Bachelor Thesis in Accounting and Financial Management
Stockholm School of Economics

DO STOCK PRICES REACT TO GREEN BOND ISSUANCE ANNOUNCEMENTS?

An event study and cross–sectional investigation of green bonds on the US market

Elin Ashrafi & Nina Källmén

May 2021

Abstract

The green bond market has grown rapidly in recent years; however, it has still received little academic exploration. To further understand green bond issuances, this study examines how stock prices react to the announcement of corporate green bond issuances and compares it to the stock market reactions of traditional corporate bond issuance announcements. Moreover, the paper investigates any possible differences in stock market reactions of green bond announcements between different business sectors as issuances in some industries are more common than others. Hence, it is of interest to look at how stock price reactions from green bond announcements differ per sector. The study contributes to previous research by focusing on one country, the US market, using a sample from exchange-listed companies between 2014 and 2020. We find that the stock market reacts more positively to green bond announcements than traditional bond announcements but no significant results proving that green bond announcements positively impact stock prices on a standalone basis. Furthermore, no statistically significant results are found on sector differences when announcing a green bond issuance.

Keywords: Green bonds, event study, abnormal returns, market model, CAR

Authors: Elin Ashrafi (24087), Nina Källmén (24188)

Tutors: Katerina Hellström, Assistant Professor, Department of Accounting, Stockholm School of Economics; Karl Wärneryd, Associate Professor, Department of Economics, Stockholm School of Economics

Acknowledgements: We would like to extend our gratitude specifically towards our main tutor Katerina Hellström for providing us with fantastic guidance and organising a well-structured process throughout the writing of this thesis.

List of abbreviations:

CAR	Cumulative abnormal return
CAAR	Cumulative average abnormal return
EMH	Efficient market hypothesis
GBP	Green Bond Principles
SDG	Sustainable Development Goals
TMT	Technology, Media and Telecommunication

Bachelor Thesis

Bachelor Program in Business & Economics, Stockholm School of Economics

Table of Contents

1.0 Introduction

1.1 Background

As global warming has become a scientific consensus and has been declared the most threatening issue of the 21st century (UN Environment Programme, 2017), governments and corporations face pressure from society to mitigate the climate effects. In December 2015, 196 parties adopted the Paris Agreement, meaning many countries have gone together and set an ambitious goal to limit global warming to well below 2°C, preferably 1.5°C by 2100 (United Nations Climate Change, 2016). However, recent research forecasts that we are to reach 1.5°C in less than 10 years if it continues to increase at the current rate (Intergovernmental Panel on Climate Change, 2018). According to The World Bank, the financing required to transition to a low carbon resilient economy with climate-compatible infrastructure is estimated to be around $90 trillion by 2030 (UN Environment Programme, 2017).

The concept of green bonds was developed by SEB and The World Bank in 2007/2008 as an innovative way to attract investments in climate mitigation and adaptation awareness as well as enable mainstream investors to access climate-related assets (SEB, 2020). SEB forecasts the sustainability-labelled financing and green bonds issuance in 2021 to exceed $1 trillion and $500 billion, respectively (SEB, 2020). Thus, the appetite for sustainable investments is continuously increasing.

Bond issuance announcements usually impact firms' equity prices due to their high information content and potential to signal a firm's prospects. This is a result of information asymmetry between investors and firm management (Flannery, 1986). In theory, in a situation with information asymmetry, a firm can transfer information to the other party by signalling and resolve the asymmetry. Previous studies conclude that debt issuance is a valuable way of signalling a firm's certain qualities, allowing high-quality firms to distinguish themselves from low-quality firms. This implies that a public firm issuing bonds will most likely result in a stock reaction.

Previous literature concludes that the stock market reacts differently by bond announcements depending on the debt type and the sector in which the issuing firm operates. Further, the studies investigating the relationship between equity prices and bond issuances have mainly focused on traditional bonds. The relationship between stock prices and green bond issuances is an academic

area that has received less exploration. There are few comprehensive studies examining firms' equity implications of a green bond issuance announcement and comparing them to the announcements of traditional bonds. Existing studies demonstrate that stock price reactions are more negative for traditional bonds and that green bonds have positive abnormal returns on stock prices. These conclusions might be due to green bonds differing from traditional bonds in terms of yield, premia, and purpose.

Moreover, when comparing green bonds between sectors, issuances in some industries are more common than others. Hence, it is of interest to look at how stock price reactions from green bond announcements differ. Some previous literature concludes that, e.g., industrial firms face significant abnormal returns when issuing a green bond and that financial firms do not. Two reasons mentioned are (1) difference in the fund's usage and (2) whether the firm's operations are linked to the environment and are financially material.

1.2 Research Questions and Purpose

This paper will be devoted to further investigate green bond issuance announcements and their impact on stock prices of publicly traded companies. We analyse whether stocks of companies that announce a green bond issuance face larger abnormal returns compared to when announcing the issuance of a traditional bond. Moreover, we investigate if there is a difference in abnormal returns across different business sectors. In other words, the study addresses the two major research questions detailed below.

1) Does a firm's stock price react differently to a green bond issuance announcement compared to a traditional bond issuance announcement?
2) Is there a difference in stock price reactions when announcing a green bond issuance across different business sectors?

Our data sample to answer the research questions is based on US exchange-listed firms that have issued both green and traditional bonds between 2014 and 2020. This data is analysed through an event study and multivariate regressions.

The results suggest that, on the US market, announcing the issuance of a green bond impacts the stock price more, and in a positive direction compared to when announcing the issuance of a traditional bond. Additionally, the results show that traditional bond announcements have a

significant negative impact on the stock price. Thus, there is evidence supporting our first hypothesis, which confirms that green bond issuance announcement is perceived as a value-creating event compared to traditional bonds. However, we cannot conclude anything about green bond issuance announcements on a standalone basis as the results did not yield significant abnormal returns for the green observations. Regarding the second research question investigating if there is a difference in abnormal returns across different business sectors, we cannot make any conclusions regarding the sector differences due to insignificant results.

1.3 Outline

The remaining parts of the paper are structured as follows. Section 2 provides a comprehensive overview of the green bond market. Section 3 consists of a literature review on the efficient market hypothesis, the signalling theory, and abnormal returns in correlation with bond issuance announcements and industry differences. Section 3 also includes the hypothesis development and specification. Section 4 contains a presentation of the empirical data collection and methods used to analyse the data. Section 5 presents the results of the analysis. Lastly, section 6 presents a discussion of the results, and section 7 provides conclusions, contributions, limitations and suggestions for future research.

2.0 Green Bond Market

The concept of green bonds was developed as an innovative way to attract investments in climate mitigation. The market has been fuelled by the presence of the Paris Agreement, limiting global warming to 2°C by the year 2100 (United Nations Climate Change, 2016). This section aims to give a broad overview of the current green bond market in terms of definition, historical growth, geographical and sector characteristics, proceeds, and the future implications for the green bond market.

2.1 Overview

The definition of green bonds is somewhat ambiguous since there is no universal or official framework to categorise bonds' greenness. In early 2014, as the green market proliferated and more clarity of the process and definition of green bonds were needed, a group of banks initiated the Green Bond Principles (GBP) development. GBP provide voluntary guidelines for green bond

issuance and a rather explicit definition of green bonds: "Green bonds are any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible green projects…" (ICMA, 2018). The World Bank (2015) provides a resembling definition of green bonds stating that a green bond is a debt security issued to raise capital to support climate-related or environmental projects specifically. In conclusion, what unifies all definitions is that a green bond is used to finance environmental-related projects and to issue a green bond can be seen as an opportunity to signal a firm's commitment to the environment to public stakeholders, including both beneficiaries and public policymakers (Wood & Grace, 2011).

The green bond market has grown rapidly in the last few years (Appendix 1). However, the amount of green bonds issued is still low in capital markets standards, accounting for approximately 3.5% of the 2019 total bond market (Dealogic, 2020). In 2019, $259 billion green bonds were issued, corresponding to a 51% increase compared to 2018. Five years earlier, in 2014, when the GBP were implemented, the amount issued was $37 billion (Climate Bonds Initiative, 2020). Marszalek and Kuna-Marszalek (2017) state that the increasing demand for green bonds is likely due to the Sustainable Development Goals (SDGs) set out under the United Nations Development Programme and the Paris Agreement from the United Nations Framework Convention on Climate Change. Although the SDGs and the Paris Agreement mainly focus on governments and countries' climate actions, governments pressure individuals and firms to invest in sustainable initiatives. In that way, the corporate sector is also adding to the size of the green financing market (Clapp, 2014). In line with Marszalek and Kuna-Marszalek (2017) and Clapp (2014), Climate Bonds Initiative (2020) states the two most recent growth drivers of the green bond market as (1) the mainstreaming of green finance in the financial system and (2) the continued rise of a broader range of SDG-related debt labels (such as sustainability bonds and social bonds) and ESG-linked credit.

2.2 Countries, Sectors and Proceeds

According to Climate Bonds Initiative (2020), the current largest green bond issuer country is the US; the country issued green bonds for $51.3 billion in 2019, corresponding to a 44% growth from the year before. Following the US, the largest issuers are China, France, Germany, and the Netherlands (Appendix 2). The US is also the market leader in the number of green bond issuers. The country had 105 issuers in 2019, with Fannie Mae being the largest one; the institution issued

$22.8 billion green bonds via its green mortgage-backed securities programme. However, excluding Fannie Mae, the US experienced an even larger green bond growth corresponding to 85% instead of 44% (Climate Bonds Initiative, 2020). The main reason behind the growth is that major US corporates, including PepsiCo, Apple and several energy and utility companies entered the green bond market in 2019 (SEB, 2020).

Regarding sectors, the corporate and the financial sectors are currently the largest sectors issuing green bonds. Together they amounted to approximately 54% of the total green bond market in 2019. The growth of the corporate sector was 90%, while the financial sector grew 26% (SEB, 2020). The green proceeds allocation in 2019 was mainly to the energy, buildings and transportation sectors (Climate Bonds Initiative, 2020).

