the other hand, other studies have shown that the market is efficient over time by adjusting to new information and eliminating the possibility of excess returns. (Shleifer 2000, 1-10)

The random walk theory offers an alternative view of asset pricing on the market, which states that future prices are independent of historical prices, therefore they cannot be used to forecast the future value of an asset. As the name suggests the share prices are unpredictable and follow a random walk, without any kind of pattern or trend. In theory, yesterday's information does not affect the prices of today, the price changes solely depend on the new information which is incorporated into the asset prices immediately. The theory states that most of the investors on the market are rational and are trying ways to beat the market by analysing the prices and development of assets. (Malkiel 2003, 15-23)

The efficient market and random walk theory are essential when examining the impact of the green bond announcement. The idea of efficiency is present in the announcement effect since new information is being announced to the public and it should be incorporated to the prices. As sustainability and green investments are coming increasingly popular among investors the information about the announcement should be viewed in a positive way by the public. The positive signalling effect of announcing a green bond and having the information reflected in the share prices short-term, which causes them to rise.

## 3.2 Capital structure and signalling theory

Modigliani and Miller (1958) examined the relationship between the company's value and its capital structure. In a perfect market, the capital structure of a company won't affect its value, but in reality, markets are rarely perfect if ever, therefore the valuation of a company is influenced by its capital structure. According to the capital structure theory, a company's value is solely determined by its ability to create value with its assets, thus the origination of the funding has no significance. By considering taxation and tax advantages the company benefits from taking debt financing. The theory argued that taking more debt increases the company's value. (Modigliani and Miller 1963)

Debt is one of the primary sources of financial risk, rational investor requires a leverage premium demonstrating the relationship between leverage and returns. The identification of agency problems exhibited that taking more debt caused conflicts between the shareholders and debtholders, leading to agency costs, making the relationship between company value and external financing to be approached from a new angle. The trade-off theory takes into consideration the possible cost of financial distress which includes agency costs, bankruptcy and/or reorganization costs. (Myers 2001)

The trade-off theory states that optimal capital structuring maximizes the company's value, which can be accomplished by adjusting the ratio of debt and equity used to finance the company's operations. The optimal capital structure is achieved by recognizing the marginal costs and benefits of each added unit of financing, subsequently determining the optimal amount of financing that equates to the costs and benefits. (Myers 2001) According to the theory, more profitable companies should have higher leverage ratios (Abel 2018). To reach the optimal capital structure the company needs to borrow up to the point where marginal tax advantages (tax shield) gained through additional debt financing are counteracted by the present value of financial distress (Kraus and Litzenberg 1972).

Capital structure can be used to communicate the company's value to the market and ultimately attract new investors. The signalling theory hypothesizes that managers typically have a better understanding of the company's actual value than external investors, which results in information asymmetry between the two parties. As a consequence of the information asymmetry, the quality or value of the company or project is hard to evaluate by external parties (Akerlof 1970). Individuals can convey information to others on the market,

but in the context of information asymmetry theory, the conveyed information will not affect the actions of the information recipient. However, in the real-world companies can make financing decisions to share information or in other words signal the market, which will generate a reaction on the market. The information asymmetry has been used as a foundation of multiple theories, one of them being the aforementioned signalling theory and another one being the pecking order theory. (Campbell and Kracaw 1980)

The pecking order theory proposes that companies use their capital in a preferred order to finance their operations. Managers of a company seize more information about the company's operations, risks, performance and outlook, than external stakeholders. Therefore, parties providing external financing expect higher rates of return as compensation for the information asymmetry, which is associated with a higher risk that they are taking. Due to the higher rate of return required by external financing, companies prefer to use internal financing first like retained earnings. In a case, that external funds are needed for a capital investment companies prefer debt over equity, working from the safest debt option to the riskiest, and finally equity as the last resort. (Myers 2001)

In theory capital structure should affect how the announcement of bonds is perceived if the company is on the edge of default or restructuring, the bonds may not have the desired outcome. The financial profitability of a company will make financing more feasible through bond issuance. Bonds are perceived as a safe financing option, therefore issuing bonds is a common way to receive external funds and is higher up on the order of preferred types of external financing. (Denis and Mihov 2003)

A green bond announcement is presumably a positive event that should therefore cause a positive reaction in the share price, as it signals the company's commitment to sustainability and the environment. In addition to the signalling effects, green bond announcements disclose more information compared to conventional bond announcements. The green bond announcement publishes information about the use of proceeds, details about the green project and possible future investments, which diminishes the information symmetry on the market resulting in a reaction on the market (Myers and Majluf 1984). However, if the company's capital structure is not optimal in the eyes of the shareholders and possible investors the green bond announcement might cause a negative market reaction overriding the positive information, therefore the signalling has an adverse effect. Previous literature

has identified capital structure and company size are possible drivers of the market reaction to new information (Glavas 2020).

## 3.3 Stakeholder theory

Milton Friedman (1970) introduced the shareholder theory also known as the Friedman doctrine, which states that a company's only social responsibility is to produce profits for its shareholders. Therefore, other actions that do not increase the profits are at the expense of the shareholders. Obviously, this is an outdated theory about the social responsibility of a company and has received substantial criticism as social, environmental, and sustainable guidelines were developed further.

Fatemi and Fooladi (2013) propose a modern view of the company's social responsibilities, with a focus on sustainable value creation as well as financial value creation. The stakeholder theory expands the concept of shareholder theory about corporate responsibility, by focusing on stakeholder value creation instead of shareholders. A stakeholder can be defined as a party that is interested in the company and can be affected or will be affected by its operations. The stakeholder theory states that the company's ultimate objective is to meet its stakeholders' expectations, whether they are social, environmental, or sustainable, in addition to profit-making. In addition, the shareholders can benefit from the expanded scope of the stakeholder theory. The acknowledgement of stakeholders influences the company's long-term success since no modern-day corporation operates in a void where its operations only affect its shareholders. (How, Lee and Brown 2019)

The development of non-financial reporting also raised awareness about environmental, social and climate risks, it has brought new aspects to investment strategies. Rational investors are trying to minimize risks and simultaneously trying to maintain acceptable returns. If a company is willing to commit to green, social, sustainable, or otherwise ethical business values and actions, the non-financial risks like unsustainable and non-green actions are mitigated, but this can also mean lower returns for investors. Empirical evidence supports the aforementioned, as sustainable investments that minimize non-financial risks are acceptable for investors even if they yield lower returns (Boulatoff and Boyer 2009). Vice

versa unsustainable and unethical investments have higher returns due to their higher risks (Fabozzi, Ma & Oliphant 2008).

Furthermore, a link has been found between sustainability and increased risk-adjusted returns, which in some respects provides empirical evidence of the stakeholder theory. More predominantly empirical evidence of positive share price reaction to environmental and social related announcements. (Konar and Cohen 2001) Nevertheless, financial performance and responsibility are complex concepts that make it difficult to determine their causation.

The general assumption is that green announcements and actions that are beneficial to the environment will have a positive impact on abnormal returns, trading volume and overall financial performance (Nishant, Teo and Goh 2017; Corbett and Klassen 2006). There are other factors other than green or sustainable focused announcements or commitments that affect the value gained by the shareholders. Jacobs, Singhal and Subramanian (2016) point out, that the market reaction is expected to be greater to the announcements of smaller companies compared to larger ones. In addition, companies that publish announcements less frequent are expected to cause a significant market reaction, but companies with frequent announcements, also companies with higher environmental reputations receive minor market reaction effects to their announcements.

There are inconsistencies in the empirical results of the academic papers addressing the green announcements. Gilley, Worrell, Davidson and El-Jelly (2000) found that green initiatives had no overall effect on share prices. Similarly, the impact of positive and negative announcements was examined, and it was found that either of the announcement types had a significant effect on share prices (Videen 2010). Nonetheless, Fillbeck and Gorman (2004) detected environmental awards having a significant positive impact on the share prices. Ding (2020) ended with a similar result that green announcements had a positive but not a significant impact on the share prices. The inconsistencies in the results are explained by Jacobs et al. (2016) as differences in small sample sizes, insufficient measures, or controversial methodologies.

The stakeholder theory is linked to information asymmetry and signalling theories as fulfilling the stakeholders' expectations require disclosing more information about the company's operations and goals. Subsequently, causing a market reaction as outlined in the previous chapter.

