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Corporate green bonds in the equity and debt capital markets – a comparative study of Sweden, the US and Europe

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Abstract

Title: Corporate green bonds in the equity and debt capital markets – a comparative study of Sweden, the US and Europe

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Keywords: Corporate green bonds, debt capital markets, equity capital markets, country comparison, Sweden, US, Europe, signalling theory, information asymmetry, bond coupons, Price-to-Book, WACC, environmental attitude, investors taste

Purpose: This paper aims to explain the differences between green and conventional corporate bond issuers dependent on the country of issuance. In detail, the focus lies on the analysis of the differences within the equity and debt capital markets on the firm level.

Methodology: This paper uses quantitative data collection with a deductive research approach. In detail, Difference-in-Differences models, as well as multivariate regression models, are applied as well as propensity score matching.

Theoretical Perspective: The applied theories in this paper are the Signalling theory and the information asymmetry theory.

Empirical foundation: This paper includes 1731 firms in total, of which 1557 firms are conventional and 174 are green bond issuers. The data is collected from Bloomberg's equity screening tool and FactSet and covers the years between 2015 and 2021.

Conclusion: This paper finds no difference in investor valuation within the equity capital markets for the respective countries, whilst finding on average lower bond prices for corporate green bond issuers in Sweden, whilst this correlation does not apply to the US or selected EU debt capital markets. Further, we suggest that this lower coupon of green bonds in Sweden is reflected by an on average lower WACC of green bond issuers in Sweden, whilst this relation cannot be found for the US or selected EU capital markets. This finding can be explained through the signalling and the information asymmetry theory.

Thank you,

We would like to thank our supervisor Marco Bianco for his time, support and guidance during the process of writing this paper.

With kind regards,
Valentin Eriksson and Ole Heinrichs

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Table of Contents

Table of Figures

Table of Tables

Abbreviations

ATET	-	Average Treatment Effect for the Treated
BICS	-	Bloomberg's Industry Classification System
CO_2	-	Carbon Dioxide
Covid-19	-	Official name of the Coronavirus
DiD	-	Difference-in-Differences
EOSDIS	-	NASA's Earth Observing System Data and Information System
EU	-	European Union
EPI	-	Environmental Performance Index
EUR	-	Euro
FE	-	Fixed Effects
GDP	-	Gross Domestic Product
IPCC	-	Intergovernmental Panel on Climate Change
m	-	Million
NYSE	-	New York Stock Exchange
OECD	-	Organization for Economic Cooperation and Development
OLS	-	Ordinary Least Squares
PB	-	Price-to-Book
RE	-	Random Effects
ROA	-	Return on Assets
ROE	-	Return on Equity
SE	-	Sweden
SEDAC	-	Socioeconomic Data and Applications Center
US	-	United States
USD	-	US-Dollar
WACC	-	Weighted Average Cost of Capital

1. Introduction

In this chapter, we provide a brief background for our research area, and a problem discussion, which focuses on the explanation of our research idea, followed by purpose and consequent research questions. Further, we summarize our main findings as well as contributions to the current body of literature. Finally, we touch upon the limitations of this paper and end this chapter with an explanation of its structure.

1.1. **Background**

Global warming is among the most pressing systemic risks for economic growth, global development, peace, and biodiversity (OECD, 2021). As such, climate change can be perceived as one of the most successful topics in politics and society, as it arguably is one of the most dominantly discussed topics. Since the Paris Agreement in 2015, where 191 parties set the common goal to limit global warming to 1.5°C, the issue of climate change found its solid place within the political agendas of most of the world's governments. However, the latest evidence suggests that so far little has effectively been achieved in terms of global emissions reduction and long-term sustainable transformation (OECD, 2021). The latest IPCC report on climate change 2022 states that "Without immediate and deep emissions reduction across all sectors, limiting global warming to 1.5°C is beyond reach. However, there is increasing evidence of climate action." (IPCC, 2022). This shows that the increasing climate action not at least by corporates can significantly contribute to the mitigation of climate change (World Bank, 2021).