2.3 Future of Green Bond Market

The whole sustainable finance market is projected to continue its growth in the coming years, increasing the number of issuances, bond sizes, sectors, and investor base. In 2021, $500 billion green debt is expected to be raised, which is nearly half the total that has been raised since the inception of the asset class (SEB, 2020). A key factor fuelling future growth is likely the new investor generation becoming more socially aware and eager to make a positive climate impact; hence, green bonds have the potential of being the investment type to choose (Le Houérou, 2019). Additionally, the green bond market will be fuelled by new compliance and regulatory structures coming into places, such as the roll-out of EU Sustainable Finance Taxonomy and G20's Taskforce for Climate-related Financial Disclosure (Klier, 2020). Furthermore, the US green bond market outlook is especially optimistic. Joe Biden's new presidency is expected to provide a tailwind for the sector citing Biden's promises to re-join the Paris Agreement and get the US to carbon neutrality by 2050 (Nauman, 2021).

However, the future of the green bond market has been criticised as well. Lack of regulations on green bonds makes the greenwashing phenomenon more likely and misleads stakeholders on the bond's actual environmental impact (Grene, 2015). Deschryver and de Mariz (2020) question the green bond market growth due to its risk of greenwashing as well as the deficit of global standards, the perception of higher issuance costs, the supply lack of green bonds for investors and the overall infancy of the market. Furthermore, a new type of debt called sustainability-linked bonds has developed recently and could threaten the rapid growth of green bonds. While green bonds are used

to fund climate-related projects, sustainability-linked bonds are designed to reward and penalise borrowers for hitting or missing their environmental goals. Since there are no restrictions on how the issuer of sustainability-linked bonds uses the money, the risk of greenwashing is significantly less compared to green bonds (Nauman, 2021).

Although scepticism towards the asset class exists, the green bond market growth seems promising. The attractiveness among investors is high; 32% of high-net-worth individuals view sustainable investments as the most appropriate and forward-looking choice (Morgan Stanley, 2017). Furthermore, previous studies show that an increasing number of corporates strive to achieve the climate goals set under the Paris Agreement and Sustainable Goals development due to pressure from governments for the corporate world to contribute to climate. Lastly, reports on the market agree that issuances of green bonds are likely to continue their growth (Morgan Stanley, 2017; Climate Bonds Initiative, 2020; Klier, 2020; SEB, 2020).

3.0 Literature Review and Hypotheses

The following section details the literature review that will lead to the hypothesis development for this study. Firstly, we introduce the efficient market hypothesis, which is the fundamental assumption when conducting an event study, our chosen method. Secondly, we dig into the concept of information asymmetry and signalling theory to understand the theoretical framework behind what affects the market price. Going further, we review the literature on how different types of debt announcements affect stock prices and if there are any differences across sectors. The section will then end with a hypothesis development.

3.1 Efficient Market Hypothesis

The economic theory behind event studies is the efficient market hypothesis (EMH), developed during the 1960s. The idea is based on that share prices reflects all available information; hence it is impossible to generate abnormal returns since all shares are traded at the correct market value (Fama et al., 1969). Efficient markets can be categorised into three levels of market efficiency: weak, semi-strong, and strong (Fama, 1970). In a weak efficient market, it is impossible to generate abnormal returns by analysing historical returns since the share prices follow no significant pattern. In a semi-strong market, the market reacts immediately to new information, and it is impossible to generate abnormal returns by analysing historical returns or annual and quarterly reports (Fama,

1969). In a strong efficient market, there is no way to generate abnormal returns even when insider information exists; all information, public or not, is reflected in the share prices (Fama, 1970).

The theoretical case for the efficient market theory relies on the assumption of rational investors. A rational investor values the security for its fundamental value, which is the net present value of future cash flows, discounted using their risk characteristics. Whenever new information is accessible, the price is revalued to a new value based on if the information is good or bad. However, the EMH can be applicable even when investors are not rational. Irrational investors trade randomly, and when there are many irrational investors with uncorrelated trading strategies, their trades are likely to cancel each other out, and the market will still be efficient (Shleifer, 2000).

The event study we use in the method is built upon this hypothesis which we will explain further in section 4 devoted to the methodology.

3.2 Information Asymmetry and Signalling Theory

Decisions made by households, businesses and governments are affected by the available information. Information can be public, available for everyone, and private, only available to a subset of the public. When different parties have different information, information asymmetry occurs; since some information is private, those who hold the private information could potentially make better decisions (Stiglitz, 2002). Stiglitz (2000) highlights two types of information where asymmetry is significantly important: information about quality and information about intent. In the first type, information asymmetry is important when one party is not aware of the other party's characteristics. In the second type, it is also important when one party is concerned about the other party's behavioural intentions or actual behaviour.

A common problem occurring from information asymmetry is adverse selection. The fundamental idea of adverse selection is when a buyer and seller have different information. One of the parties may participate in trades that are most beneficial for them at the other party's expense (Akerlof, 1970). This may cause the other party to worry and withdraw from the trade, thus, diminishing the market trade volume. A primary solution, suggested by Akerlof (1970), to the adverse selection, and thus the information asymmetry problem is signalling.

The signalling theory was initially developed by Michael Spence (1973) based on observed knowledge gaps between potential employees and organisations. Spence (1973) proposes that in a

situation with information asymmetry, people can signal what they want to communicate and, thus, transfer information to the other party and resolve the asymmetry. The intuitive nature of the concept has led it to be applicable in the job market, between employees and organisations, and in other parts of businesses and financial markets as well (Connelly et al., 2010). The primary actors of signalling are described in a study by Connelly et al. (2010) and include the signaller, the signal, and the receiver. The signaller is an insider who obtains negative or positive information about an individual, product or organisation that is not available for outsiders. Simply stated, the information provides the insider with a valuable perspective regarding the quality or behaviour of the individual, product, or organisation. The second actor, the signal, is communicated by signallers to outsiders and can be positive or negative. However, the signalling theory mainly focuses on communicating positive information to convey positive organisational attributes. The third element of the signalling timeline is the receiver. The signal receiver is the outsider who lacks information about the organisation and would like to receive it. For signalling to happen, the signaller should benefit from the receiver's action that would not have happened without the signal. Simultaneously, the receivers should also gain from deciding based on the obtained information (Connelly et al., (2010). In financial markets, receivers could, for example, be shareholders, potential investors or debtholders (Kang, 2008); (Park & Mezias, 2005); (Elliott et al., 2009).

In line with information asymmetry and signalling theories, information asymmetry could affect the decision of an investor whether to invest in a firm or not, and the firm can try to influence the decision through signalling. Many previous studies conclude that a valuable way of signalling a firm's certain qualities is by issuing debt. Leland and Pyle (1977), Ross (1977) and Myers and Majluf (1984) stipulate that debt signalling can help high-quality firms to distinguish themselves from low-quality firms. Brennan and Kraus (1987) conclude that convertible debt can reduce asymmetric information costs between companies and bond investors. Epure and Guasch (2020) state that debt is an effective governance signal, supported by agency theory and transaction cost economics.

3.3 Debt Announcements and Stock Prices

To develop and form our hypotheses, an assessment of the bond literature is necessary. Previous literature concludes that stock prices are differently affected by bond announcements depending

on the debt type and the sector in which the issuing firm operates. The following section will discuss each of the two areas by drawing upon traditional bond and green bond literature.

3.3.1 Debt Types

The relationship between traditional debt issuances and stock prices is investigated in numerous studies. Many of them conclude that the debt type is a significant factor for the market stock price reaction when announcing the debt issuance. Eckbo (1986) examines convertible and straight corporate bond offerings and their impact on equity prices and concludes that convertible bond offerings have a negative impact on the stock price and that straight bond offerings have a non-positive impact on the stock price of the issuing firm. Mikkelson and Partch (1986) examine the stock price effects of security offerings on the US market between 1972 and 1982. In line with Eckbo (1986), the authors find that convertible bond issuance announcements result in negative stock returns and that straight bond announcement returns are insignificant. Furthermore, they find that completed convertible bond offerings and equity obtain positive returns between the announcement date and issuance date and negative returns at the issuance date.

A more recent study by Duca et al. (2012) concludes that convertible bonds affect stock prices negatively for the sample period of 1984 to 2009 on the US market. Additionally, returns become even more negative in the last years of the sample than in earlier years indicating that investor responses to convertible bond announcements are becoming more negative over time. However, in a study based on 17 European countries, Fungáčová et al. (2020) compare the effect of syndicated loan and bond announcements on the stock price and conclude that bond announcements have a positive, yet smaller, reaction on stock prices than loan announcements.

Green bonds differ from traditional bonds in terms of yield and premia as well in terms of purpose (Hachenberg & Schiereck, 2018); (Baker et al., 2018); (Zerbib, 2019); (Mikhaylova & Ivashkovskaya, 2020). The studies made on green bond announcements and stock price reactions are much smaller than on traditional ones. Still, the limited amount of existing literature demonstrates that green bonds have positive abnormal returns on stock prices.

In a study made by Tang and Zhang (2020), the authors conclude that green bond issuance announcements from corporates positively impact stock prices, especially at a first-time issuance announcement. A sample of 1,181 green bond issuances in 27 countries from 2007 to 2017 is used

and analysed through an event study. A similar result is obtained by Flammer (2021) by using a sample of 1,189 corporate green bonds between 2013 to 2018 in an event study with a two-day event window. Glavas (2018) compares green bond issuance announcements to traditional bonds and finds a positive stock price reaction to green bond issuances compared to traditional ones. The author states that positive reaction is increased after the Paris Agreement. The sample used in the study is 780 bonds issued between 2013 and 2018, of which 302 are green. A positive impact on stock prices from green bond announcements is also found in a study by Vishaal (2019) made on 54 UK–listed companies. The author implies that investors view green bonds as a value-enhancing financing strategy.

An underlying reason for the positive abnormal returns of green bonds could be their signalling effect. Flammer (2021) stipulates that by issuing green bonds, firms signal their commitment toward the environment; green bonds allow firms to signal that they are willing to invest in green projects. This is seen as valuable information, as investors rarely have sufficient information about a company's environmental commitment ((Lyon & Maxwell, 2011); (Lyon & Montgomery, 2015). A similar conclusion was drawn in a study by Shishlov et al. (2016), stating that issuing green bonds help companies to communicate their sustainability strategy, which, in turn, increase their reputation and image among outsiders.

3.3.2 Sectors

Corporate green bonds are more common in some industries than in others (Flammer, 2021). Hence, it is of interest to look at how green bond announcements impact stock prices differently depending on the sector of the issuing firm.