## 3.4 Previous academic literature

As green bonds are a relatively new security it's beneficial to briefly examine the market response to the announcement and issuance of conventional bonds, considering they are the closest counterpart on the marker to green bonds. Previous literature has found mixed results regarding how the market reacted to conventional bond issuance. Eckbo (1986) studied the announcement of conventional bond issuance and concluded that there was no significant effect on the shareholder wealth. Theories by Jensen (1986) and Krasker (1986) proposed that issuing bonds affects share prices negatively, as a result of asymmetric information. This is further backed up by Howton, Howton and Perfect (1998) who provide evidence that issuing debt produced a negative reaction on the market. Martel and Padron (2006) along with Chin and Abdullah (2013) reached a contradicting result to Howton et al. (1998), they concluded that issuing new debt affected share prices positively. Fungáčová, Godlewski and Weill (2020) extend the literature by examining the European market reaction to the issuance of bonds and loans. The share price returns that model the market reaction, are found to be positive and significant, for bonds and other loan instruments.

As discussed in the previous chapters the announcement of sustainable and environmentally friendly financial instruments like green bonds should in theory increase shareholder value by causing a positive reaction on the market. Nevertheless, the literature has found varied results of the market reaction to the announcement of green bonds. Flammer (2021) examined the announcement effect of corporate green bonds by public companies from 2013 to 2018, the study included a total of 1189 green bonds issued globally. Similarly, to the literature on the market reaction to conventional bond issuance, Flammer used the event study methodology with the main event window of [-5,10], including five prior days and ten following days to the event date will consider possible prior information to the event day and the possibility of a slow reaction to the announcement. The abnormal returns in the study were estimated using the market model. The coefficients in the model were estimated with the ordinary least squares (OLS) based on 200 prior trading days to the event window. The study estimated a significant cumulative abnormal return (CAR) of 0.49 percent. Additionally, Flammer (2021) found that the reaction to the announcement of certified green bonds was stronger than to uncertified green bonds and improved environmental performance following the announcements.

Further evidence about the strong and significant positive connection between the announcement of green bond issuance and the share price increase is provided by Tang and Zhang (2020). The study focused on green bonds from 2007 to 2018, which included a total of 1510 green bonds. The event window used in the study was [-10,10] which is slightly longer than the event window used by Flammer (2021). Similarly, the abnormal returns were estimated over a longer period at 300 trading days, ending 50 days prior to the announcement. Tang and Zhang used the CAPM model in the estimation of abnormal returns, resulting in a cumulative average abnormal return of 1.4 percent. They also noted that the share's liquidity improved significantly after the green bond announcement.

Additionally, both Tang and Zhang (2020) and Flammer (2021) found, that the abnormal cumulative return became less significant and positive after the announcement of the first green bond as more bonds were announced. Following the finding, both the two studies also concluded that the subsequent green bond announcement had no significant impact on the share price.

Wang, Chen, Li, Yu and Zhong (2020) extend the academic literature by providing evidence from an emerging market about the positive market reaction to green bonds. The study focused on the green bond announcements of listed companies on the Chinese exchange, which included a total of 159 green bonds from 2016 until 2019. In accordance with other studies in the literature, multiple event windows were examined to understand the cumulative abnormal returns [-1,1], [-3,3] and finally [-10,10] following the announcement. Furthermore, Wang et al. (2020) compared the announcement effect of the green bonds to conventional bonds and the findings suggest that the market reacts more positively to the announcement of green bonds. The cumulative average abnormal return estimated was smaller compared to other studies at 0.012 percent and statistically significant.

Glavas (2020) extended the scope of the other studies by examining the reaction to the announcement of green bonds before and after the Paris agreement. The research included all the globally listed corporate bonds from 2013 to 2018. The share price reaction was stronger and more significant after the Paris agreement, implicating that the investor behaviour and interest changed due to the agreement. Glavas (2020) also tested if the abnormal returns were caused by the green label, the debt component or other possible factors that may affect market reaction by conducting a regression analysis on CARs obtained from the event study. The results of the analysis point out that the green label

component is identified as value-enhancing and the primary component of the abnormal returns. Therefore, it is more beneficial for a company to issue green bonds than conventional bonds.

The previous literature also documents contrary results, Lebelle, Lajili and Sassi (2020) studied the announcement effect on a global scale. The research follows the event study methodology like the studies presented above with multiple event windows. The findings of the study show that green bond announcements are met with a negative market reaction. Notably, first-time announcements have a significant negative impact on share prices. The cumulative abnormal returns are estimated to be -0.5 percent and -0.2 percent, depending on the length of the event window. In addition, in developed markets, the negative market reaction was more noticeable than in emerging markets. (Lebelle et al. 2020)

In major of the existing previous academic literature, the company's environmental responsibility was positively correlated with the performance of the stock market. In light of the prior results, green bond announcements were found to produce significant cumulative abnormal returns globally. The market reaction was more substantial to first-time green bond issuers and certified green bonds. The results are in line with theories about the signalling argument that states, companies signalling their interest in the environment and issuing green bonds which will cause a positive market reaction. (Klassen and McLaughlin 1996; Flammer 2013; Krueger 2015).

# 4. Data and methodology

This chapter focuses on the data and methodology used in this thesis. This chapter can be divided into two parts beginning with describing the data and the limitations. Afterwards, the event study methodology and other methodologies used are presented.

## 4.1 Data

All data used in this thesis is obtained from the Refinitiv Eikon database. The initial data set includes all green bonds listed in Europe between 2013 to 2020. Refinitiv Eikon labels the green bonds with a "green" label in the database. The green label is collected and certified from the Climate bond initiative database, designating that all the bonds classified as green are in line with the Climate bond standards (CBS) presented in chapter 2.2. The data includes basic characteristics of a green bond including announcement date, issuance date, coupon rate and other defining characteristics of the bond. In addition to the green bond data, the historical pricing of the issuers' shares, indexes and descriptive information about the issuer is extracted.

### 4.1.1 Limitations and data sample

The initial sample was narrowed down by only including listed companies due to the scope of this study, requiring share prices and detailed information about the company which is only available to public companies. Nonetheless, several private green bond issuances are included in the dataset as they are by private companies that are direct subsidiaries of publicly listed European companies (Tang and Zhang 2020). For instance, the Iberdrola Finanzas SA is privately listed, but it is fully controlled by its publicly traded parent company Iberdrola SA, the issuance of a green bond by the subsidiary is included in the data sample. The announcement effect is examined from the parent company's shares.

In addition, excluded from the sample are green bonds issued by financial companies, for example, banks and financial institutions, due to the financial companies using green bonds to finance their green loans, which are used to finance other companies. The proceeds from

the green bonds are not directly invested in eligible green projects and might therefore result in deviating results. (Fatica, Panzica and Rancan 2019; Gilchrist, Yu and Zhong 2021) This is also done in previous studies like Glavas (2020). The data is filtered with the industry sector to identify and exclude the financial sector.

The initial sample size was 545 green bonds before excluding financial companies, this is reduced noticeably to 159 green bond announcements. The sample size is further narrowed down by excluding companies with insufficient pricing data. The insufficient data can be that the company had their IPO within the estimation window, or the stock was delisted from the stock exchange. Afterwards, the sample size is 145 green bond announcements by 71 individual companies.

This study is conducted with the event study methodology, thus uncontrolled events that may alter the announcement effect and therefore degrade the quality and credibility of the study are checked for every announcement. All companies included in the data sample were screened for significant events that may have overlapped with the event window, if there was a significant event the green bond announcement was excluded from the study. Such significant events are mergers & acquisitions, earning announcements, share buybacks & splits, changes in senior management and credit rating, or other significant company actions that may impact share prices. The Dow Jones Factiva database was used to identify the events, and if such event accrued the announcement was removed from the sample.

In Refinitiv Eikon all the bond tranches are separated, therefore counting the overlapping issuance dates from the same issuer were counted as one. The final data sample includes 106 unique green bond announcements from 66 companies.

### 4.1.2 Descriptive statistics

The final data sample consists of 106 green bond announcements, of which 85.0 percent are CBI aligned green bonds, 5.7 percent are CBI certified green bonds and 9.4 percent are self-labelled. The majority of the bonds included in the sample are aligned with the relevant frameworks or have been certified, but all the bonds included in the final data sample fulfil the basic characteristics of a green bond. Table 2 displays an overview of the descriptive statistics of the issuances in the data sample. Green bond issuances and the amount issued has been growing over the sample period, the two last two years covering 61 percent of the

issuances. The growing amount of green bond issuances indicates that the non-financial companies are issuing more green bonds every year and the private European green bond market is growing with these issuances.