One tool to take action against climate change that becomes increasingly more popular amongst corporates is green bonds. Since the first issuance of a green bond by The World Bank in 2008, more and more green bonds have globally been issued by mostly municipals, but within recent years more commonly also by corporates. In detail, annual green bond issuances exceeded for the first time in 2021 the half-trillion mark with 522.7 billion US-Dollars, which is a 75% increase on 2020. In 2021, the private sector experienced the strongest growth driven by financial (+143%) and non-financial (+111%) corporates (Harrison et al., 2022).

Green bonds are a class of fixed-income financial instruments, that are like conventional bonds with the exception that the proceeds need to be strictly invested into environmentally friendly projects. One example of such a green bond would be Apple's issuance in November 2019 raising 2.2 billion US-Dollars for internal investments in "low carbon design and engineering, energy efficiency, renewable energy, carbon mitigation as well as carbon sequestration" (Apple, 2021, p. 3).

1.2. Problem Discussion

Previous studies primarily focus on the pricing of green bonds in comparison to conventional bonds using an event study methodology and focusing on the market reaction to the announcement of the green bond issuance (Karpf & Mandel, 2018; Zerbib, 2019; Tang & Zhang, 2020; Flammer, 2021). Coherently, the literature finds positive abnormal returns around the announcement of green bond issuances, which is commonly explained by the evidentially positive reaction of investors towards a firms eco-friendly behaviour (Klassen & MyLaughlin, 1996; Flammer, 2013; Krueger, 2015). That in turn has partially been explained by superior historical returns of sustainable strategies (Edmans, 2011; Nagy, Kassam & Lee, 2016; In, Park & Monk, 2019) and the growing investor appetite for environmentally-conscious investments (Fama & French, 2007). Furthermore, the green bond literature dominantly focuses on the yields of green bonds compared to conventional bonds. Here, the findings are not as coherent as the stock market reaction to the announcement of the green bond issuance. Whilst some studies suggest no difference between green and conventional coupons (Larcker & Watts, 2020; Flammer, 2021), others find a green bond premium (Karpf & Madel, 2017; Baker et al., 2018; Zerdib, 2019).

The largest part of previous studies focuses on the US green bond market, as well as municipal green bonds, leaving corporate green bonds as a side field, which did so far not receive a lot of attention in the previous literature. However, a few studies widen the scope of the green bond research when investigating green bond issuances for a global sample of firms. Specifically, Flammer (2021) fills a gap in the literature when she focuses on explaining green bond issuances for a sample consisting of global corporate green bonds. However, it appears that no current studies are focusing on country differences within the green bond issuances in the equity and debt capital markets. Whilst Flammer (2021) is using a matching methodology, comparing green bond issuers to their closest conventional bond issuing neighbour, and thus automatically controlling for country effects, Flammer does not aim to find, investigate, or explain specific country differences on the country-level.

We argue that understanding local differences within the corporate green bond market would contribute to understanding differences in previous findings regarding yields of green bonds, as well as complement the literature about the motivation behind the issuance of green bonds. Specifically, we choose to compare Sweden with the US and the main green bond issuing countries in western Europe in this study.

In detail, we base our choice of countries on Pastor et al.'s (2021) findings on the interplay of societal environmental concern and green stocks performance. Based on the media index of Ardia et al. (2021) and as interpreted by Pastor et al. (2021), green stocks outperform conventional stocks, whenever the concern about the state of the environment rises in society.

Arguably, the concern about the state of the environment differs among countries due to differences in local cultures and exposures. For example, whilst Greta Thunberg's environmental activism sparked sudden and widespread attention on global warming in 2018, environmental education had long been a solid anchor in the Swedish educational system. Some education scholars pinpoint the beginning of the inclusion of the topic of environmental sustainability in the Swedish curriculum as early as 1919 (Hansson, 1993), whilst others mark the start of the integration of the modern environmental discourse in the 1960s (Breiting & Wickenberg, 2010). Ever since, environmental concerns have been an essential part of the common public debate in Sweden. Thus, it has shaped Sweden's society to be as environmentally aware as the activism of Greta Thunberg publicly displays today. Leaving Sweden and its society to be one of the top global performers when it comes to sustainability (Wendling et al., 2020; Global competitive index, 2021).