Previous literature on sector differences from announcements on the green bond market has various conclusions. Additionally, most green bond literature only classifies sectors into financial and non-financial without dividing them into further subsectors. Flammer (2021) concludes that the stock price increase from green bond announcements is larger for firms in sectors where the environment is strongly linked to the firm's operations and where it is financially material to the firm. The author claims this intuitive as when the natural environment is financially material to the firm's operations, the pursuit of green projects contributes more substantially to financial performance. This, in turn, is reflected in a stronger stock market reaction. Tang and Zhang (2020), categorise firms into industrial and financial firms and find that green bond announcements generate significant positive

abnormal returns for industrial firms, while financial firms do not yield any significant result. According to the authors, this is due to the difference in the funds' usage between the sectors. While industrial firms use green bond funds to finance their green projects, financial firms use the funds to pay out loans and invest in customers' green projects (Tang & Zhang, 2020). In contrast, Lebelle et al. (2020) compare the abnormal returns of green bond issuance announcements of financial and non-financial corporations and find non-significant negative cumulative abnormal returns for green bond issuance announcements by non-financial firms and significant negative cumulative abnormal returns for financial firms. However, the authors stipulate that the difference is minimal and that stock market reactions should be almost the same for the two sectors.

3.4 Hypothesis Development

The existing literature has established a link between debt announcements and the stock market – debt issuance announcements affect the stock prices. Traditional bond literature shows that different debt types affect stock prices differently hence exhibiting no clear positive or negative market reaction for debt issuances as such. In recent years, the literature on green bond announcements has been added to the traditional literature. However, it is not very extensive. The existing green bond literature highlights that green bond issuance announcements generate a positive abnormal return. Hence, based on the previous literature on green bond issuances, and the environment-related signalling effect of green bonds, it is most likely that green bond issuance announcements will have more positive abnormal returns than traditional bond announcements. Therefore, our first hypothesis is:

H1: Green bond issuance announcements have more positive abnormal returns than traditional bond issuance announcements.

As mentioned previously, green bonds are more common in certain sectors. However, green bond studies incorporating a cross-sector analysis of firm announcements to investigate if returns differ are few and inconsistent. To bridge the gap on how abnormal returns of green bond announcements differ between sectors, our second hypothesis is:

H2: Abnormal returns from green bond issuance announcements will differ between different sectors.

4.0 Methodology

The purpose of this chapter is to describe how data is extracted and analysed in order to test the two hypotheses. Section 4.1 details the data collection and the sample description. Section 4.2 presents the methodology of an event study, our selected analysis method. We explain the models used in the event study and detail out the hypotheses. Lastly in section 4.3 we present the regression models and its variables.

4.1 Data

The first step of the data selection process is to identify all firms that have issued both green and traditional corporate bonds. Following that, we divide issuing firms into sectors. Lastly, we collect the issuing firms' stock returns and company-specific control variables, as well as market returns.

Table 1. Summary of data sources

Data Sources	Information
Eikon by Thomson Reuters	Bond data and announcement dates
Bloomberg website	Sector classification
FactSet	Index and stock prices, control variables

4.1.1 Sample Construction

The bond data and the issuance announcement dates used for the study are collected from the database Eikon by Thomson Reuters. The geographical selection criteria for the sample is exclusively the US market. Our decision is based on three major factors. The first one is that the US market is the leading market in issuing green bonds (Climate Bonds Initiative, 2020). Secondly, comparing green bonds across multiple nations might cause inconsistencies in the analysis due to institutional nuances between them. Thirdly, recent green bond studies have focused on the international market, and few are country-specific. Our second sample criteria is the time frame. When the Green Bond Principles were implemented in 2014, the green bond market started to show rapid growth with a significant increase in issuances and issuers (Climate Bonds Initiative, 2020). Hence, only green and traditional bonds issued from 2014 to 2020 are used in the sample.

Going further, we determine what type of bonds to include in the sample. We include instrument types labelled as "bonds" or "notes" in the Eikon bond search function. This selection contains term bonds, serial bonds, green bonds, and notes. Hence, all asset-backed securities, agency bonds and municipal bonds are excluded since they are different in nature and not perfectly comparable to other bond issues (Hachenberg & Schiereck, 2018). The rationale behind why notes are included in the data selection is that they are almost perfectly comparable to bonds, the only difference is the shorter maturity date. Bonds due in under ten years form issues are called notes (Fabozzi, 2010). After that, we choose to include only US exchange-listed bond issuers or private firms wholly owned by US-listed parents as we target the US market. At this point, we have 12,909 bond observations.

To compare returns from traditional bonds to green bonds, we only include firms that have announced both types. Each green bond is paired with a traditional bond from the same issuer. This is in line with a similar study made by Glavas (2018). To distinguish the green bonds from the traditional bonds, we use Eikon's green bond labelling. Eikon defines green bonds as: "Green bonds are a fixed income product that offers investors the opportunity to participate in the financing of large sustainable energy green projects that help mitigate climate change and help countries adapt to the effects of climate changes". The last step in our data selection is to exclude bonds that have announced any other bond activity during the estimation period prior to the event period. The estimation window will be furthered explained in section 4.2.1. This is done to diminish the risk of disturbances in measuring the normal return. Our main dataset is narrowed down to 54 bond observations, of which 27 is green.

Table 2. Data filtering process	**# of obs.**
Corporate bonds with issuer parent domicile in the US	117,870
Issue date: 2014-12-31 to 2020-12-31	69,762
Instrument type: Notes and bonds	67,003
Exchange listed: Yes	12,909
Observations from firms that have issued both traditional and green bonds	1,233
Matching each unique green bond with one traditional bond	94
of which are green bonds	*47*
Excl. obs. with other bond activity during estimation window	54
of which are green bonds	*27*
Dataset 1 (incl. other bond activity)	**94**
Dataset 2 (excl. other bond activity)	**54**

For the event study and H1 regression, we use dataset 2, which excludes observations with other bond activity during the estimation window. The dataset consists of 54 bond observations, of which 27 are green bonds. However, for the H2 regression, we use dataset 1, which includes observations that have had other bond activity during the estimation window. The dataset consists of 94 bond observations, of which 47 are green bonds. The reason behind this decision is that there are not enough observations in each sector in dataset 2 to conduct the regression.

Table 3. Overview of samples used for the analyses	**# of obs.**
H1: Event study & regression	54
of which green bonds	*27*
H2: Regression	94
of which green bonds	*47*

To test the second hypothesis, the green bond observations must be divided into business sectors. Sectors are based on Bloomberg's online sector classification. In our sample, the issuers belong to 5 different sectors: Real Estate, Utilities, Financials, Technology, Media and Telecommunications (TMT), and Manufacturing.

Table 4. Sector split of green bond observations	**# of obs.**
Real Estate	16
Utilities	12
Financials	8
TMT	8
Manufacturing	3
Total	**47**

4.2 Event Study

This paper is conducted to examine the difference in a firm's stock price from the issue announcement of green and traditional bonds. The appropriate methodology to assess the impact of a specific event on the value of a firm is, according to (MacKinlay, 1997) an event study. The

method is based on the theory of efficiency and rationality in the marketplace explaining the effects of an event will be reflected directly in the stock's price. Previous literature on the topic indicates to be unanimous with this (Flammer, 2021; Klassen & McLaughlin, 1996; Lebelle et al., 2020; Tang & Zhang, 2020).

An event study compares stock returns from two time periods, the event window and the estimation window. The event window is the period around the event day, while the estimation window is a period before the event day that the event window is compared against. The estimation window is used to estimate the stock's normal return to calculate the expected normal return for the event window as if the event had not occurred. The difference between the expected normal return and the actual return is the abnormal return. Thus, a positive abnormal return implies that the actual return is higher than the expected normal return.

4.2.1. Estimation Window

To determine the expected normal return for the firm's stock, an estimation window is decided. MacKinlay (1997) suggests that the estimation window starts 120 days before the event window and should not overlap with the event window. This is to avoid that the market reaction from the event announcement affects the estimation of the firm's normal return.

Secondly, for estimating the expected normal return, there are two main models; the constant mean return model and the market return model (MacKinlay, 1997). The constant mean return model assumes that the mean return is constant through time, while the market return model assumes a stable linear relationship between the market return and the stock. The market return model reduces the variance of the returns as it controls for correlation between the market and the firm, hence, removing the portion of the return that is related to variation in the market's return (MacKinlay, 1997). As this can lead to an increased ability to detect event effects, we will use the market return model.

To estimate the return of a given firm, given the variance in its market, the following model is used:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

R_{it} is the return of firm i at time t, α respectively β is the firm's alpha and beta values. R_{mt} is the return of the market m at time t, and ε being the zero mean disturbance term. Alpha and beta are estimated by regressions on the firm's return and the corresponding market returns during the

estimation window. To decide the expected normal return in the event window, in line with MacKinlay (1997), the following model is used:

$$E[R_{it}|\Omega_{it}] = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

The alpha and beta are derived from the regression as the intercept, respectively, the slope. Thus, adding alpha to beta times the market return in the event window gives the estimated normal return in the event window. The abnormal return is simply the difference between the actual return, R_{it}, and the calculated expected normal return $E[R_{it}]$.

$$AR_{it} = R_{it} - E[R_{it}|\Omega_{it}]$$

4.2.2. Event Window

In order to estimate abnormal returns, an event window is defined to capture the time frame of interest and relevancy. In this case, it is a firm's issue announcement of green bonds. Thus, the date of the press release is defined as t=0. According to MacKinlay (1997), the event window period is often expanded to multiple days to capture any price effects of announcements that occur after the stock market closes on the announcement day. However, consensus regarding the exact length of the event window does not prevail. Lebelle et al. (2020) examine three separate time intervals which are [-20, 20], [-5, 5] and [-1, 1] while Tang & Zhang (2020) use [-10, 10]. The rationale behind a larger time interval is that it captures if any event-related pricing information has been leaked to the market before the official announcement (McWilliams & Siegel, 1997) Nevertheless, (Brown & Warner, 1980) state that a longer event window results in a lower power of the statistical tests. Therefore, in line with previous literature, the three event windows are defined as [s1, s2] where s1 is the starting day and s2 the ending day:

- [-2,2]
    - This event window is measured from two days before the announcement date until two days post-announcement date
- [-5,5]
    - This event window is measured from five days before the announcement date until five days post-announcement date
- [-10,10]

- This event window is measured from ten days before the announcement date until ten days post-announcement date

The rationale behind choosing three event windows is that we want to capture as exact stock market reactions as possible. Since market reactions can be delayed or information can be leaked earlier than on the event date, the window is extended.