Table 2. Green bond issuances per year
This table provides the yearly statistics for the number of bonds issued, the total amount issued and the mean maturity. The amount issued is in millions of Euros and the mean maturity is reported in years.

| Year | Bonds issued | Total amount issued (M€) | Mean maturity |
|---|---|---|---|
| 2013 | 1 | 1 400 | 4.6 |
| 2014 | 9 | 5 625 | 3.6 |
| 2015 | 5 | 1 550 | 3.5 |
| 2016 | 4 | 4 200 | 3.0 |
| 2017 | 11 | 7 545 | 2.9 |
| 2018 | 11 | 6 925 | 2.6 |
| 2019 | 28 | 16 825 | 6.8 |
| 2020 | 37 | 24 181 | 10.8 |
| Total | 106 | 68 251 | 6.7 |

The industry breakdown of the green bond issuances is presented in table 3. It is noteworthy that most of the issuances happened in the electricity sector and the closely related energy sectors, which is most likely due to the increasing popularity of renewable energy sources, making the sector clearly the biggest issuers of green bonds during the sample period. Followed closely by the gas, water, and multi-utilities sector in the number of issuances. The amount issued is clearly dependent on the number of issued green bonds. In the cases of subsidiaries that were classified in the other financial sector, the industry is taken according to their parent company, for example, Iberdrola Finanzas SA issued green bonds are counted in the energy sector as their parent company Iberdrola SA is in the electricity industry.

The country breakdown of the green bond issuances can be found in appendix 1. The highest number of green bonds were issued in France, Germany, Spain, Italy, and Sweden. Regionally Southern Europe had the most issuances followed by Northern Europe. It is worth noting that most of the countries are part of the European Union, indicating that they have a similar process in the issuance of the bonds and legislation, therefore there shouldn't be major differences in terms of incentives to issue bonds in a specific country, it is mostly depended on where the company operates and their market.

Table 3. Green bond issuances per ICB sector

| ICB Sector | Bonds issued | Percent | Amount (M€) | Percent |
|---|---|---|---|---|
| Alternative Energy | 6 | 5.66 % | 2 940 | 4.31 % |
| Automobiles and Parts | 1 | 0.94 % | 10 | 0.01 % |
| Chemicals | 2 | 1.89 % | 1 300 | 1.90 % |
| Construction and Materials | 6 | 5.66 % | 3 014 | 4.42 % |
| Consumer Services | 1 | 0.94 % | 500 | 0.73 % |
| Electricity | 40 | 37.74 % | 26 665 | 39.07 % |
| Electronic and Electrical Equipment | 1 | 0.94 % | 300 | 0.44 % |
| Food Producers | 2 | 1.89 % | 2 200 | 3.22 % |
| Gas, Water and Multi-utilities | 15 | 14.15 % | 10 351 | 15.17 % |
| General Industrials | 3 | 2.83 % | 765 | 1.12 % |
| Household Goods and Home Construction | 3 | 2.83 % | 2 225 | 3.26 % |
| Industrial Materials | 4 | 3.77 % | 4 050 | 5.93 % |
| Industrial Support Services | 1 | 0.94 % | 500 | 0.73 % |
| Industrial Transportation | 5 | 4.72 % | 2 950 | 4.32 % |
| Medical Equipment and Services | 1 | 0.94 % | 750 | 1.10 % |
| Real Estate Investment and Services Development | 5 | 4.72 % | 3 156 | 4.62 % |
| Real Estate Investment Trusts | 1 | 0.94 % | 100 | 0.15 % |
| Telecommunications Service Providers | 7 | 6.60 % | 6 250 | 9.16 % |
| Waste and Disposal Services | 2 | 1.89 % | 225 | 0.33 % |
| Total | 106 | 100.00 % | 68 251 | 100.00 % |

The descriptive statistics for the green bonds can be found in table 4. As one may notice the issuance amount of the green bonds deviates considerably, which may be a result of the amount of financing needed for the green project or the size of the project. It is noteworthy that is a moderate correlation between the total assets of the issuer and the amount issued, so larger companies issue larger amounts. The correlation matrix of the green bond and company variables can in appendix 2. The median amount issued is lower than the mean

signifying that there are a few higher bond issuance amounts. The maturity of the bonds has a significant deviation. The mean maturity of the bonds is around 6.7 years, but the range of the maturities is anywhere from two and half months to approximately 59 years.

The coupon of the green bond ranges anywhere from zero to over 8 percent, in the sample, there are three zero-coupon bonds. The CBI Aligned, Fixed and First Green Bond variables are dummy variables to examine to differentiate the certified green bonds and the bonds that have fixed coupon payments. Of the final sample, 86 of the bonds have fixed coupon payments. The final data sample has 66 first time green bond announcements.

Table 4. Green bond descriptive statistics
The green bond-specific variables are presented in the table below. The amount variable is in millions of Euros. The maturity variable is recited in years. The coupon variable is reported as a percentage. CBI Aligned, Fixed and First green bond are dummy variables that receive values 1 or 0.

| Variable | N | Mean | Median | Min | Max | Standard deviation |
|---|---|---|---|---|---|---|
| Amount | 106 | 643.88 | 575.00 | 10.00 | 2 400.00 | 431.35 |
| Maturity | 106 | 6.74 | 3.79 | 0.28 | 59.19 | 11.76 |
| Coupon | 106 | 1.89 | 1.45 | 0.00 | 8.13 | 1.66 |
| CBI Aligned (1/0) | 106 | 0.90 | 1.00 | 0.00 | 1.00 | 0.31 |
| Fixed (1/0) | 106 | 0.81 | 1.00 | 0.00 | 1.00 | 0.39 |
| First Green Bond (1/0) | 106 | 0.62 | 1.00 | 0.00 | 1.00 | 0.49 |

The share prices for all the companies included in the final sample were also obtained from the Eikon Refinitiv database. If the company had multiple series of shares listed on the exchange, the most traded share was selected for the sample. The daily returns of the shares are calculated from adjusted daily prices, which take into account dividends and possible stock splits. Using the adjusted daily prices reduces the possibility of thin trading that may affect the estimates of β in the market model by making the estimate inconsistent and biased (Brown and Warner 1985). The list of parent companies used in the sample can be seen in appendix 3.

As mentioned before descriptive statistics about the issuers were extracted for the regression analysis and are displayed in table 5. The descriptive statistics were retrieved for the parent companies, and it resulted in 65 companies. The environmental, social and governance (ESG) score scale is from 0 to 100, four of the companies did not have an ESG score, therefore there are four missing values in the ESG score variable. The mean score of approximately 70 is considered good ESG performance since it is in the third quartile, therefore, can be considered above average score. The total asset mean is considerably above the median, signifying there are few big companies like Electricite de France SA, Orsted A/S and Volvo AB in the sample, that account for a substantial proportion of the variable.

For each company, the corresponding stock market indexes are used to reflect the market where the company is listed. The 16 stock market indexes used in the study can be found in appendix 4.

Table 5. Issuer descriptive statistics
This table presents the issuer's descriptive statistics. ESG score variable presents the company ESG score on the year of the issuance, the variable receives values from 0 to 100. Return on assets (ROA) and Equity to assets are ratios that receive values from 0 to 1. Total assets are the company's assets in millions of Euros.

| Variable | N | Mean | Median | Max | Min | Standard deviation |
|---|---|---|---|---|---|---|
| ESG Score | 61 | 70.16 | 72.86 | 93.33 | 20.36 | 17.12 |
| ROA | 65 | 0.04 | 0.04 | 0.33 | -0.06 | 0.05 |
| Total Assets (M€) | 65 | 51 633 | 17 676 | 515 856 | 196 | 91 839 |
| Equity to Assets | 65 | 0.26 | 0.26 | 0.63 | -1.90 | 0.32 |

## 4.2 Methodology

Following the previous studies on the topic (Glavas 2020; Tang and Zhang 2020; Flammer 2021), event study methodology will be used to measure the effects of the change in market value. The methodology relies heavily on the efficient market hypothesis as information is made available to the market; the new information should be reflected in the prices immediately. In addition, the event is unexpected implicating that is not reflected in the prices before. (MacKinlay 1997) As the new information is made public on the event date the market is expected to react immediately or with a slight delay.