This environmental awareness is additionally reflected in the Swedish finance market. The Swedish Krona has become the fourth largest currency for green bond issuances worldwide since 2019 (Ferlin & Fryxell, 2020). Between 2013 and 2018, Sweden issued a total amount of 140 green bonds amounting to 11.6 billion US-Dollars whilst the US issued a total of 194 green bonds amounting to 31.5 billion US-Dollars (Flammer, 2021). Relative to the GDP of the two countries, it is noteworthy that Sweden issued roughly one-third of the US green bond issuances making Sweden a frontrunner within green finance. 2019, 20 and 22 have each been record years when it comes to green bond issuances with the US in the first place and Sweden remaining under the top ten issuers worldwide. We argue that the well-developed green finance market in Sweden combined with Sweden's environmental awareness on the societal level offers fertile ground to compare Sweden with other countries and the effect green bond issuances have on the companies in the respective countries.

To distinguish country differences in green bond coupons in the debt capital markets and the effect on the issuing companies in the equity capital markets, we chose to compare Sweden with the US as the US is the number one green bond issuer worldwide. Additionally, sustainability goals have long been on the US-American political agenda whilst lacking environmental action on the societal level, which is reflected by the Environmental Performance Index[1] of the US, scoring 69.3 in 2020 (Wendling et al., 2020).

Further, we compare Sweden and the US with western European countries that are among the top green bond issuers (Germany, France, Italy, The Netherlands, and Spain[2]). That is to compare Sweden to countries that are in a more similar political sphere with being members of the European Union. This allows us to filter out any European effect that might contrast our findings when comparing the Swedish with the US market.

1.3. **Purpose and Research Question**

Whilst aiming to explain the differences between green and conventional corporate bond issuers on a country level, we analyse the differences within the equity and debt capital markets on the firm level from a finance perspective. Accordingly, the following two research questions are formulated:

RQ1: Is there a difference in investor valuation between green and conventional bond issuing firms in the equity capital markets dependent on the country of issuance?

RQ2: Is there a difference in the coupon of bonds between green and conventional bond issuing firms in the debt capital markets dependent on the country of issuance?

1.4. **Main Findings**

In this study, two samples of firms are used. The first sample of firms is used for a cluster-robust Difference-in-Differences analysis of long-term Price-to-Book values between 2015 and 2021 of green and conventional bond issuing companies. The second cross-sectional sample is subsequently used for two multivariate, cluster-robust regression analyses. The first

[1] For an explanation of the index, see Appendix, Variable Definition Table
[2] Moving forward, we are referring to Germany, France, Italy, The Netherlands, and Spain, when writing western European countries or Europe.

multivariate regression is used to investigate if there is a bond coupon difference between green and conventional bond issuing firms. The second multivariate regression is used to understand if the difference (if any) in valuation in the equity capital markets and/ or the difference in coupon (if any) in the debt capital markets is reflected by a difference in the cost of capital between green and conventional bond issuing firms.
This second sample consists of a sub-sample of our first sample for 2021. For both samples, a matching methodology is applied to compare green bond issuers to their closest neighbours in terms of some firm-specific characteristics such as industry and market capitalization. This results in a further reduction of the sample in the final models. In addition, we choose to display the model results using the whole sample without matching for transparency reasons, as well as split all models according to the country of operation of the issuing firms. Further, models that display the cross-country results are included.

We find that neither for the Swedish, the US-American, nor the selected European green bond issuing companies exist a difference in valuation in the equity capital markets when compared to conventional bond issuing companies between 2015 and 2021. Furthermore, we find that a company that issues green bonds in Sweden has cheaper access to capital reflected by an on average lower WACC, which in turn reflects our finding, that green bond issuers have significantly lower average bond coupons (-0.923 percentage points) compared to corporate conventional bond issuers in Sweden. For the matched US sample and the matched EU sample, we do not find any significant difference for bond coupons between green and conventional bond issuers. Our results remain robust when excluding the financial industries for the Difference-in-Differences and multivariate regression models, as well as for changing the post-treatment period from 2021 to 2019 for the Difference-in-Differences models.