4.2.3. Testing the Significance of the Results for H1

In this section, the significance testing of the abnormal returns is considered. This is done to determine whether the event is impactful and reliable. According to MacKinlay (1997), the cumulative abnormal return (CAR) aggregates along two dimensions – over time and across securities, making it applicable to test for multiple period event windows. The CAR is defined as the sum of the abnormal returns from s1 to s2 for a given security *i*:

$$CAR_i(s1, s2) = \sum_{t=s1}^{s2} AR_{it}$$

By aggregating the abnormal returns for security *i*, *i*=1→N, the cumulative average abnormal can be defined as:

$$CAAR(s1, s2) = \frac{1}{N} \sum_{t=1}^{N} CAR_{it}(s1, s2)$$

To test the CAAR of both green and traditional bond issuance announcements, the following hypothesis is tested:

$$H_0: CAAR = 0;\ H_1: CAAR \neq 0;$$

The hypothesis is that announcing the issuance of a green bond impacts returns, i.e., a cumulative average abnormal return unequal of zero. The test is statistically significant if the null hypothesis is rejected. To be statistically significant, the consensus in financial literature is that the result must be at least significant at a 5% confidence level.

To compare the CAAR from green and traditional bond announcements, we use the two-sample t-test to complement the cross-sectional regressions described in the next section. The t-test is used to determine if two population means are equal (Snedecor & Cochran, 1989). The null hypothesis

in this study is that the CAAR does not differ between traditional and green bonds. Hence, if the CAAR difference is statistically different from zero, the null hypothesis is rejected. If the difference is positive and statistically significant, it supports the first hypothesis of the study.

$$H_0: CAAR_{Green} - CAAR_{traditional} = 0;\ H_1: CAAR_{Green} - CAAR_{traditional} \neq 0;$$

4.3 Cross-Sectional Regressions

To test our two hypotheses, we perform cross-sectional regressions. Cross-sectional regressions are appropriate when investigating if multiple hypotheses exist for the source of the abnormal return (MacKinlay, 1997). To estimate the regression model, we use the obtained green and traditional CAR for each observation from the event study.

The first hypothesis investigates whether abnormal returns differ between green and traditional bonds, and the regression will be the following:

$$CAR_i(s1, s2) = \beta_0 + \beta_1 GreenBond + Control\ Variables_i + \varepsilon_i$$

Where *CAR* is the dependent variable and β_0 is the intercept. The coefficient β_1 is used to test the first null hypothesis. Depending on the positive or negative value of the coefficient, we can reject or confirm the null hypothesis that there is no difference in abnormal returns between green and traditional bond announcements. To investigate the coefficient, a *GreenBond*-dummy is added in the first cross-sectional regression. The *GreenBond*-dummy have a value of zero for traditional bonds and a value of one for green bonds. *Control Variables* are the selected control variables for firm *i*.

The second hypothesis investigates whether abnormal returns differ between the different sectors when announcing a green bond issuance:

$$CAR_i(s1, s2) = \beta_0 + \beta_1 Utilities + \beta_2 TMT + \beta_3 Manufacturing + \beta_4 Financials + Control\ Variables_i + \varepsilon_i$$

The second regression follows the same structure as the first one but includes *Utilities*, *TMT*, *Manufacturing*, and *Financial* dummies. The last sector, *Real Estate*, is used as a reference dummy and is not included in the regression. The coefficients of the sector dummies are used to investigate our second null hypothesis: there is no difference in abnormal returns between sectors when announcing a green bond issuance. When the dummies take on the value of one, firms are in the

respective sector; otherwise, the dummies will be zero. If the dummy coefficients used in the regression are positive and significant, it implies that these sectors have more abnormal returns than the reference sector *Real Estate*.

4.3.1. Control Variables

Several bond and firm-specific factors may affect the reactions of equity investors (Glavas, 2018). To control for the impact of those factors, we use control variables in our regressions. Control variables minimise the endogeneity problem, which occurs when there is a correlation between the explanatory variable and the error term (Roberts & Whited, 2012). Based on previous studies on similar topics, we have identified five firm and bond specific control variables: firm size, operating margin, leverage, coupon rate and maturity length. Moreover, we include year fixed effects to allow control for unobserved factors related to time.

Firm Size

Zariyawati et al. (2009) conclude the larger firms will receive larger abnormal returns upon bond announcements. Firm size is defined as the natural logarithm of the firm's total assets at the opening balance of the announcement year (Bradshaw et al. (2006); Spiess & Affleck-Graves (1999)).

Leverage

Financial leverage has proven to be negatively correlated with firm value meaning that firm value decreases when leverage goes up (Rayan, 2008). Leverage is defined as total debt divided by total assets at the opening balance of the announcement year.

Operating Margin

Previous studies state a correlation between profitability and financial distress – firms tend to announce bond issuances when profits are high (Bradshaw et al., 2006; Glavas, 2018). Operating margin is calculated as operating income (earnings before interest and tax) divided by total revenue for the full year prior to the announcement year.

Coupon Rate and Maturity Date

Bond specific characteristics may affect the perception of firm value by equity investors (Godlewski et al., 2013). Hence, we choose to interpret each bond's maturity length and coupon as

two separate control variables. The maturity length is measured as the period from when the bond is issued to when the bond matures and must be repaid to investors. The coupon rate is the interest rate that the bondholder receives from the issue date to maturity date (Berk & DeMarzo, 2016).

4.3.2. Multicollinearity

One assumption in the regression is that the explanatory variables are not correlated with each other. To understand this, a Pearson's correlation matrix is carried out. The matrix investigates the dependence between the dependent and independent variables and the interrelationships between all variables, including the control variables. If we see that the correlation coefficients between the independent variables are significantly positive or negative, multicollinearity exists. To address and confirm the level of multicollinearity, a variance inflation factor (VIF) test is carried out. Many scholars such as Pallant (2013) and Barnett and Salomon (2012) argue that individual variables' VIF should not be greater than 10 to be considered acceptable.

4.3.3. Heteroskedasticity

Another assumption under the multiple regression is that the variance of the residuals is constant. If not, the residual variance is said to be heteroskedastic. To mitigate heteroskedasticity, regressions using robust standard errors are conducted in the robustness tests (White, 1980).

5.0 Results

In this section, we present the results of our analyses. We show the descriptive statistics for the variables used for both hypotheses and the results of the univariate and multivariate regressions. We also present the results from the tests related to robustness.

5.1 Results for H1

The results for H1 are divided into two parts. The results of the event study are presented in section 5.1.1 and the results of the regression analysis are presented in 5.1.2.

5.1.1 Event Study

Descriptive Statistics of CAAR

Table 5 provides a summary of the descriptive statistics of the variables used for the event study. We note that the mean CAAR for green bond announcements takes a positive value in all event windows, while the mean for traditional bonds takes a negative value in all event windows. The standard deviation is ~0.3% in both panels initiating that the variation of CAARs is relatively low.

Table 5. Descriptive statistics of green and regular bond CAAR

Panel A: CAAR for green bonds (n=27)	Mean	Median	Std.Dev.	Max	Min.	Std. Err.
[-10, 10]	0.1%	0.1%	0.3%	0.7%	(0.6%)	0.1%
[-5, 5]	0.1%	0.1%	0.3%	0.6%	(0.4%)	0.1%
[-2, 2]	0.0%	0.1%	0.3%	0.3%	(0.4%)	0.1%
Panel B: CAAR for traditional bonds (n=27)	Mean	Median	Std.Dev.	Max	Min.	Std. Err.
[-10, 10]	(0.1%)	(0.0%)	0.3%	0.5%	(0.6%)	0.1%
[-5, 5]	(0.3%)	(0.3%)	0.3%	0.5%	(0.6%)	0.1%
[-2, 2]	(0.1%)	(0.3%)	0.4%	0.5%	(0.5%)	0.1%

Table 5 presents the descriptive statistics of CAAR for the sample of 54 observations in total

When plotting the CAARs for both green and traditional bonds over time (figure 1), the indications from descriptive statistics are supported. The general take-away is that firms issuing green bonds affect stock prices positively while traditional bonds affect stock prices negatively. However, considering that the abnormal returns do not reach an absolute value above 1.0%, the variance is relatively low.

The green bonds' CAAR is fluctuating before the event day, and after the announcement, the green bonds' CAAR experiences a slightly positive trend for 2-3 days. However, the traditional bonds' CAAR starts to rise ~3 days before the event day, and in contrast to green bonds' CAAR, the traditional bonds' CAAR peaks on the event day, followed by a declining trend.

Figure 1. CAAR evolution in the event window

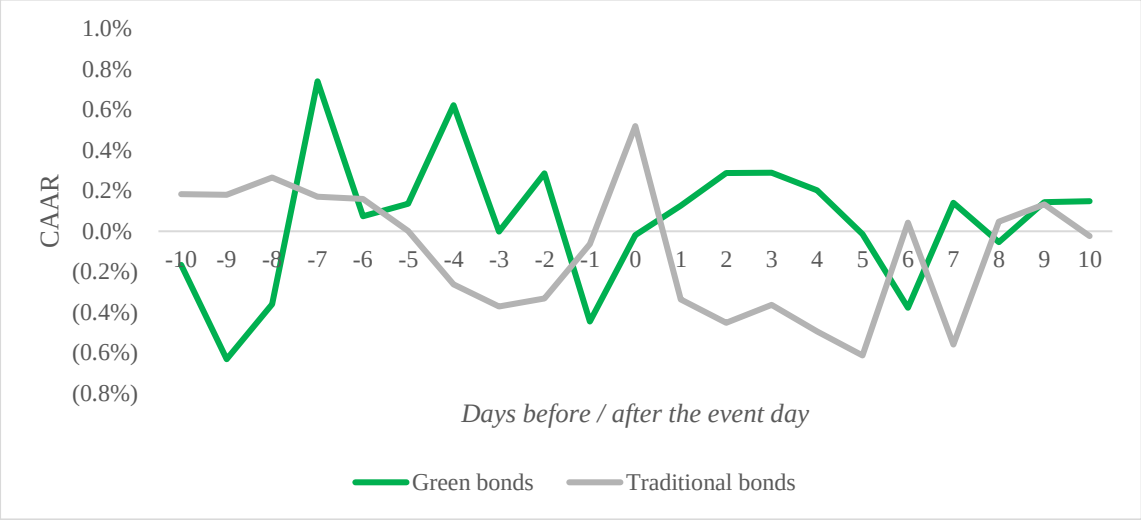


Figure 1 illustrates the CAAR trend for the two debt types during the event window of 21 days – 10 days prior to the announcement and 10 days post and the announcement day itself.