### 4.2.1 Event study

In the case of the green bond, the event of interest is the announcement of the green bond, not the issuance date, as the share prices reflect the new information announced, therefore the issuance day shouldn't cause abnormal returns as no new information is provided to the market (Flammer 2021). Prior to the announcement, the estimation window is determined to estimate the normal returns of the issuer, which are equated with the returns during the announcement period. The estimation window length should be determined so that it minimizes the variance of the daily returns while capturing the share price fluctuations (Strong 1992). The event window follows after the estimation period, and it is used to estimate if the returns of the event period deviate from the estimated normal returns. Similarly, the event window should be long enough to capture the effect of the announcement but not short enough to exclude any confounding effects that may occur (McWilliams and Siegel 1997). Following previous studies, the full length of the event window is set as 21 days, so 10 days prior to the event and 10 days after [-10,10]. Also, shorter event windows of [-5,5], [-3,3], [-1,1] and [0,1] are tested to capture short-term effects of the announcement. The Estimation window is set as [-221, -21], using the span of 200 trading days before the event for the normal return estimation. Closing the window 21 days prior to the event to ensure that, no predictive information like insider information related to the event is present in the estimation window. Figure 4 illustrates the timeline of the event study.

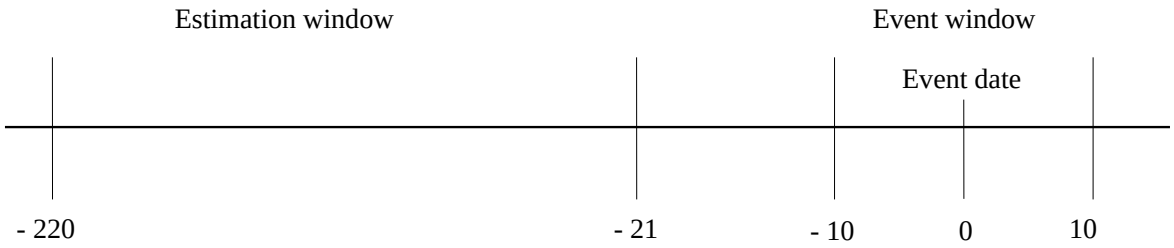


Figure 4. Timeline of the event study

The event day is the supposed day that the returns might deviate from the estimated normal returns of the shares. The reaction to the announcement may be positive or negative, if the reaction is delayed, meaning that the prices do not immediately reflect the new information

and the market is functioning on a semi-strong form of efficiency. Abnormal returns before the event date might be an indication of insider information, that investors are taking advantage of before the announcement or anticipation of the event itself.

### 4.2.2 Estimation of returns

The daily prices of the shares were retrieved in their original currencies from Refinitiv Eikon. The daily returns were calculated in Microsoft Excel, with the following formula

$$R_t = \frac{P_t}{P_{t-1}} - 1 \quad (1)$$

where $R_t$ is the daily return of the security at time $t$, $P_t$ and $P_{t-1}$ are the security prices at time $t$. Formula 1 is used to calculate the actual daily returns for the shares and the stock market indexes.

To approximate the effects of the announcement green bond announcement associated with the share price movements, the cumulative abnormal returns (CAR) will be estimated. CARs are calculated by aggregating the daily abnormal returns of the shares throughout the event period. Before CARs can be determined, the daily abnormal returns are calculated, by taking the difference between actual returns and the normal returns or in other words expected returns. The estimation of expected returns can be expressed as

$$\hat{R}_{it} = \alpha_i + \beta_i R_{mt} \quad (2)$$

where $\hat{R}_{it}$ is the expected return of the security at time $t$, $R_{mt}$ is the return of the market portfolio at time $t$, $\alpha_i$ and $\beta_i$ are parameters of the market model (formula 4) and they are estimated using OLS regression. The parameters are estimated for every announcement as market and company characteristics might vary over time. Both $\alpha_i$ and $\beta_i$ are estimated in the event window. As specified in the previous chapter, the corresponding market indices of each company were retrieved and are used to model the return of the market.

Expected return is expressed as the return of the share if the event of interest did not occur, to measure the impact of the event the abnormal returns (ARs) are calculated with the following formula:

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

where $R_{it}$ is the return and $\hat{R}_{it}$ is the expected return of the share *i* at time *t.* Formula 3 is used to calculate the abnormal returns during the event window. The expected return formula and the abnormal return formula can be combined for a more compact presentation as the market model

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) + \varepsilon_{it} \quad (4)$$

$$E(\varepsilon_{it}) = 0 \quad (5)$$

$$Var(\varepsilon_{it}) = \sigma_{\varepsilon i}^2 \quad (6)$$

where, $\varepsilon_{it}$ is the error term, that measures the estimation error of the model. The error term is assumed to be independent with the expected value of zero and a finite variance. It is presumed that the error term is not correlated with the share returns or the market returns. As specified earlier, the market model parameters are approximated with OLS, the parameters are determined as follows

$$\alpha_i = \mu_i + \beta_i \mu_m \quad (7)$$

$$\beta_i = \frac{\sum_{t=T_{0+1}}^{T_1} (R_{it} - \mu_i)(R_{mt} - \mu_m)}{\sum_{t=T_{0+1}}^{T_1} (R_{mt} - \mu_m)^2} \quad (8)$$

$$\sigma_{\varepsilon i}^2 = \frac{1}{L_1 - 2} \sum_{t=T_{0+1}}^{T_1} (R_{it} - \alpha_i - \beta_i R_{mt})^2 \quad (9)$$

where,

$$\mu_i = \frac{1}{L_1} \sum_{T_{0+1}}^{T_1} R_{it} \quad (10)$$

$$\mu_m = \frac{1}{L_1} \sum_{T_{0+1}}^{T_1} R_{mt} \quad (11)$$

the $R_{it}$and $R_{mt}$ are returns of the security and the market at time $t$ and $L_1$ referring to the length of the estimation window. (MacKinlay 1997)

Cumulative abnormal returns (CARs) for the event windows are calculated to examine the total effect of the announcement. CAR is estimated by totalling all the abnormal returns (AR) of the asset over the event period as follows

$$CAR_{i(T_1,T_2)} = \sum_{T_1}^{T_2} AR_{it} \quad (12)$$

where $T_1$ and $T_2$ are the start and end date of the event window. The overlapping announcements were removed to be able to examine the aggregate effect of the event. The AARs are also aggregated over all the securities to approximate the effect of green bond announcements in the sample. The cumulative average abnormal return (CAAR) is defined as

$$CAAR_{i(T_1,T_2)} = \frac{1}{N} \sum_{T_1}^{T_2} AAR_t \quad (13)$$

the $AAR_t$ is the average abnormal return for the time $t$ and $N$ referring to the number of observations. The CAARs estimated from the event study must be statistically significant before inference can be drawn.

Statistical significance is tested with a parametric and a non-parametric test. The two tests complement each other to ensure the robustness of the results. The standardized cross-sectional test is applied as the parametric test to determine if the abnormal returns and cumulative abnormal returns are statistically different from zero. The standardized cross-sectional test takes into account the share price movements during the estimation window as well as the event window, making it more robust than a t-test. (Kolari and Pynnönen 2010). As the non-parametric test, the Wilcoxon signed-rank test is used (Wilcoxon 1945; Tang and Zhang 2020). As the previous studies have produced mixed results of the market reaction to the announcement of green bonds, both of the tests are performed as two-tailed.

Kolari and Pynnönen (2010) raise the issue of cross-sectional correlation of abnormal returns if there are multiple events on the same date. This may lead to falsely rejecting the hypothesis, but after removing the overlapping announcement dates, the cross-sectional

correlation is not an issue. The two significance tests presented above are enough to test the significance of the abnormal returns and cumulative abnormal returns.

### 4.2.3 Regression

Previous academic literature on debt issuance has identified a link between bond and company characteristics that could influence the market reaction when a bond announcement occurs (Bradshaw, Richardson, and Sloan 2006; Tang and Zhang 2020; Flammer 2021). Therefore, to support the event study results a regression analysis of the cumulative abnormal returns is conducted to identify if the market reaction has possible underlying determinants that may explain the positive or negative impact of the announcement.

Based on previous research the independent variables can be divided into two distinct categories, company-specific characteristics, and bond characteristics. Company-specific variables are considered as potential drivers of the market reaction to green bond announcements. (Bradshaw et al. 2006; Glavas 2020) The company-specific variables were ESG rating, company size, return on assets (ROA) and equity to asset ratio. All the variables expect ESG rating are prior-year values to the announcement. ESG rating is representing the company's commitment to green and sustainable values and business operations. Company size is modelling the size of the business and is calculated by taking the natural logarithm of the total assets. Return on assets and equity to asset ratio model financial performance and risk factors associated with the company respectively.