In summary, we find that the Swedish debt market is favouring corporate green bonds reflected by an on average lower coupon of green bond issuer bonds in the local debt capital market compared to conventional corporate bond issuers, however this taste is not reflected in the Swedish equity capital market in terms of long-term Price-to-Book value of the issuing firm. Further, we find an on average lower WACC of the green bond issuing Swedish firms, which is likely to reflect the on average lower coupon of Swedish green bond issuers compared to Swedish conventional bond issuers. Whilst this relationship is found for the Swedish market, there seems to exist no significant difference in coupon between green and conventional bonds for the selected European countries and the US.

1.5. **Contributions**

Due to the relatively young green finance market, there is a general lack of research in this specific field. In detail, previous studies focus on the municipal green bond markets (Karpf & Mandel, 2017; Baker et al., 2018; Zerdib, 2019; Larcker & Watts, 2020), whilst only a few investigate the corporate green bond markets and the effect of green bonds on the firm-level of the issuing company (Flammer, 2021).

Further, there is a specific gap in the literature for comparing green bond issuances across countries and explaining the differences between green and conventional bonds and their issuing firms on a country level. So far, green bonds have mainly been studied for the US market as well as in a pooled worldwide manner across borders (Flammer, 2021).

Moreover, there are only a few papers that look at the long-term effect of green bond issuances and stock performance and there exists contractionary evidence for whether green bonds are priced at a premium or a discount (Karpf & Mandel, 2017; Baker et al., 2018; Zerdib, 2019; Larcker & Watts, 2020; Flammer, 2021). Further, we investigate the influence of green bond issuances on the average coupons of all bonds outstanding of a given firm, which has so far not been studied. In detail, this allows us to understand the potential spillover effects of the anticipated green bond signal on the firm-level of the issuers.

1.6. **Paper Structure**

The paper is structured in the following way. We start by giving a brief review of the empirical results within the green bond literature focusing on the corporate motivation for green bond issuances and the coupon of green bonds in the debt capital markets. In the subsequent chapter, the applied theories are explained, followed by the development of our hypotheses. This section is followed by a description of the sample including an explanation of how the data is retrieved, some facts about green bonds derived from the data and a variable definition section defining dependent, explanatory and control variables. The section is ending with a display and description of common summary statistics. The methodology section is followed, in which we first introduce our overall scientific approach. Then, the choice of methods is explained in detail, specifically for the Difference-in-Differences approach and the multivariate regression models. In the same section, the matching methodology is explained as well as several statistical tests that include further explained implications for our models.

In the following section, empirical results for the Difference-in-Differences models and the multivariate regression models are summarized in the first part. The section ends by revisiting our formulated hypotheses, subsequently rejecting, or accepting them. The subsequent analysis section includes the analysis of the main models split into indications for the equity and debt capital markets. This section is finalized with an analysis of the weighted average cost of capital and possible connections to the indications derived from the findings for the equity and debt capital markets. The next chapter includes robustness tests for the main models of this study, excluding the financial industries and changing the post-treatment period for the Difference-in-Differences analysis from 2021 to 2019. This section is followed by a chapter dedicated to the main limitations of the study. Finally, the paper ends with a conclusion, in which we summarize the findings of the analysis, followed by suggestions for future research and stakeholders.

2. Literature Review

This chapter gives an overview of the empirical literature within the field of green bonds, split into the topics of corporate motivation for green bond issuances and the pricing of green bonds.