Results of the Event Study

To identify if there is any significant difference between CAAR for traditional and green bond announcements and to see if the stock market reacts differently depending on the bond type, we calculate the difference between green bond CAAR and traditional bond CAAR. We also perform a significance test on the results (see table 6 below).

None of the green bond CAAR coefficients are significant positive, but the traditional bond CAAR coefficients in the [-10,5], [-10,10], [-5,1] and [-5,5] event windows are significant negative. The difference in CAAR between the two debt types is significant on a 1% level in the [-10, 5] [-10, 10], [-5, 1] and [-5, 5] event windows.

Hence, these results cannot conclude anything about the green bond CAAR on a standalone basis, but rather in relation to traditional bond CAAR. The traditional bonds' statistical significance of the negative coefficient values suggests that traditional bond announcements generate negative stock market reactions. The statistically significant difference between green and traditional bonds' CAAR indicates that the announcement of green bonds affects the stock price more positively in relation to traditional bonds.

Table 6. Significance tests of CAAR

Event Window	Green Coefficient *(T-stat.)*	Traditional Coefficient *(T-stat.)*	Diff. Coefficient *(T-stat.)*
Panel A: Event Window [-10, 10]			
[-10, 0]	0.24% *(-0.27)*	0.45% *(-0.78)*	-0.21% (-0.52)
[-10, 1]	0.36% *(-0.39)*	0.11% *(-0.19)*	0.25% *(-0.21)*
[-10, 5]	1.13% *(-1.02)*	-1.81%** *(-2.50)*	2.94%*** *(-3.52)*
[-10, 10]	1.13% *(-0.89)*	-2.18%*** *(-2.62)*	3.31%*** *(-3.51)*
Panel B: Event Window [-5, 5]			
[-5, 0]	0.58% (-0.93)	-0.51% *(-1.26)*	1.09%** *(-2.19)*
[-5, 1]	0.71% *(-1.04)*	-0.85%* *(-1.91)*	1.55%*** *(-2.94)*
[-5, 5]	0.71% *(-0.77)*	-2.14%*** *(-3.56)*	2.85%*** *(-4.33)*
Panel C: Event Window [-2, 2]			
[-2, 0]	-0.18% *(-0.46)*	0.13% *(-0.49)*	-0.31% *(-0.95)*
[-2, 1]	-0.05% *(-0.11)*	-0.21% *(-0.68)*	0.16% *(-0.57)*
[-2, 2]	0.15% *(-0.24)*	(0.66%) *(-1.64)*	0.81%* *(-1.88)*

Table 7 presents the results of the significance tests for green and traditional bond CAAR for different event windows for the sample of 54 observations. The last column presents the results of the test of equality of 2 means with the CAAR difference between green and traditional bond announcements. The statistical significance of the coefficients at 10%, 5% and 1% level are marked with *, ** and *** respectively. The values in brackets represent the t-values.

Robustness Test of the Event Study

The results of the robustness test can be found in Appendix 3. The robustness tests are conducted similar to the previous event study, however using the sample with 94 observations instead of 54. Overall, the results show less statistically significant values however, yield significance for green bonds coefficient in event window [-10, 10]. The robustness test generates higher abnormal returns for traditional bonds. The lower abnormal returns for green bonds and higher abnormal returns for traditional bonds leads to less significant coefficients in the difference column.

5.1.2. Regression Model

Descriptive Statistics of the H1 Variables

Notable is that the average CAR for our three event windows is around zero, however including both green and traditional bonds.

Table 7. Descriptive statistics of variables

Variables	Obs.	Mean	Std. Dev.	Max	Min
CAR (-10, 10)	54	0.000	0.037	0.112	-0.007
CAR (-5, 5)	54	-0.001	0.006	0.020	-0.026
CAR (-2, 2)	54	0.000	0.006	0.113	-0.016
GreenBond	54	0.500	0.505	1.000	0.000
FirmSize	54	10.422	1.436	13.462	8.272
Leverage	54	0.367	0.109	0.583	0.124
EBITmargin	54	0.209	0.128	0.670	0.024

Table 7 presents the descriptive statistics used in H1 regression. *FirmSize* is as presented previously on a natural logarithmic scale. *Leverage* is a ratio from 0-100%, our sample generates a mean of 36.7% of debt to total assets.

Results of the Univariate Analysis

In Table 8 below, the results from Pearson's correlation matrix are shown. The results confirm that the *GreenBond* independent variable is statistically significant correlated with *CAR [-5,5]* on a 5 % level which support H1. The results also indicate a strong significant intercorrelation between the independent variables *Leverage* and *FirmSize;* thus, multicollinearity may affect the regression results. To address this, we conduct a VIF-test which confirmed that multicollinearity exists but on a moderate level only; the mean VIF is 1.11 and the highest VIF value is 1.19. The VIF-test results can be found in Appendix 4.

Table 8. Pearson's correlation matrix for H1 regression

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) CAR [-10, 10]	1.000						
(2) CAR [-5, 5]	0.736***	1.000					
(3) CAR [-2, 2]	0.542***	0.460***	1.000				
(4) GreenBond	0.215	0.310**	0.153	1.000			
(5) FirmSize	0.10000	0.014	0.214	0.035	1.000		
(6) Leverage	0.055	0.116	0.033	0.052	-0.375***	1.000	
(7) EBITmargin	-0.231*	-0.202	-0.134	-0.017	0.189	-0.140	1.000

Table 8 presents the results of Pearson's correlation matrix for the H1 variables on the 54 observations sample. The statistical significance of the coefficients at 10%, 5% and 1% level are marked with *, ** and *** respectively.

Results of the Multivariable Analysis

The results of regression I, II, and III are shown in table 9 below. The difference between the regressions is in the period of the event window for the CAR. Regression II confirms the result of the univariate analysis stating that there is a positive association between *GreenBond* and *CAR [-5.5]*. *GreenBond* has a positive coefficient of 0.005 and is statistically significant on a 5% level. This indicates that, holding everything else equal, green bond issuance announcements affects a

firm's stock price by generating 0.5 percentage points more abnormal returns than a traditional bond announcement. This finding supports our first hypothesis.

All the independent variables have a positive coefficient except *EBITmargin*. *EBITmargin* is also the only independent variable, except *GreenBond*, which is statistically significant. However, the negative coefficient contradicts our expectations of a positive coefficient and previous research stating that firms tend to announce bond issuances when profits are high. The adjusted R^2 value is relatively low for all regressions indicating that the explanatory power of our independent variables is low.

Table 9. H1 Regression results for regression I, II, III

Dependent variable		CAR [-10, 10]	CAR [-5, 5]	CAR [-2, 2]
Regression nr.		I	II	III
Independent variable	Expected sign			
GreenBond	+	0.002	0.005**	0.002
		(1.40)	(2.48)	(1.12)
FirmSize	+	0.000	0.000	0.001
		(0.96)	(0.51)	(1.65)
Leverage	-	0.004	0.009	0.010
		(0.67)	(0.98)	(0.12)
EBITmargin	+	-0.008*	-0.007	-0.007
		(-1.95)	(-0.98)	(-1.09)
Regression details				
FE		YES	YES	YES
Observations		54	54	54
R^2		0.225	0.201	0.206
Adj. R^2		0.045	0.015	0.021
F-test		1.819	2.197	1.328

Table 9 presents the results of H1 regression I, II and III. The statistical significance of the coefficients at 10%, 5% and 1% level are marked with *, ** and *** respectively. The values in brackets represent the t-values. FE includes firm and time fixed effects.

Results of the Robustness test

The results of the robustness test can be found in Appendix 5. The robustness tests are conducted on regression I, II and III. Due to the regression I and III not showing significant CARs for the *GreenBond* variable, these are not further investigated. Four robustness tests with *CAR [-5,5]* (regression II in Table 9) as the dependent variable are conducted. Regression IV is similar to our

main regression II but conducted using robust standard errors. Regression V is similar to regression II but adds *CouponRate* as a control variable. Regression VI is also similar to regression II but adds *MaturityLength* as a control variable. Regression VII is similar to regression II but adds both *MaturityLength* and *CouponRate* as control variables.

When regression IV is conducted with robust standard errors, the *GreenBond* coefficient remains positive but the t-value drops from 2.48 to 2.24, indicating the statistical significance decreases. Furthermore, the adjusted R^2 in regression IV remains at the same value of 0.015. When adding the bond-specific control variables, in regression V, VI and VII, the adjusted R^2 decreases in all regressions, and the significance level of the *GreenBond* coefficient decreases to 10% from 5% in regression VI. These results indicate that the correlation between *GreenBond* and *CAR [-5,5]* is stronger when conducting the regressions with normal standard errors and excluding *MaturityLength* and *CouponRate* as control variables.

5.2 Results for H2

The results for H2 are presented below.

5.2.1. Regression Model

H2 is investigated through univariate and multivariate regressions. In table 10 below, the descriptive variables of H2 are presented.

Table 10. Descriptive statistics of H2 regression variables

Variable	Mean	Std. Dev.	Max	Min
CAR22	0.000	0.005	0.011	-0.012
CAR55	0.001	0.006	0.020	-0.016
CAR1010	0.001	0.004	0.011	-0.007
TMT	0.170	0.380	1.000	0.000
RealEstate	0.340	0.479	1.000	0.000
Utilities	0.255	0.441	1.000	0.000
Financials	0.170	0.380	1.000	0.000
Manufacturing	0.064	0.247	1.000	0.000
FirmSize	11.305	1.917	14.804	8.272
Leverage	0.342	0.122	0.554	0.058
EBITmargin	0.213	0.115	0.670	0.024

Table 10 presents the descriptive statistics of the variables used for H2 regression.

Results of the Univariate Analysis

In Table 11, the results from Pearson's correlation matrix are shown. The results confirm that the *TMT* independent variable is negatively correlated with *CAR [-10,10], [-5,5]* and *[-2,2]* on a 10% statistical significance level. In addition, *RealEstate* is statistically significant positively correlated with *CAR [-10,10]*. The results also indicate that there is a strong statistically significant intercorrelation between the independent variables. To address this, we conduct a VIF-test, which confirmed that multicollinearity exists but on a moderate level only, the mean VIF value is 2.75 and the highest VIF value is 5.29. The VIF-test can be found in Appendix 4.