The green bond specific variables are the first green bond issuance, bond size, maturity, and coupon rate. The first green bond issuance is a dummy variable, the bond size is the amount issued and the coupon rate is a percentage.

The regression analysis will be done using the model presented (Brooks 2008, 98) as

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_k X_k + u \qquad (14)$$

where $Y$ is the dependent variable in this case the CAR, $\alpha$ is the constant also known as the intercept of $Y$, $\beta$ is the coefficient of the independent variable ($X$) that indicates how much the dependent variable will increase or decrease with one unit of $X$ and $u$ is the error term.

The main interest of the regression analysis is the $\beta$-coefficient since it suggests if the previously presented variables affect the CAR positively or negatively, to approximate if the investors find, for example, the first green bond issuance as value-enhancing. If the $\beta$-coefficient is not statically significant, referring that the investors do not find the variable relevant in terms of value significance. As the data sample consists of announcements by several companies over 8 years, there are differences between industries and countries. Therefore, controlling these factors is crucial since they might be correlated with variables in the regression analysis. (Glavas 2020)

A few considerations should be made about the interpretation of the findings of the regression analysis. The abnormal returns may be depended on company characteristics, as investors might anticipate the company's actions and change their behaviour based on their assumptions. For example, using company characteristics like ESG reputation to estimate the probability of an event occurring, in this context subsequent green bond issuances to happen in the near future. Resulting in incorrectly valuing the company's actions and its shares, therefore, the valuation of the green bond approximated in the event study might be under or overpriced. (MacKinlay 1997) Prabhala (1997) argues that the actual parameters and the estimated coefficients are comparable if they can be regarded as statistically significant.

# 5. Empirical results and discussion

## 5.1 Results of the event study

As mentioned in section 4.2.1 the announcement is the date of interest as the semi-strong form of efficiency market hypothesis states, new information should be incorporated into the prices immediately as it is released. The event window selected to examine the abnormal returns of the shares was 21 days ten days before and ten days after. Figure 5 displays graphically the average abnormal returns for each day of the event window.

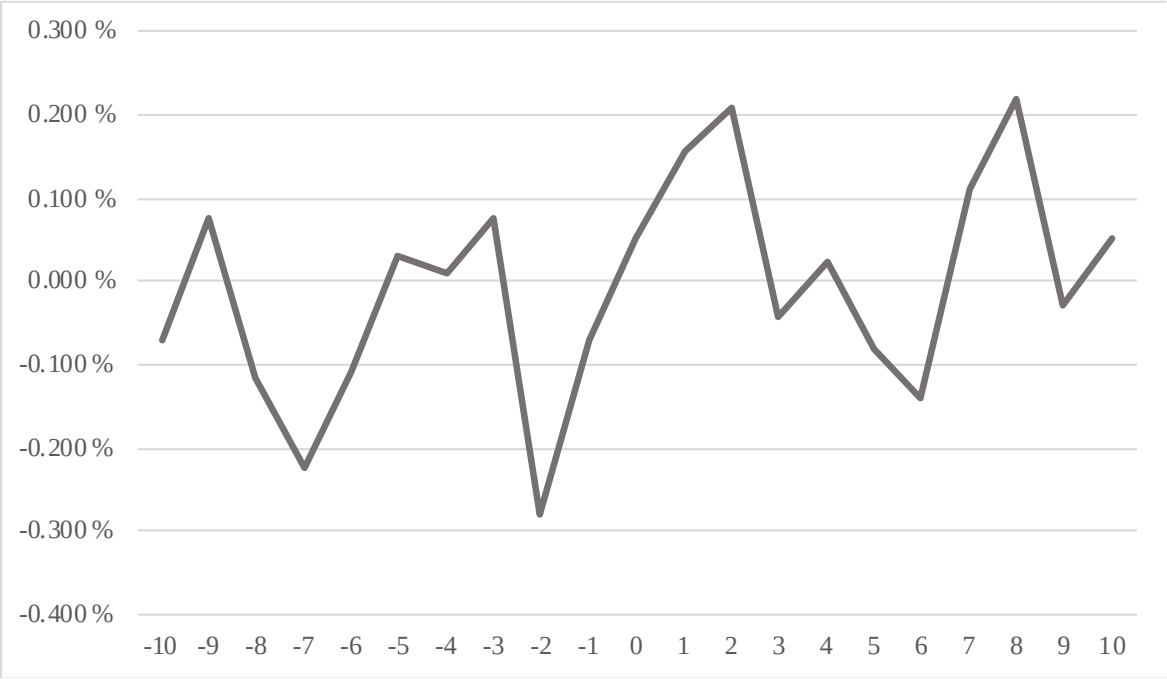


Figure 5. The average abnormal returns (AAR) for the event window

Table 6 displays the average abnormal returns for the event window. The average abnormal returns were statistically significant at a 10 percent level on six days (-7, -2, 1, 2, 6, 8) in the whole event window, four of those days the AARs were significant on a 5 percent significance level. The average abnormal returns were the highest eight days after the event and the lowest at two days before the event. It is noteworthy that the abnormal returns were quite volatile throughout the event window, which can be noticed both from the figure above as well as in table 6.

Table 6. The average abnormal returns for the event window [-10,10]
The table presents the average abnormal return, standard deviation, also min and max AARs for the day of the event window. ***, ** and * indicate statistical significance on a 1%, 5% and 10% level. The significance was tested with a two-tailed standardized cross-sectional test.

| T | AAR - % | Standard deviation | Min | Max |
|---|---|---|---|---|
| -10 | -0.07 | 0.018 | -8.85 | 5.26 |
| -9 | 0.08 | 0.019 | -4.43 | 10.18 |
| -8 | -0.12 | 0.015 | -4.00 | 6.31 |
| -7 | -0.22** | 0.017 | -6.47 | 6.00 |
| -6 | -0.11 | 0.015 | -4.56 | 6.11 |
| -5 | 0.03 | 0.015 | -4.68 | 8.25 |
| -4 | 0.01 | 0.015 | -6.22 | 4.78 |
| -3 | 0.08 | 0.014 | -3.52 | 5.92 |
| -2 | -0.28*** | 0.015 | -5.15 | 5.17 |
| -1 | -0.07 | 0.016 | -5.79 | 5.00 |
| 0 | 0.05 | 0.016 | -3.75 | 8.30 |
| 1 | 0.16* | 0.019 | -4.23 | 6.13 |
| 2 | 0.21** | 0.018 | -3.81 | 13.94 |
| 3 | -0.04 | 0.015 | -6.12 | 4.74 |
| 4 | 0.02 | 0.014 | -5.34 | 6.08 |
| 5 | -0.08 | 0.014 | -6.94 | 4.83 |
| 6 | -0.14* | 0.013 | -4.36 | 3.23 |
| 7 | 0.11 | 0.014 | -4.36 | 7.53 |
| 8 | 0.22** | 0.019 | -8.62 | 11.25 |
| 9 | -0.03 | 0.013 | -3.51 | 4.43 |
| 10 | 0.05 | 0.017 | -4.57 | 9.57 |

The market reaction to the announcement of a green bond was mixed, near the event date abnormal returns were positive or slightly negative but they weren't as volatile as before the event. The maximum and the minimum ARs deviate vastly from the average, indicating there might be a few outliers in the ARs. Overall, there doesn't seem to be a clear pattern or trend in the AARs during the event window.

Table 7 presents the cumulative average abnormal returns (CAARs) for the different event windows. The results mainly demonstrate a positive market reaction to the announcement of green bonds. The longest event window [-10,10] indicated a negative market reaction, which is contrary to the other event windows. The shorter event windows exhibit a positive CAAR, specifically the shorter the event window the higher the CAAR. Indicating that the positive reaction is happening around the announcement day of the green bond, which is evident in table 6 as well.