2.1. **Corporate motivation for green bond issuances**

Only recently scholars started to investigate the reasoning for why corporates issue green bonds. In arguably the most comprehensive paper so far, specifically about *corporate* green bonds, Flammer (2021) aims to answer this question. Flammer argues that, following mathematical optimization theory, a company should naturally prefer conventional bonds as this would be the less constraining option compared to green bonds, for which the proceeds are strictly tied to exclusively green projects. To explain why firms, choose to issue green bonds instead of conventional bonds, Flammer is using a sample of 565 green bonds of international public firms issued between 2013 and 2018. She finds that companies are using green bonds as a signal of their environmental commitment to fill an information gap for investors. This environmental commitment information gap has previously been found by Lyon and Maxwell (2011) and Lyon and Montgomery (2015). In detail, Flammer (2021), as well as Tang and Zhang (2020), find significant positive abnormal returns for the announcement of green bond issuances. These findings are in line with papers that find a positive stock market reaction to a company's eco-friendly behaviour (Klassen & MyLaughlin, 1996; Edmans, 2011; Flammer, 2013; Nagy, Kassam & Lee, 2016; In, Park & Monk, 2019).

Further, Flammer (2021) finds that corporate green bond issuers improve their environmental performance post-issuance. However, Flammer points out that the direct causal effect of the green project financed by the green bond and the material environmental improvement for instance in form of improved environmental rating or CO_2 reduction is weak as the average green bond issue size of her sample is 0,008% in comparison to the issuer's asset size. Instead, Flammer argues it would be fair to assume that the effective environmental improvement of the issuing parent reflects the overall environmental commitment of the firm, supporting the signalling theory further.

In this study, we mainly build on Flammer's findings for the signalling theory. Specifically, we argue that if the issuance of green bonds serves as a credible signal for a firm's environmental commitment without being the main driver for environmental improvement (i.e., CO_2 reduction), it would be fair to assume that there is a positive long-term effect on the stock price of a company that issued a green bond. This effect would reflect the favourable market reaction to a credible signal of environmental corporate commitment in form of a green bond.

The superior stock price performance of green stocks compared to conventional stocks has additionally been investigated by Pastor et al. (2021). In detail, they analyse the implications of past performance for future performance of green assets in mainly the US between 2012 and 2020. They find that the positive stock market reaction towards green bonds and green stocks does not reflect investors' expectation of higher returns but increases in environmental concerns among the investors. By using the media index defined by Ardia et al. (2021), Pastor et al. observe a steady increase in climate concerns amongst the population within their period of analysis. Further, they find that bad news about climate change triggers green stocks to outperform conventional stocks. Counterintuitively, they find evidence for the equal performance of green and conventional stocks when they simulate no release of "bad climate news". This discovery leads Pastor et al. (2021) to believe that it is hard to predict future stock performance based on past performance as the performance seems to be dependent on external factors such as the societal perception of climate change urgency.

This relation between societal sensitivity towards environmental concerns influenced by external media releases and green stock performance inspires us to compare local textualities in this study. Specifically, we use Pastor et al.'s (2021) findings to argue why it would be interesting to look at the performance of green bonds and their issuing companies' price to book performance within different countries. Specifically, Sweden's society's arguably stronger awareness of environmental issues due to education and activism could be correlated with a more favourable attitude/taste towards green bond issuing companies, reflected by higher valuations in the equity market and lower coupons in the debt market (Hansson, 1993; Breiting & Wickenberg, 2010).

Fama and French (2007) suggest that assets are priced according to investors' tastes, thus indicating that investors' taste for environmental friendliness should be reflected in the stock price of a company. In line with this notion, Heinkel et al. (2001) find that the stock prices of polluting firms are lower than non-polluting firms' stock prices, which results in a higher cost of capital for polluting firms. Counterintuitively, some studies suggest that lower corporate environmental impact results in a lower cost of equity capital (Heinkel et al., 2001; Chava, 2014). These findings would suggest a connection between the pricing of green bonds or/and the valuation of the green bond issuers and the weighted average cost of capital of the issuing firms.

2.2. **Pricing of green bonds**

Flammer (2021) finds no significant difference between the pricing of green and conventional bonds in her sample. In line with Flammer (2021), Larcker & Watts (2020) additionally find no evidence for a discount, or a premium of green compared to conventional bonds. Those findings are in stark contrast to previous findings in the field of green bond pricing, as this suggests that investors are not willing to trade off wealth for investments in environmentally friendly projects.