Table 11. Pearson's correlation matrix for H2 regression

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) CAR1010	1.000										
(2) CAR55	0.803***	1.000									
(3) CAR22	0.584***	0.754***	1.000								
(4) TMT	-0.275*	-0.278*	-0.252*	1.000							
(5) RealEstate	0.268*	0.209	-0.019	-0.325**	1.000						
(6) Utilities	-0.184	-0.059	0.116	-0.265*	-0.421***	1.000					
(7) Financials	0.096	-0.041	0.007	-0.205	-0.325**	-0.265*	1.000				
(8) Manufacturing	0.085	0.190	0.205	-0.118	-0.188	-0.153	-0.118	1.000			
(9) FirmSize	-0.065	-0.207	-0.084	0.191	-0.623***	-0.036	0.737***	-0.155	1.000		
(10) Leverage	0.100	0.315**	0.128	-0.234	0.536***	-0.055	-0.525***	0.226	-0.707***	1.000	
(11) EBITmargin	-0.207	-0.319*	-0.188	0.389***	-0.256*	-0.181	0.265*	-0.185	0.364*	-0.380***	1.000

Table 11 presents the results of Pearson's correlation matrix for the H2 variables on the 47 green bond observations sample. The statistical significance of the coefficients at 10%, 5% and 1% level are marked with *, ** and *** respectively.

Results of the Multivariable Analysis

The results of regression I, II, and III are shown below in table 12. The difference between the regressions is in the period of the event window for the CAR. The *RealEstate* variable is excluded from the regression since it is used as a reference dummy.

Regression I confirm the result of the univariate analysis stating that there is a positive association between *TMT* and *CAR [-10.10]*, but no significant association with *CAR [-5.5]* and *CAR [-2.2]*. *TMT* has a negative coefficient of -0.004 and is statistically significant on a 10% level. This indicates that holding everything else equal, abnormal returns for green bond issuance announcements are, on a 10% significance level, 0.04 percentage points lower than abnormal returns in the reference sector *RealEstate.*

None of the other sectors have significant associations with the dependent variables meaning there is insufficient evidence to conclude that abnormal returns differ between sectors when announcing

green bond issuances. The adjusted R^2 value is rather low for regression I and II, implying that the independent variables only can explain 4.9% and 6.2% of the variability in our dependent variables *CAR [-10,10] and CAR [-5,5]*. The adjusted R^2 for *CAR [-2,2]* is negative, implying insignificance of the explanatory variables.

Table 12. H2 Regression results for regression I, II and III

Dependent variable	CAR [-10, 10]	CAR [-5, 5]	CAR [-2, 2]
Regression nr.	I	II	III
Independent variable			
TMT	-0.004*	-0.002	-0.001
	(-1.81)	(-0.59)	(-0.24)
Financials	-0.004	-0.002	0.001
	(-1.04)	(-0.3)	(-0.13)
Utilities	-0.003	-0.001	0.002
	(-1.44)	(-0.29)	(-0.73)
Manufacturing	-0.001	0.001	0.004
	(-0.45)	(0.37)	(1.06)
FirmSize	0.001	0.000	0.000
	(0.91)	(0.46)	(0.04)
Leverage	-0.003	0.008	0.002
	(-0.46)	(0.77)	(0.18)
EBITmargin	-0.005	-0.011	-0.005
	(-0.85)	(-1.22)	(-0.52)
Regression details			
FE	YES	YES	YES
Observations	47	47	47
R^2	0.297	0.306	0.207
Adj. R^2	0.049	0.062	-0.072
F-test	0.838	0.853	0.505

Table 12 presents the results of H2 regression I, II and III. The statistical significance of the coefficients at 10%, 5% and 1% level are marked with *, ** and *** respectively. The values in brackets represent the t-values. FE includes firm and time fixed effects.

Results of the Robustness Test

As the H2 regression did not yield any significant results except for one independent variable, *TMT*, we run robustness tests of the results to test sensitivity. The result of the robustness test can be found in Appendix 6. The robustness tests are conducted on regression I, II and III using robust standard errors. The results of the robustness tests do not show any additional statistically significant results. The t-value of *TMT* decreases slightly from -1.81 to -1.84 in regression IV, and the adjusted R^2 for all regressions remains the same for all regressions as before the sensitivity test. The results indicate that there is insufficient evidence to reject the null hypothesis, which could be

based on that data is too limited, we are using the wrong explanatory variables or that the null hypothesis is correct.

6.0 Discussion

In this section, we will discuss our results. We start by discussing our research methodology. After that, we discuss the results of the study related to our hypotheses.

6.1 Research Method

6.1.1. Data Selection

One reason for conducting this study on a country-level, compared to previous studies being conducted across regions / global basis, was to eliminate discrepancies between regulations and policies affecting the attractiveness of issuing green bonds. Further, the US market is one of the largest markets for green bond issuance indicating that it is one of the most appropriate countries to conduct this study on. Despite this, the sample size for our study is somewhat limited and has a distinct implication on our results, especially for the second hypothesis. This is an issue we return to in section 6.2.2. The limited sample size shows that green bonds are still relatively new on the bond market (Appendix 7). 42% of our green bond observation were issued in 2020 which may distort our results as it may not be a comparable and representative year for previous years.

Further, our study is dependent on secondary data as Eikon by Thomson Reuters makes the classification of green bonds. According to its definition, firms can self-classify the bonds as green which could be less reliable since there is no guarantee that the bond proceeds are used for the right purposes. Even though there is no official classification of green bonds, many issuers use the well-known voluntary process guidelines (Green Bond Principles) that guarantee that the green bond is correctly issued and that proceeds are used for the right purposes.

When retrieving the bond data from Eikon by Thomson Reuters, observations of subsidiaries to listed companies were also included. In practice, this implies that a listed firm whose subsidiary has issued a green bond is included in our sample, and we assume that the event influences the parent company's stock price. However, depending on the group, this might be reflected differently, especially for large conglomerates since other firms within the conglomerate may announce events during our estimation and event windows that may affect the stock price.

6.1.2 Method

When conducting an event study, the normal return of a firm is estimated using an estimation window of 120 days prior to the event window. However, during the 120 days prior to the event window, it is likely that other events have been announced about / by the firm, affecting the stock price. To avoid this, we manually sorted out firms that announce the issuance of another bond activity during the estimation window of a green bond which was used in the main study. However, it is possible that other non-bond activity has been announced during the period. We also conducted robustness test with the unfiltered sample, resulting in less significant results. Therefore, the method used for estimating the normal return during the event window might not be perfectly suitable as it can factor in other events that affect a firm's stock price.

As described in the method, six firm and bond specific control variables were chosen based on previous studies on similar topics. However, as discussed in the robustness tests, there is multicollinearity among them. Beyond that, the expected positive sign for the *EBITmargin* coefficient is not aligned with the outcome of the regression (significantly negative). These two reasons indicate that the chosen control variables might not be the most appropriate ones.

6.2 Analysis of Results

6.2.1. Hypothesis 1

The event study and t-test results support our first hypothesis that green bond issuance announcements have more positive abnormal returns than traditional bond issuance announcements. This is in line with previous research on green and traditional bonds made by Glavas (2018). In table 6, the difference between green and traditional bond CAAR is positive and significant on a 1% level in the [-10,10] event window and the [-5,5] window and significant on a 10% level in the [-2,2] window. However, since our data did not support any significant results of the green bond CAAR coefficients in the event study, we cannot conclude that green bond issuance announcements positively affect returns, but just that it is more positive than traditional bond announcements. A rationale behind this could be that green bonds signal a firm's commitment to the environment, which is increasing in importance as investors are getting more environmental-conscious.

The results from the regressions do only support the first hypothesis in the [-5,5] event window where the *GreenBond* coefficient takes a positive statistically significant value of 0.005. This indicates that green bonds positively affect stock returns when comparing to traditional bonds. Since the [-2,2] event window is included in the [-5,5] window, it is notable that only [-5, 5] event window proved to be significant of the two. The explanation for this could be seen in figure 1, illustrating that there is a time lag. The graph shows that the stocks face the highest abnormal return after 2 days, between day 2-5 after the event day at t=0. This could indicate that announcement reaches stakeholders at different points in time. As traditional bonds' stock prices lead up to the peak on the day before the event, it could indicate an information leakage in the market. Another thing noted is the low adjusted R^2 for all our regressions, which means that our independent variables do not explain our dependent variable very well. We believe a too small data sample can cause the low value, or control variables not being perfectly chosen to explain our dependent variable. Lastly, we get a different result when conducting the robustness test on the regressions than without the test — the adjusted R^2 declines and the t-values decrease, indicating lower statistical significance. A possible reason for this outcome may be that our data is not heteroskedastic from the beginning, the data sample is too small, or we have too many control variables in the regression.

6.2.2. Hypothesis 2

Previous research (Tang & Zhang, 2020; Lebelle et al., 2020) investigating sector differences on abnormal returns mostly divide issuers into the financial and non-financial sectors. To differentiate ourselves and conduct a more detailed sector analysis, we choose to include more sectors. However, since bonds are overrepresented in some sectors, the split becomes skewed, which may affect the results significantly.

As shown in table 12, the results from the regressions are only statistically significant for the *TMT* coefficient in the [–10,10] window. The *TMT* coefficient is statistically significant on a 10% level. It takes on a negative value of -0.004, indicating that firms in the TMT sector have lower abnormal returns from green bond announcements than firms in the reference sector *Real Estate*. This result aligns with our second hypothesis; however, the lack of significant results for the other sector coefficients provides insufficient evidence to fully support our second hypothesis. One plausible reason for the inadequate evidence is the lack of observations in each sector, as shown in table 4.

For example, only three firms are in the Manufacturing sector, which is not enough to represent a sector as a whole. Furthermore, the total dataset of 47 observations can be too small.

7.0 Conclusion

This section is devoted to drawing conclusions about our findings, discussing the limitations and providing suggestions for future research.

7.1 Contributions

This paper has been devoted to further investigate green bond issuances and their impact on stock prices of publicly traded companies. This was done by analysing the stocks of firms that have issued both green and traditional bonds in the last seven years in the US market. Our study contributes to the literature on green bonds which is among the first to be conducted on a single-country basis. The results show that announcing a green bond issuance impacts the stock price more and in a positive direction compared to when announcing the issuance of a traditional bond. In fact, the announcement of a traditional bond issuance impacts the stock price negatively. Thus, there is evidence supporting our first hypothesis confirming that green bond issuance is perceived as a value-creating event compared to traditional bonds. However, we cannot conclude anything about green bond issuance announcements on a standalone basis since results did not yield significant abnormal returns for the green observations, even if proved in previous literature, albeit on a global level. The potential reasons for this were discussed in section 6.2.1.