Table 7. Cumulative average abnormal returns for the event windows
The top row presents the event windows; the following rows present the cumulative average abnormal return (CAAR) as a percentage for that window. $Z_1$and $Z_2$ present the statistical significance tests to determine if the CAAR is significantly different from zero, the former is the standardized cross-sectional test, and the latter is the Wilcoxon signed-rank test. Finally, the skewness, kurtosis and number of observations are displayed. ***, ** and * indicate statistical significance on a 1%, 5% and 10% level.

| Event Window | [-10,10] | [-5,5] | [-3,3] | [-1,1] | [0,1] |
|---|---|---|---|---|---|
| CAAR | -0.156 | 0.075 | 0.096 | 0.136 | 0.207* |
| $Z_1$ | 1.272 | 1.029 | 0.474 | 1.159 | 1.721 |
| $Z_2$ | 1.301 | 0,984 | 0.267 | 1.134 | 1.673 |
| Skewness | -0.180 | 0.529 | 1.109 | 0.260 | 0.140 |
| Kurtosis | 0.477 | 1.661 | 5.225 | 3.951 | 0.827 |
| N | 106 | 106 | 106 | 106 | 106 |

In order to determine the statistical significance of the obtained CAARs, parametric and non-parametric tests were run to ensure the robustness of the results. The event window of [0,1] is the only one that has statistically significant CAAR, out of the event windows. This indicates that only the actual event day and the following day are significant in terms of the market reaction. The skewness suggests that CAARs at least during the shortest event window the estimated CAARs are quite symmetrically distributed, and the kurtosis indicates that there are not too many outliers or fat tails in the distribution. The [0,1] event window is the only statistically significant out of the five, indicating that the other possible trends that are unrelated to the announcement of the green bond during the event window are not relevant to positive market reaction. The statistical significance is only at the 10 percent level, so if using a lower significance level, the CAARs of all the event windows can be considered insignificant. To answer the main research question, a positive market reaction

of 0.207 percent is found to the announcement of a green bond. The observed CAAR is statistically significant only on a 10 percent level.

There isn't any indication of information leakage or insider information exploitation before the announcement date. On the day before the actual event date, AARs are not statistically significant. The AARs of the two days following the event day are positive and statistically significant which would indicate a delayed market reaction to the announcement of the green bond, but the other unrelated trends might already be present after the event day. The market seems to react to the announcement and the new information on the event day and the prices continue to adjust on the following two days. The delay in adjustment of the prices can be analyzed by the time of the announcement if it was released during the trading hours or not. Which can explain could cause the new information to be incorporated into the prices the following day of the announcement. To answer the first supporting research question, the market seems to function according to the semi-strong form of the efficient market hypothesis. This is supported further by the shortest event window being the only significant event window.

The results of the event study are consistent with the previous academic literature, which suggests a positive market reaction to the environmentally friendly project announcements and green bond announcements (Klassen and McLaughlin 1996; Tang and Zhang 2020; Flammer 2021). The reasoning behind the positive market reaction is mixed, one theory suggests that announcing green bonds improves the company's visibility on the market and attracts possible investors, therefore enlarging the investor base. The basis of the green aspect being the attracting factor of the announcement is based on the rationale that traditional corporate announcement like the issuance of a conventional bond doesn't attract enough investor attention (Eckbo 1986; Ben-Rephael, Da and Israelsen 2017). Reboredo (2018) suggests that green bond announcements attract investors that are looking for green investments to satisfy their mandate or trying to improve their ESG score, which may lead to an increase in the share prices. The visibility of a company is crucial to shareholders as it has been found that it can create value or destroy it (Grullon, Kanatas and Weston 2004). The announcement of a green bond is usually related to a press release of the green project that is being financed, which attracts not just investor attention but media attention as well (Krueger 2015).

Tang and Zhang (2020) presented an alternative rationale, the "fundamental channel" for the positive market reaction. As a green bond announcement contains extensive information about the use of proceeds and possible future investments and other aspects that conventional bond announcements do not. Disclosing more information reduces information asymmetry on the market causing a reaction on the market (Myers and Majluf 1984). Therefore, shareholders benefit from the announcement as new information is being disclosed and from a positive market reaction.

The table below presents the CAARs of the first-time announcements and the subsequent announcements. The CAARs of the first announcements are found to be positive in every event window except the longest event window. Signifying a strongly positive market reaction to the first-time announcement of green bonds. Similarly, to the whole sample CAARs the event window of [0,1] is statistically significant on a 10 percent level.

Table 8. CAARs for the first-time announcements and subsequent announcements
The table presents the first green bond announcement on the left and the subsequent announcements on the right. $Z_1$and $Z_2$ present the statistical significance tests to determine if the CAAR is significantly different from zero, the former is the standardized cross-sectional test, and the latter is the Wilcoxon sign rank test. ***, ** and * indicate statistical significance on a 1%, 5% and 10% level.

| | First Announcement | | | | | Subsequent Announcement | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Event Window | [-10,10] | [-5,5] | [-3,3] | [-1,1] | [0,1] | [-10,10] | [-5,5] | [-3,3] | [-1,1] | [0,1] |
| CAAR | -0.326 | 0.208 | 0.329 | 0.239 | 0.249* | 0.150 | -0.068 | -0.362 | -0.095 | 0.153 |
| $Z_1$ | 1.327 | 0.891 | 0.512 | 1.187 | 1.897 | 1.139 | 0.456 | 0.994 | 0.687 | 1.401 |
| $Z_2$ | 1.198 | 0.802 | 0.687 | 0.914 | 1.803 | 1.084 | 0.501 | 1.093 | 0.721 | 1.277 |
| Skewness | -0.358 | 0.807 | 1.201 | 0.868 | 0.135 | 0.350 | -0.422 | 0.369 | -0.778 | 0.163 |
| Kurtosis | 0.707 | 1.988 | 5.774 | 5.190 | 0.947 | -0.379 | -0.045 | 0.438 | 2.005 | 0.799 |
| N | 66 | 66 | 66 | 66 | 66 | 40 | 40 | 40 | 40 | 40 |

The CAARs of the subsequent green bond announcement are negative except for the shortest and the longest event windows, but none of the CAARs is statistically significant, implying that the announcements following the first announcement do not have a significant impact

on the share prices and therefore do not cause a reaction on the market. The positive reaction is found to be higher with the first-time announcement of green bond with CAAR of 0.249 percent, similarly to the whole sample findings the first-time announcement is statistically significant on a 10 percent level. The results are in line with stakeholder theory's extended social responsibilities of a company as the green bond can be viewed as a commitment to green projects. Signifying that the commitment is considered positive information on the market. (How, Lee and Brown 2019) Answering the second supporting research question "*Does the first-time green bond announcement enhance the positive market reaction?".* The first-time announcement of green bond has a higher cumulative average abnormal return than the subsequent announcements and the whole data sample.

The green bond announcement information can be split into two pieces of information the company's environmental commitment and the bond issuance. The market reaction to the conventional bond announcement is unresponsive, implying that the commitment to the environment and green projects are already incorporated into the prices after the first announcement and therefore the following green bond announcement is being treated as a conventional bond announcement (Eckbo, Masulis and Norli 2007, 233-373; Flammer 2021). Investors don't benefit from the subsequent announcements to the same extent as from the first-time green bond announcement. Therefore, it is valid to assume that the investor attention is lower towards subsequent announcements, which could explain why the subsequent announcements are not statistically significant. However according to Tang and Zhang (2020) as the announcement of a green bond includes extensive information about the projects and possible future investments, the market should react to subsequent announcements as they contain new information that should be reflected in the share prices. The results of the event study show a positive cumulative reaction on the day of the event and the following day. However, the reaction is not statically significant, signalling that the information provided in the announcement is not the defining factor of the positive market reaction.

The previous academic literature is in line with the findings of the event study, Flammer (2021) found that the CAARs of the first-time announcement are positive and higher than the CAARs of the whole sample. In addition, the subsequent announcements were not statistically significant, but mostly positive which is the opposite of this study's results, which are negative in three of the five event windows. It is noteworthy that the results of the

previous studies were significant on a lower level than the 10 percent which was the case in this event study. (Glavas 2020; Tang and Zhang 2020; Wang et al. 2020; Flammer 2021)

The event study shows a positive market reaction to the announcement of a green bond for publicly listed European companies. The previous studies are in line with the findings, but the CAAR found in those studies is higher than found in this study (Glavas 2020; Tang and Zhang 2020; Wang et al. 2020; Flammer 2021). This may be caused by the regional differences as those studies were conducted on a global scale. Regional differences could be explained by multiple factors. In Europe, the requirements for non-financial reporting are higher and the green bond framework that is currently being developed will add to the requirements, increasing the amount of information companies need to enclose. Therefore, reducing information asymmetry drastically on the European market compared. The classification differences between regions if the bond can be labelled as green deviate from region to region, Europe has one of the stricter frameworks for certified green bonds, compared to for example China's "green" label is more inclusive than in Europe. (Climate Bond Initiative 2017; Wang et al. 2020; European Commission 2022) The European market might be accommodated to the extensive information about the green projects and financing than other markets, thus the positive market reaction might be lower than on a global scale.