In contrast, several studies suggest that there exists a premium[3] for green bonds. When investigating 2083 US municipal and 19 corporate green bonds issued between 2010 and 2016, Baker et al. (2018) find that green bonds are issued at a premium compared to conventional bonds. In a sample of 1065 international green bonds issued between 2013 and 2017, Zerbib (2019) additionally finds a premium of green bonds compared to conventional bonds. And when Karpf & Madel (2017) use a sample of 1880 green US municipal bonds, they also find a premium of green bonds compared to conventional bonds.

[3] Premium here and throughout this paper is defined as lower yields or coupons compared to conventional bonds.

Further studies, that investigate the relationship between social responsibility and the cost of capital of firms suggest that superior performance on corporate social responsibility leads to better access to finance, among other reasons due to reduced information asymmetry (Ghoul et al., 2011; Edmans, 2011; Cheng et al., 2014). Those findings, in contrast to Flammer's (2021) and Larcker's and Watts's (2020) findings, would suggest that investors are willing to trade off wealth for environmental projects if one would assume the same relation between environmental activism and the cost of capital as for social responsibility and the cost of capital.

3. Theory and Hypothesis Development

This chapter starts by introducing the main theories that build the base for our analysis. Subsequently, we develop and state our 6 hypotheses.

3.1. **Information Asymmetry**

Information asymmetry is a commonly used theory in economics to explain the rationale behind the behavior of market participants and other involved parties. The occurrence of information asymmetry can simply be put as two parties holding different, and different amounts of information, hence the name asymmetry. This problem exists between "those who hold that information and those who could potentially make better decisions if they had it" (Connelly et al., 2011). An example would be a creditor not willing to extend a loan to a counterparty as it doesn't have information about the debtor's ability to repay the loan. If the debtor can cover debt repayments without any problem, then the debtor holds information that would allow the creditor to make better decisions if they had it.

The problem of information asymmetry is not static, meaning it could be mitigated but it often comes at a cost. In the example of information asymmetry between creditor and debtor, the creditor could do credit checks on the debtor, which can be costly and time-consuming, thus generating transaction costs. Closer related to this study, information about a firm's environmental initiatives might not always be public information as it's not legally required to be reported to the same extent as financial reporting, thus investors seeking to invest sustainably would be better off making decisions with this information. This could potentially be mitigated through signalling, which will be explained in more detail in the following section about signalling theory.

3.2. **Signalling Theory**

The signalling theory can be put as a situation where two parties have different amounts of information. To bridge the gap of information asymmetry, one can with the signalling of their actions, portray an image the counterparty can use to fill the blanks. The authors of the article "Signalling Theory: A Review and Assessment" use an analogy of a football coach arriving at prospective schools in a hummer limousine to give the impression of coming from a wealthy and resource-rich environment (Connelly et al., 2011). This example portrays the potential football recruits as the party with less information and the coach as the counterparty wanting to bridge the gap by signalling an image of a good and wealthy football team, by which the potential recruits can be impressed.

Moreover, the use of signalling is an attempt to some extent mitigate information asymmetry without directly providing further information. The indirectness of the information leaves room for interpretation (Connelly et al., 2011), meaning that it's up to the receiver of the signal to process and interpret it, potentially very different from the sender's intentions.

An example of the potential for different interpretations can be made using the hypotheses Flammer is testing in her paper "Corporate green bonds" to connect it to this paper and green bonds. The first hypothesis Flammer is testing is that firms might use green bonds as a signal for environmental commitment, which would be the preferred perception for the sender of the signal. However, the other party or receiver of the signal, which in this case would be the investors, might perceive it differently than intended. Flammer's second hypothesis, that firms might issue green bonds with the intent of greenwashing is a good example of how investors could perceive the usage of green bonds instead, showing how the same action or created setting, in this case, the usage of green bonds can be interpreted very differently.