Secondly, we investigated if there is a difference in abnormal returns across different business sectors. Due to insignificant results, we cannot make any conclusions regarding the differences in abnormal returns sectors across.

These results are valuable to investors, proving that green bonds have a signalling value compared to traditional bonds and serves a complement to previous research by focusing on the US market. Moreover, our results are of interest for firms issuing green bonds; if bond investors react positively to green bond issuances, issuers will continue to be interested in issuing green bonds. Since our findings suggest that green bond announcements have a more positive effect on stock returns than traditional bond announcements, they could also have implications on other types of sustainable debt.

7.2 Limitations

The sample size is the primary limitation of the study. Although green bond issuances are increasing in the US, they are still relatively few. Furthermore, by only including firms that have issued both traditional and green bonds and deleting all observations overlapping with other bond events in the estimation window of our sample, our sample set decreases even more. Our small set of final data on US-listed companies may imply that the results are not generalisable and cannot be used in other countries due to different firm characteristics and investor preferences. The sample limitation does also have implications on our sector distribution. The observations become obliquely distributed in the sectors with insufficient observations in each one to become representative for the whole sector.

Another limitation is the distribution of green bonds over the chosen period. Due to the strong increase in green bond issuances each year, most of the observations are from 2020 (Appendix 7). Since investors' perception of green bonds may have changed over time and became more positive or negative, this could be reflected in the issuing firms' abnormal returns.

7.3 Suggestions for Future Research

In order to improve the results, we believe that one could increase the sample size by choosing another method to compare traditional and green bonds. This study compares the returns by only including firms who have issued both bond types. Lastly, a suggestion is to investigate other firm and bond-specific control variables that better can explain *CAR*. An example of this is to measure operating margin differently to make sure it aligns with its expected sign to strengthen the regression results' reliability.

From a more forward-looking perspective, we believe more improvements and suggestions can be made. Presumably, the small amount of issued green bonds has been a limitation for most previous studies to generate reliable and generalising conclusions. However, since green bonds are estimated to continue expanding on the global bond market, more data will be available. Thus, we believe that the topic can be researched more extensively in the future, both on a country-specific level, like this study, or on a broader geographical level. For example, it would be interesting to investigate differences in abnormal returns based on firm sectors' level of cleanliness, such as the sectors level of pollution abatement. Moreover, as other types of sustainable debt are growing, such

as sustainability-linked bonds and social bonds, a comparison of the abnormal returns from green bonds and other new sustainable debt types would be intriguing.

8.0 Bibliography

Akerlof, G. A. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. *Quarterly Journal of Economics, 84*

Baker, M., Bergstresser, D., Serafeim, G., & Wurgler, J. (2018). *Financing the Response to Climate Change the Pricing and Ownership of U.S. Green Bonds* . (). https://www-nber-org.ez.hhs.se/system/files/working_papers/w25194/w25194.pdf

Barnett, M. L., & Salomon, R. M. (2012). Does it pay to be really good? addressing the shape of the relationship between social and financial performance. *Strategic Management Journal, 33* https://www-jstor-org.ez.hhs.se/stable/41679849

Baulkaran, V. (2019). Stock market reaction to green bond issuance. *Journal of Asset Management, 20* https://search-proquest-com.ez.hhs.se/docview/2298923421/fulltextPDF/3228F7B194804F1APQ/1?accountid=39039

Berk, J., & DeMarzo, P. (2016). *Corporate finance* (4th ed.). Pearson.

Bradshaw, M. T., Richardson, S. A., & Sloan, R. G. (2006). The relation between corporate financing activities, analysts' forecasts and stock returns. *Journal of Accounting and Economics, 42*

Brennan, M., & Kraus, A. (1987). Efficient Financing Under Asymmetric Information. *The Journal of Finance, 42* https://www-jstor-org.ez.hhs.se/stable/2328524

Brown, S. J., & Warner, J. B. (1980). Measuring security price performance. *Journal of Financial Economics, 8*

Clapp, C. (2014). *Climate finance: capitalising on green investment trends.* ().Climate Strategies. https://www.jstor.org/stable/resrep15562.12

Climate Bonds Initiative. (2020). *Green Bonds - Global State of the Market.* (). https://www.climatebonds.net/files/reports/cbi_sotm_2019_vol1_04d.pdf

Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2010). Signaling Theory: A Review and Assessment. *Journal of Management,*

Dealogic. (2020). *DCM Highlights: Full Year 2019.* https://dealogic.com/insight/dcm-highlights-full-year-2019/

Deschyvrer, P., & de Mariz, F. (2020). What Future for the Green Bond Market? How Can Policymakers, Companies, and Investors Unlock the Potential of the Green Bond Market? *Journal of Risk and Financial Management, 13* https://search-proquest-com.ez.hhs.se/docview/2384087385?pq-origsite=primo

Duca, E., Dutordoir, M., Veld, C., & Verwijmeren, P. (2012). Why are convertible bond announcements associated with increasingly negative issuer stock returns? An arbitrage-based explanation. *Journal of Banking & Finance, 36*

Eckbo, E. B. (1986). Valuation effects of corporate debt offerings. *Journal of Financial Economics, 15*

Elliott, W. B., Prevost, A. K., & Rao, R. P. (2009). The announcement impact of seasoned equity offerings on bondholder wealth. *Journal of Banking & Finance, 33*

Epure, M., & Guasch, M. (2020). Debt signaling and outside investors in early stage firms. *Journal of Business Venturing, 35*

Fabozzi, F. J. (2010). *Bond markets, analysis, and strategies* (7th ed.). Pearson International.

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance, 25* https://www-jstor-org.ez.hhs.se/stable/2325486

Fama, E. F., Fisher, L., Jensen, M. C., & Roll, R. (1969). The Adjustment of Stock Prices to New Information. *International Economic Review, 10* https://www-jstor-org.ez.hhs.se/stable/2525569

Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*,

Flannery, M. J. (1986). Asymmetric Information and Risky Debt Maturity Choice. *The Journal of Finance, 41* https://www-jstor-org.ez.hhs.se/stable/2328342

Fungáčová, Z., Godlewski, C. J., & Weill, L. (2020). Does the type of debt matter? Stock market perception in Europe. *The Quarterly Review of Economics and Finance, 75*

Glavas, D. (2018). *How Do Stock Prices React to Green Bond Issuance Announcements?* (). https://papers.ssrn.com/abstract=3279069

Godlewski, C. J., Turk-Ariss, R., & Weill, L. (2013). Sukuk vs. conventional bonds: A stock market perspective. *Journal of Comparative Economics, 41*

Grene, S. (2015, June). The dark side of green bonds. *Financial Times* https://www.ft.com/content/16bd9a48-0f76-11e5-b968-00144feabdc0

Hachenberg, B., & Schiereck, D. (2018). Are green bonds priced differently from conventional bonds? *Journal of Asset Management, 19* https://search-proquest-com.ez.hhs.se/docview/2116237183?pq-origsite=primo

ICMA. (2018). *Green Bond Principles.* (). https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Green-Bonds-Principles-June-2018-270520.pdf

Intergovernmental Panel on Climate Change. (2018,). *Summary for Policymakers — Global Warming of 1.5 ºC.* https://www.ipcc.ch/sr15/chapter/spm/

Kang, E. (2008). Director Interlocks and Spillover Effects of Reputational Penalties from Financial Reporting Fraud. *Academy of Management Journal, 51*

Klier, D. (2020). *HSBC Green Bonds Report.* ().HSBC Holdings plc.

Le Houérou, P. (2019). *A bigger role for green bonds.* https://www.ft.com/content/acb2c94c-86cd-11e9-a028-86cea8523dc2

Lebelle, M., Jarjir, S. L., & Sassi, S. (2020). Corporate Green Bond Issuances: An International Evidence. *Journal of Risk and Financial Management, 13* http://ez.hhs.se/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip&db=eoh&AN=1868128&site=ehost-live

Leland, H. E., & Pyle, D. H. (1977). Informational Asymmetries, Financial Structure, and Financial Intermediation. *The Journal of Finance, 32* https://www-jstor-org.ez.hhs.se/stable/2326770

Lyon, T. P., & Maxwell, J. W. (2011). Greenwash: Corporate Environmental Disclosure Under Threat of Audit. *Journal of Economics & Management Strategy, 20*

Lyon, T. P., & Montgomery, W. A. (2015). The Means and End of Greenwash. *Organization & Environment, 28* https://www-jstor-org.ez.hhs.se/stable/26164732

MacKinlay, A. C. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature, 35*

Marszalek, J., & Kuna-Marszalek, A. (2017). *Some Considerations on the Green Bonds Market Development*

McWilliams, A., & Siegel, D. (1997). Event Studies in Management Research: Theoretical and Empirical Issues. *Academy of Management Journal, 40*

Mikhaylova, A., & Ivashkovskaya, I. (2020). Do Investors Pay Yield Premiums On Green Bonds? (Working Paper) *Journal of Corporate Finance Research / Корпоративные Финансы | ISSN: 2073-0438, 14*

Mikkelson, W. H., & Partch, M. M. (1986). Valuation effects of security offerings and the issuance process. *Journal of Financial Economics, 15*

Morgan Stanley. (2017). *Behind the Green Bond Boom.* https://www.morganstanley.com/ideas/green-bond-boom

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics, 13*

Nauman, B. (2021, January). Analysts expect as much as $500bn of green bonds in bumper 2021. *Financial Times* https://www.ft.com/content/021329aa-b0bd-4183-8559-0f3260b73d62

Pallant, J. (2013). *SPSS Survival Manual: A step by step guide to data analysis using SPSS* (5th ed.). Maidenhead: McGraw-Hill.

Park, N. K., & Mezias, J. M. (2005). Before and after the Technology Sector Crash: The Effect of Environmental Munificence on Stock Market Response to Alliances of E-Commerce Firms. *Strategic Management Journal, 26* https://www-jstor-org.ez.hhs.se/stable/20142287

Rayan, K. (2008). *Financial leverage and firm value* https://repository.up.ac.za/handle/2263/23237

Roberts, M. R., & Whited, T. M. (2012). *Endogeneity in Empirical Corporate Finance.* (). https://papers.ssrn.com/abstract=1748604

Ross, S. A. (1977). The Determination of Financial Structure: The Incentive-Signalling Approach. *The Bell Journal of Economics, 8*

SEB. (2020). *The Green Bond Report: 2021 to be Record Year for Sustainable Finance.* https://sebgroup.com/press/press-releases/2020/sebs-the-green-bond-report-2021-to-be-record-year-for-sustainable-finance

Shishlov, I., Morel, R., & Cochran, I. (2016). *Beyond transparency: unlocking the full potential of green bonds.* (Working Paper).