Another reason for the lower positive market reaction might be caused by the maturity of the sustainable and green financing market, as the growth of the compound annual growth rate of the market was only 1 percent from 2014 until 2020 compared to the United States' growth rate of 17 percent (Global Sustainable Alliance 2021). As mentioned in chapter 2.4 the European green bond market is growing every year, but the market being more accustomed to green financing may cause a lower positive market reaction to green bond announcements.

## 5.2 Results of the regression analysis

The dependent variable for the regression analysis is the cumulative abnormal returns of the [0,1] event window as it was the only CAAR that was statistically significant. The eight independent variables were presented in chapter 4.2.3. Three regression analyses were conducted to determine if the independent variables are significant for the whole sample, the second regression takes into account the fixed effects of country and issuance year, and

finally, the third regression takes into account the industry and year fixed effects. Table 9 presents the results of the regression analysis, for the three regressions.

Table 9. Regression results

The three regressions results are displayed in the table below, along with the dependent variable and independent variables on the left and the results on the right. regression 1 includes all variables without fixed effects (1), regression (2) includes all other variables except amount issued, also fixed year and country effects, and finally, regression (3) excludes issued amount and includes year and industry fixed effects. The first green bond is a dummy variable that receives a value of 1 if it is the first announcement, otherwise 0. The amount issued variable is reported in millions of Euros, Coupon variable is in percentage, Maturity variable is expressed in years, ESG score is the issuer's ESG rating, ROA is the ratio of net income and total assets. The size variable is the logarithm of the total assets. The equity to assets variable is the ratio of total equity to total assets. The standard errors are displayed in brackets under the coefficient. Four observations were excluded from the regression as they had missing ESG scores. ***, ** and * indicate statistical significance on a 1%, 5% and 10% level.

| CAR [0,1] | 1 | 2 | 3 |
|---|---|---|---|
| Intercept | -2.066 | | |
| | (1.722) | | |
| First Green bond | 0.701* | 1.049** | 0.805* |
| | (0.447) | (0.553) | (0.495) |
| Amount issued | 0.000 | | |
| | (0.001) | | |
| Coupon | -0.156 | -0.167 | -0.160 |
| | (0.137) | (0.167) | (0.141) |
| Maturity | 0.071*** | 0.057** | 0.076*** |
| | (0.018) | (0.023) | (0.019) |
| ESG score | -0.013 | -0.015 | -0.004 |
| | (0.015) | (0.021) | (0.017) |
| ROA | 3.097 | -0.187 | 4.008 |
| | (5.421) | (6.313) | (5.700) |
| Total Assets | 0.216 | 0.270 | 0.152 |
| | (0.156) | (0.213) | (0.174) |
| Equity to Assets | 0.708 | 0.131 | -0.024 |
| | (0.866) | (1.030) | (0.906) |
| Observations | 102 | 102 | 102 |
| R2 | 0.196 | 0.328 | 0.381 |
| Adjusted R 2 | 0.127 | 0.047 | 0.191 |
| P-value | 0.007 | 0.290 | 0.012 |
| FE Country | No | Yes | No |
| FE Year | No | Yes | Yes |
| FE Industry | No | No | Yes |

The first regression includes all variables, notably the Amount issued variable is excluded in the other two regressions as it is found in previous studies and as well in this analysis, as it has a minimal effect on the share prices (Glavas 2020). In addition, regressions 2 and 3 have included controlled fixed effects in the analyses.

The main interest of the analysis is the first green bond variable which is found to be statistically significant at a 10 percent level in regressions 1 and 3, and in regression 2 significant at a 5 percent level. The market perceives the first-time announcement of green bonds as value-enhancing, based on the positive signalling of the company's commitments. This is consistent with the result of the event study as the CAAR was statistically on a 10 percent level. Additionally, the Maturity is found to be significant at a 5 percent level in all three regressions, no other independent variables are found to be statistically significant in any of the three regressions.

The regression results indicate that the capital structure of the company doesn't affect the abnormal returns, therefore providing contradicting evidence to the capital structure theory, as Total Assets or Equity to Assets variables were not statistically significant (Modigliani and Miller 1963). Furthermore, the first green bond variable is positive and significant implies that signalling the first-time green commitment is considered value-enhancing in the regressions as well.

The findings are contrary to Glavas' (2020) results which found multiple other independent variables to be statistically significant and affect the market reaction. This might be due to differences in used regions, time periods, and sample size. Maturity is the only common variable that is statistically significant in this study as well as Glavas' (2020) research. Additionally, the previous academic literature has had mixed results on the company and bond determinants being statistically significant effects in terms of the market reaction (Asem and Baulkaran 2018). Similar determinants were used in the study conducted by Godlewski, Turk-Ariss, and Weill (2013) they concluded that none of the company or bond specific variables were statistically significant.

Endogeneity could reduce the robustness of the regression analysis results, simultaneous bias and omitted variable bias are identified to cause endogeneity (Roberts and Whited 2013, 493-572). The simultaneous bias is not an issue in the regression, as Glavas (2020) pointed out that after the green bond announcement the issuer cannot affect the market reaction to

the new information as the information has been released to the market. Therefore, the simultaneous bias is not a concern in the analysis.

Nevertheless, the omitted variable bias could be present in the regression as some variables may impact both the independent and dependent variables. To avoid the possible bias, the bond and company variables, that may affect the market reaction. In addition, the fixed effects of country, industry and year are included to control the time-invariant variables as well as fixed time effects. The use of the fixed effects did not affect the results as the first-time announcement is statistically significant on a 10 percent level. Multicollinearity for the independent variables was examined with a correlation matrix, and there was no significant correlation between the variables. The correlation matrix can be seen in appendix 2.

The last supporting research focused on the company-specific and bond-specific determinants, and if they have an influence on the market reaction. The only two independent variables that were statistically significant were the dummy variable for the first green bond issuance and maturity, which both had a positive impact on the market reaction, therefore leading to higher CAR. None of the company-specific variables was statistically significant implying that the company characteristics do not have a significant effect on the market reaction.

The results of the regression are in line with the event study results, indicating that the first-time announcement has a value-enhancing effect. Previous studies have not approached the first-time announcement with regression analysis with control variables (Tang and Zhang 2020; Flammer 2021). This study contributes to the literature about green bonds, by examining the announcement effect in Europe.

## 5.3 Generalizability, limitations, and further research

As for the generalizability and limitations of the findings, it should be noted that the estimated abnormal returns are dependent on the method and the sample, consequently, the findings might not generalize across time or other implications. The data sample is adequate for the purpose of this thesis, but the size of the data sample may affect the results, for the purpose of drawing more detailed conclusions on the value-enhancing effects of green bond announcements additional research is required. However, the result of the event study as well as the regressions analysis appears to be fairly robust. The results are consistent over

both parts of the study, implying the generalizability of the value-enhancing effects of green bond announcements. Although, most of the results are statistically significant only on a 10 percent level, which limits the generalizability of the findings.

The data sample consisted of 106 green bonds announced by publicly listed non-financial European companies, compared to previous studies the sample is considerably smaller than the studies that were not limited to Europe (Tang and Zhang 2020; Flammer 2021). Splitting the data into first-time announcements and subsequent announcements in the event study, made those subsamples relatively small, which may affect the results. Moreover, the number of announcements in relation to the independent variables in the regression analysis can be considered relatively low which may skew the results.

The geographic limitation and financial companies being excluded from the sample limited the sample size the most, but the focus of this study required narrowing the sample to understand the market reaction. Including financial companies would have increased the sample size but as mentioned in chapter 4.1.1 the green bonds issued by financial companies are used to fund green loans, not projects, which could lead to a different market reaction. The time period of the study was the longest at the time of conducting the study, being from 2013 until 2020. The 2021 announcements were excluded as all of the data was not available at the time of this study.

McWilliams, Siegel and Teoh (1999) have identified methodological issues in an event study: definition of the event and the appropriate sample, length of the event window, information leakage, sample size and industry effects. The appropriate sample and sample size were determined through the study's focus and limitations. The length of the event window isn't a relevant issue as multiple event windows are used, avoiding the possible problem of redundant "noise" in the results. Estimation of possible information leakage is difficult since the rumours and expectations are incorporated into the prices before the event date. Finally, the industry effects are considered with the regression analysis. The issues of event methodology need to be taken into account when interpreting the findings of this study even though appropriate measures were taken to minimize the downfalls of the event study methodology.