3.3. Hypothesis development

According to the signalling theory, the issuance of green bonds is a credible signal for the environmental commitment of the issuing company (Flammer, 2021). Investors reward companies with a sustainable strategy, which is reflected in the company's stock price (Klassen & MyLaughlin, 1996; Edmans, 2011; Flammer, 2013; Nagy, Kassam & Lee, 2016; In, Park & Monk, 2019; Flammer, 2021). Further, the stock price of a company reflects the taste of investors beyond the common reason of expected high returns on investments (Fama & French, 2007). Consequently, investors' tastes for environmentally-friendly investments should be reflected by a higher stock price of companies that send a credible signal of environmental commitment (in our case, the signal is the green bond issuance). This taste, respectively for environmental friendliness, responds positively to high exposure to environmental concerns (Ardia et al., 2021; Pastor et al., 2021).

Commonly, previous papers such as Flammer's study from 2021, use the stock price to measure green bonds' effect on investors (equity market), however, it is done from the perspective of the issuance event. Rather than focusing on the momentarily reaction of the equity market the focus of this study lies on the long-term effect, hence we choose a similar measurement yet not the same. Instead, by using the Price-to-Book ratio rather than solely using stock prices we get a relatable and long-term variable. This allows us to compare the equity markets valuation of a green bond issuing firm to a conventional bond issuing firm over time.

Further, different countries have different levels of exposure to environmental concerns communicated through country-specific institutions such as the government or media (Ardia et al., 2021). Thus, a country with an on average higher exposure to environmental concerns on the society level could be expected to have a higher taste for sustainable investments in the local equity market, which could be reflected in an on average higher valuation of bond issuing firms. Building on this train of thought, the following first two hypotheses are devloped:

H1: Green bond issuing firms are valued differently from conventional bond issuing firms long-term.

H2: If any, this valuation difference is dependent on the country of issuance.

Further, the same reasons explained before introducing H1 and H2 could suggest a similar trend for the respective debt capital markets of the countries. Thus, investors in different countries could be more or less willing to trade off wealth for investments in environmentally friendly projects, suggesting that there is a difference in bond coupons between green and conventional bonds dependent on the countries of issuance. Whilst this difference has been found between green and conventional bonds (Karpf & Madel, 2017; Baker et al., 2018; Zerdib, 2019; Baker et al., 2022), it has so far not been connected to the country-level. Building on this, the following two hypothese are developed:

H3: The average coupon of bonds is different between green bond issuing and conventional bond issuing firms.

H4: If any, this coupon difference is dependent on the country of issuance.

Consequently, the different costs of capital, either through the equity or debt capital markets, if any, could be reflected in a difference in WACC between the green and conventional bond issuing firms. This difference, in turn, could be expected to be different depending on the country of issuance due to the different environmental attitudes at the country level. Hence, the final two hypotheses are defined:

H5: Green bond issuing firms have a different cost of capital compared to conventional bond issuing firms.

H6: If any, this difference in cost of capital is dependent on the country of issuance.

4. Data and sample description

This chapter contains a description of the sample as well as the sample retrieval. Following, a selection of sample characteristics of the bond data at the firm level as well as the environmental performance at the country level are illustrated by various figures. These facts about the construction of our sample partly serve as motivation for choices made in our methodology as well as analysis. Finally, we explain our motivation for included variables and finish with a display of our summary statistics as well as a correlation matrix.

4.1. Sample Description/ Data Retrieval

The dataset in this paper was created by compiling data from both Bloomberg and FactSet. Data on bonds were collected through FactSet, filtered for all corporate bonds issued between January 1st 2007 and April 6th 2022 issued in Europe and the United States. Furthermore, only bonds with a yield to maturity greater than 0 were considered since we want to study the difference in yields it serves no purpose to include bonds with no yield. Data for the price to book ratio and control variables were collected using Bloomberg's equity screening tool. The subset of companies was filtered to include the 5000 largest firms (by market capitalization) from the NYSE stock exchange representing the U.S market. For Europe, Germany, France, Italy, Spain, and the Netherlands were used as representatives for the European market as these are the most prominent green bond issuers in Europe, these were also sorted by market cap and the 5000 largest firms were included. Lastly, all 1052 public companies listed in Sweden were included in the sample, yielding an initial total sample size of 11052 firms.