Shleifer, A. (2000). *Inefficient Markets: An Introduction to Behavioral Finance*. Oxford University Press.

Snedecor, G. W., & Cochran, W. G. (1989). *Statistical Methods* (8th ed.). Iowa State College Press.

Spence, M. (1973). Job Market Signaling. *Quarterly Journal of Economics, 87*

Spiess, K. D., & Affleck-Graves, J. (1999). The long-run performance of stock returns following debt offerings. *Journal of Financial Economics, 54*

Stiglitz, J. E. (2000). The Contributions of the Economics of Information to Twentieth Century Economics. *Quarterly Journal of Economics, 115*

Stiglitz, J. E. (2002). Information and the Change in the Paradigm in Economics. *American Economic Review, 92*

Tang, D. Y., & Zhang, Y. (2020). Do shareholders benefit from green bonds? *Journal of Corporate Finance, 61*

The World Bank. (2015). *What Are Green Bonds?* ().

UN Environment Programme. (2017). *Climate Change.* http://www.unep.org/explore-topics/climate-change/about-climate-change

United Nations Climate Change. (2016). *The Paris Agreement.* https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

White, H. (1980). A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica, 48* https://www-jstor-org.ez.hhs.se/stable/1912934

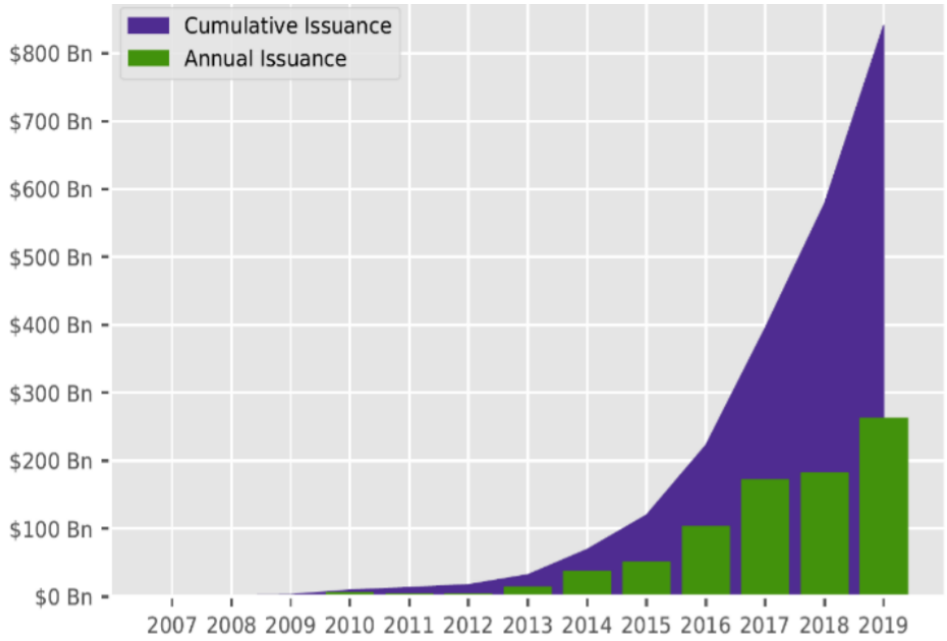
Wood, D., & Grace, K. (2011). A Brief Note on the Global Green Bond Market. (Working Paper) *Initiative for Responsible Investment,* https://iri.hks.harvard.edu/files/iri/files/iri_note_on_the_global_green_bonds_market.pdf

Zariyawati, M. A., Chun, L. S., & Nassir, A. M. (2009). Conventional vs Islamic Bond Announcements: The Effects on Shareholders ' Wealth. *International Journal of Business Management, 4* http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.654.713&rep=rep1&type=pdf

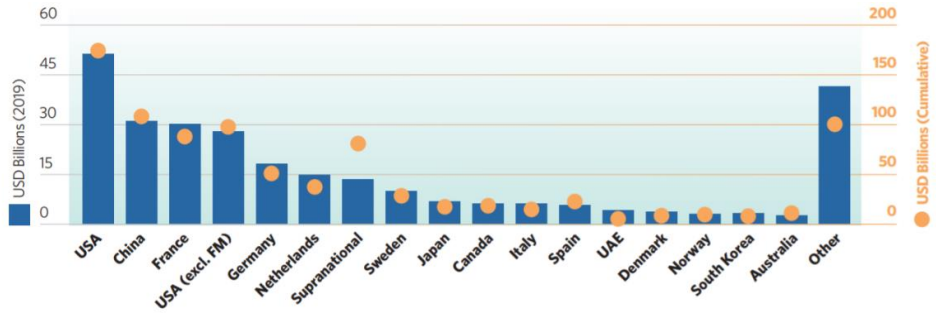
Zerbib, O. D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking & Finance, 98*

9.0 Appendix

Appendix 1. Global green bond market accumulative issuance (SEB, 2020)



Appendix 2. Top 2019 countries in amount of green bonds issued (Climate Bonds Initiative, 2020)



Appendix 3. Robustness test for the event study conducted with a sample of 94 observations

Event Window	Green Coefficient *T-stat.*	Traditional Coefficient *T-stat.*	Diff. Coefficient *T-stat.*
Panel A: Event Window [-10, 10]			
[-10, 0]	0.68% *(1.00)*	0.94%* *(1.70)*	-0.27% *(-0.69)*
[-10, 1]	0.85% *(1.20)*	0.82% *(1.41)*	0.03% *(-0.20)*
[-10, 5]	1.52%* *(1.78)*	-0.14% *(-0.20)*	1.66%** *(1.98)*
[-10, 10]	1.77%* *(1.81)*	0.04% *(0.05)*	1.73%* *(1.76)*
Panel B: Event Window [-5, 5]			
[-5, 0]	0.45% *(0.94)*	0.56% *(1.43)*	-0.11% *(-0.49)*
[-5, 1]	0.63% *(1.20)*	0.44% *(1.02)*	0.19% *(0.18)*
[-5, 5]	0.35% *(0.50)*	-0.54% *(-0.93)*	0.89% *(1.43)*
Panel C: Event Window [-2, 2]			
[-2, 0]	-0.49% *(-1.63)*	0.54%** *(2.18)*	-1.04%*** *(-3.81)*
[-2, 1]	-0.32% *(-0.85)*	0.42% *(1.38)*	-0.74%** *(-2.24)*
[-2, 2]	0.25% *(0.52)*	0.18% *(0.45)*	0.07% *(-0.08)*

Appendix 4. VIF results for H1 and H2 regression variables

H1		H2	
Variable	**VIF**	**Variable**	**VIF**
Greenbond	1.01	*TMT*	2.63
Firmsize	1.19	*Financials*	5.29
Leverage	1.18	*Utilities*	1.93
EBITmargin	1.04	*Manufacturing*	1.15
		Firmsize	4.55
		Leverage	2.27
		EBITmargin	1.41
Mean VIF	**1.11**	**Mean VIF**	**2.75**

Appendix 5. Regressions for H1 with robust standard errors: testing the effect of regression (IV) using robust standard errors, regression (V) adding *CouponRate* as independent variable, regression (VI) adding *MaturityLength* as independent variable, and (VII) adding both *CouponRate* and *MaturityLength* as independent variables.

Dependent variable	CAR [-5, 5]			
Regression nr.	IV	V	VI	VII
Independent variable				
GreenBond	0.005**	0.005**	0.005*	0.005**
	(2.24)	(2.24)	(2.01)	(2.07)
FirmSize	0.000	0.000	0.000	0.000
	(0.57)	(0.56)	(0.71)	(0.74)
Leverage	0.009	0.009	0.009	0.008
	(1.06)	(1.01)	(0.99)	(0.89)
EBITmargin	-0.007	-0.007	-0.008	-0.008
	(-1.07)	(-1.12)	(-1.18)	(-1.20)
CouponRate		0.000		0.001
		(0.14)		(-1.32)
MaturityLength			0.000	0.000
			(-1.13)	(-1.00)
Regression details				
FE	YES	YES	YES	YES
Observations	54	54	54	54
R^2	0.201	0.201	0.211	0.215
Adj. R^2	0.015	-0.079	0.005	-0.015
F-test	2.057	1.645	2.409	1.985

The table presents the results of H1 regression I, II and III and IV all with CAR [-5,5] as the dependent variable. The statistical significance of the coefficients at 10%, 5% and 1% level are marked with *, ** and *** respectively. The values in brackets represent the t-values.

Appendix 6. Regressions for H2 with robust standard errors: testing the effect of regress using OLS with robust standard errors

Dependent variable	CAR [-10, 10]	CAR [-5, 5]	CAR [-2, 2]
Regression nr.	IV	V	VI
Independent variable			
TMT	-0.004*	-0.002	-0.010
	(-1.84)	(-0.67)	(-0.19)
Financials	-0.004	-0.002	0.010
	(-0.99)	(-0.37)	(0.13)
Utilities	-0.003	-0.001	0.002
	(-1.65)	(-0.36)	(0.89)
Manufacturing	-0.001	0.001	0.004
	(-0.37)	(0.33)	(0.99)
FirmSize	0.001	0.000	0.000
	(1.07)	(0.65)	(0.03)
Leverage	-0.003	0.080	0.002
	(-0.51)	(0.89)	(0.17)
EBITmargin	-0.005	-0.011	-0.050
	(-0.69)	(-1.04)	(-0.53)
Regression details			
FE	YES	YES	YES
Observations	47	47	47
R^2	0.297	0.306	0.208
Adj. R^2	0.049	0.062	-0.072
F-test	1.256	1.048	0.673

The table presents the results of H2 regression I, II and III with CAR [-10,10], CAR [-5,5] and CAR [-2,2] as the dependent variables. The statistical significance of the coefficients at 10%, 5% and 1% level are marked with *, ** and *** respectively. The values in brackets represent the t-values. FE includes firm and time fixed effects.

Appendix 7. Sample of green bonds distributed over the study period