In future studies on the topic, the sample size could be bigger as more bonds are issued in Europe. Similarly, as the green bond market gets more mature the market reaction changes

accordingly, new legislation and frameworks are factors that will change the market reaction in the new future (Glavas 2020). Additionally, the differences between the announcement effects of conventional bonds and green bonds could be examined similarly to Flammer (2021). Related to previous studies, examining environmental performance and change in ownership before and after the announcement of green bond. Also examining the market reaction in different market situations, for example, bearish and bullish markets would be an informative addition to the study, when there is enough data available. Moreover, adding possible factors to the regression analysis that may affect the reaction. Glavas (2020) and Godlewski et al. (2013) included more company-specific as well as bond-specific variables and macroeconomic variables that might be worth adding in future research.

Lastly, deviating from the domain, as the green bond markets grow and the legislations of the issuance are established, it would be beneficial to examine the is there a green premium when trading green bonds. This has been examined on multiple occasions in the current state of the green bond market (MacAskill, Roca, Liu, Stewart and Sahin 2021; Sheng, Zheng and Zhong 2021). Any additional insights into the green bond market are relevant both for investors and academics.

# 6. Conclusions

This master's thesis examined the market reaction to the announcement of green bonds in the European markets by considering a sample of publicly listed non-financial companies' green bond announcements between 2013 and 2020. Applying the event study methodology by calculating abnormal returns for the event window to model the market reaction to the green bond announcements. The company-specific and bond-specific determinants affecting the market reaction were examined through regression analysis.

The results of the event study confirm the hypothesized positive market reaction to the announcement of green bonds. The event window of [0,1] demonstrates a positive CAAR of 0.207 percent. The event window also demonstrated the highest CAAR of all the event windows and it was the only statistically significant event window out of the five examined. Moreover, the findings of the event study support the common perception of that the market functions on a semi-strong level of efficiency (Fama 1970).

Results covering the first-time announcements and subsequent announcements indicate that the first-time announcements have a value-enhancing effect and cause a positive market reaction. The CAAR of the first-time announcements was estimated to be 0.249 percent, which is higher than the CAAR of the whole sample. The CAARs of the whole sample and first-time announcements were significant on a 10 percent level. The market reaction to subsequent announcements was found to be statistically insignificant and mostly negative. Validating that the market has incorporated the green commitment of the company into the prices after the first announcement. Conforming to the results in prior academic literature, a positive market reaction is found in the whole sample and first-time announcements. The CAARs obtained are lower than the studies conducted on a global scale the difference in the European market might be caused by differences in information transparency, investor base, current and upcoming legislation (Glavas 2020; Tang and Zhang 2020; Flammer 2021). In Addition, the signalling effect is likely weaker due to higher investor expectations and EU legislation.

To ensure the robustness of the results, regression analysis was run to determine possible company-specific and bond-specific characteristics that may affect the market reaction. The results of the regression are in line with the event study, as the first-time announcement is

found to have a value-enhancing effect. The other determinant that affected the market reaction positively is the maturity of the green bond.

This master's thesis contributes to the academic literature on green bonds in multiple ways. To the best of the author's knowledge, this study is in the first few or even first to exclusively examine the green bond announcements on the European market. Prior literature has focused on the announcement effects of green bonds in global markets. Moreover, previous studies have only used the event study methodology to examine the first-time and subsequent announcements of green bonds. By conducting a regression analysis on the company-specific and bond-specific characteristics that may affect the market reaction to first-time and subsequent announcements. Finally, this thesis provides a further understanding of how climate change could be combatted through financial markets and instruments, by providing evidence that climate and environment-focused projects can increase shareholder value alongside preventing climate change.

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# Appendices

Appendix 1: Green bond issuance per country

| Country | Bonds issued | Per cent | Amount (M€) | Per cent |
|---|---|---|---|---|
| Austria | 2 | 1.89 % | 601 | 0.88 % |
| Denmark | 4 | 3.77 % | 2 100 | 3.08 % |
| Finland | 4 | 3.77 % | 4 050 | 5.93 % |
| France | 17 | 16.04 % | 13 726 | 20.11 % |
| Germany | 12 | 11.32 % | 6 210 | 9.10 % |
| Greece | 1 | 0.94 % | 150 | 0.22 % |
| Italy | 13 | 12.26 % | 5 910 | 8.66 % |
| Luxembourg | 1 | 0.94 % | 2 000 | 2.93 % |
| Netherlands | 7 | 6.60 % | 4 045 | 5.93 % |
| Norway | 6 | 5.66 % | 5 600 | 8.20 % |
| Poland | 1 | 0.94 % | 1 000 | 1.47 % |
| Portugal | 3 | 2.83 % | 2 500 | 3.66 % |
| Spain | 13 | 12.26 % | 7 494 | 10.98 % |
| Sweden | 14 | 13.21 % | 9 700 | 14.21 % |
| Switzerland | 1 | 0.94 % | 200 | 0.29 % |
| United Kingdom | 7 | 6.60 % | 2 965 | 4.34 % |
| Total | 106 | 100.00 % | 68 251 | 100.00 % |

Appendix 2: Correlation matrix of the independent variables

| | First green | Coupon | Maturity | ROA | Equity to Assets | Amount | ESG | Total Assets |
|---|---|---|---|---|---|---|---|---|
| First green | 1 | | | | | | | |
| Coupon | 0.16 | 1 | | | | | | |
| Maturity | -0.2 | -0.076 | 1 | | | | | |
| ROA | 0.076 | -0.074 | -0.062 | 1 | | | | |
| Equity to Assets | -0.022 | -0.013 | -0.094 | 0.42 | 1 | | | |
| Amount | -0.15 | -0.11 | -0.028 | -0.024 | 0.074 | 1 | | |
| ESG | -0.065 | -0.3 | -0.12 | 0.22 | 0.12 | 0.12 | 1 | |
| Total Assets | -0.17 | -0.33 | -0.023 | 0.16 | 0.081 | 0.36 | 0.42 | 1 |

Appendix 3: List of the parent companies

| Company name | |
|---|---|
| A2A SpA | Iberdrola SA |
| Abengoa SA | Innovate Corp |
| Acciona SA | Iren SpA |
| ACS Actividades de Construccion y Servicios SA | Koninklijke Philips NV |
| ALD SA | Millicom International Cellular SA |
| Alerion Clean Power SpA | Mowi ASA |
| Arise AB | Neoen SA |
| Arkema SA | Nexity SA |
| Audax Renovables SA | Nobina AB (publ) |
| Basf Se | Nordex SE |
| BayWa AG | Orsted A/S |
| BKW AG | Photon Energy NV |
| Bonava AB (publ) | PostNL NV |
| Bonheur ASA | Red Electrica Corporacion SA |
| Cyfrowy Polsat SA | Renewi PLC |
| E.ON SE | Scatec ASA |
| EDP Energias de Portugal SA | Schaeffler AG |
| Electricite de France SA | Schneider Electric SE |
| Electrolux AB | Senvion SA |
| Ellaktor SA | Skanska AB |
| EnBW Energie Baden Wuerttemberg AG | SSE PLC |
| Engie SA | Stora Enso Oyj |
| Entra ASA | Swisscom AG |
| ERG SpA | Telefonica SA |
| EVN AG | Telia Company AB |
| Fabege AB | Terna Energy SA |
| Falck Renewables SpA | Terna Rete Elettrica Nazionale SpA |
| Gecina SA | UPM-Kymmene Oyj |
| Getlink SE | Verbund AG |
| Greenalia SA | Vestas Wind Systems A/S |
| Grieg Seafood ASA | Vodafone |
| Henkel AG & Co KGaA | Volvo AB |
| Hera SpA | |

Appendix 4: Stock market indices

| Country | Index |
|---|---|
| Austria | ATX |
| Denmark | OMXC20 |
| Finland | OMXH25 |
| France | CAC 40 |
| Germany | DAX Performance Index |
| Great Britain | FTSE 100 |
| Greece | ATHEX20 |
| Italy | FTSE MIB |
| Luxembourg | LuxX |
| Netherlands | AEX |
| Norway | Oslo Exchange All Share Index |
| Poland | WIG 30 |
| Portugal | PSI 20 |
| Spain | IBEX 35 |
| Sweden | OMXS30 |
| Switzerland | SMI |