In this paper, multiple subsets of samples were constructed based on the original dataset, primarily one for a Difference-in-Differences regression and another for the multivariate regressions. The sample for the Difference-in-Differences regression was created by merging bond data from FactSet with price-to-book ratio data from the Bloomberg terminal, using the company ticker as a point of reference when matching data. Following, all the firms that did not issue bonds were dropped, to keep the sample comparable, leaving us with 1797 firms. The sub-sample for the multivariate regression models was constructed by matching companies and their respective data with some of the bond data from FactSet to distinguish green bond issuers from conventional bond issuers. Again, companies with no bond issues were dropped along with companies that had a price to book ratio of 0 as well as firms with an average coupon of 0. Leaving us with 1753 firms in the multivariate regression sub-sample.

To cope with outliers that could potentially distort the results of our models in terms of not being representative of the population, all variables are additionally Winsorized on the 1st and 99th percentile, since extreme values for all included variables are found. Consequently, leaving 1731 firms in total, of which 1557 firms are conventional and 174 are green bond issuers. Allocated to the different regions of interest, the sample includes 89 Swedish, 1264 US and 378 other EU companies. Divided by type of bond issuance and country, the sample consists of 62 conventional and 27 green bond issuing Swedish firms, 1192 conventional and 72 green bond issuing US firms, and 303 conventional and 75 green bonds issuing EU firms.

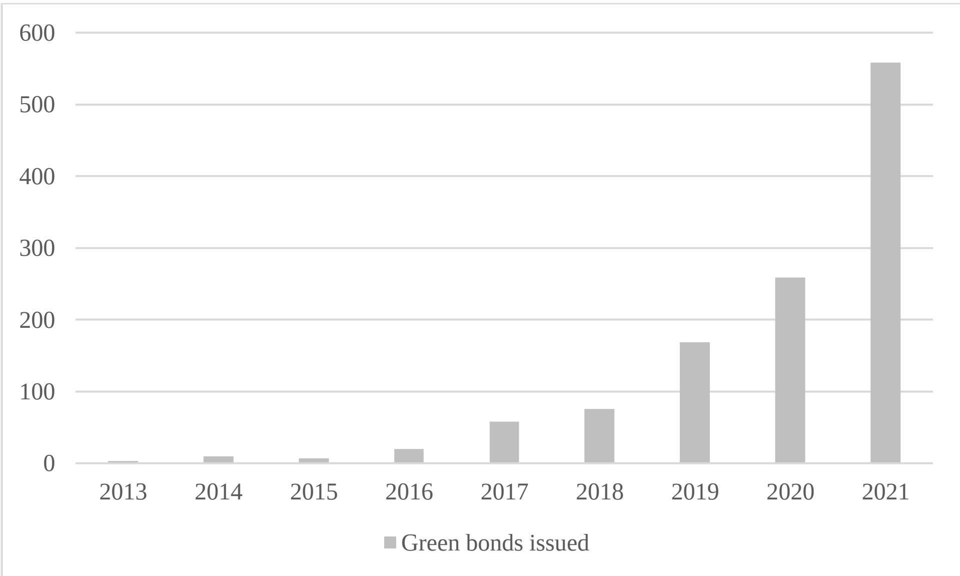
Finally, the data for the country-level variable, Environmental Performance Index, was retrieved from the Socioeconomic Data and Applications Center (SEDAC), a data center in NASA's Earth Observing System Data and Information System (EOSDIS).

4.2. **Characteristics of the sample**

Figure 1 displays the absolute amount of green bonds issued in our selected regions. When looking at the years, it is noteworthy that for our sample there were no green bonds issued before 2014. This reflects that the first issued green bonds in Europe were municipal bonds and not corporate (World Bank, 2021). As mentioned in the introduction and as explained in the literature review, this is arguably the main reason why the field of corporate green bonds is so far relatively unexplored. In contrast, Figure 2 displays conventional as well as green corporate bonds, issued between 2013 and 2021. Here, we can see that conventional bonds remained relatively steady in terms of total issuances year over year between 2013 and 2016.

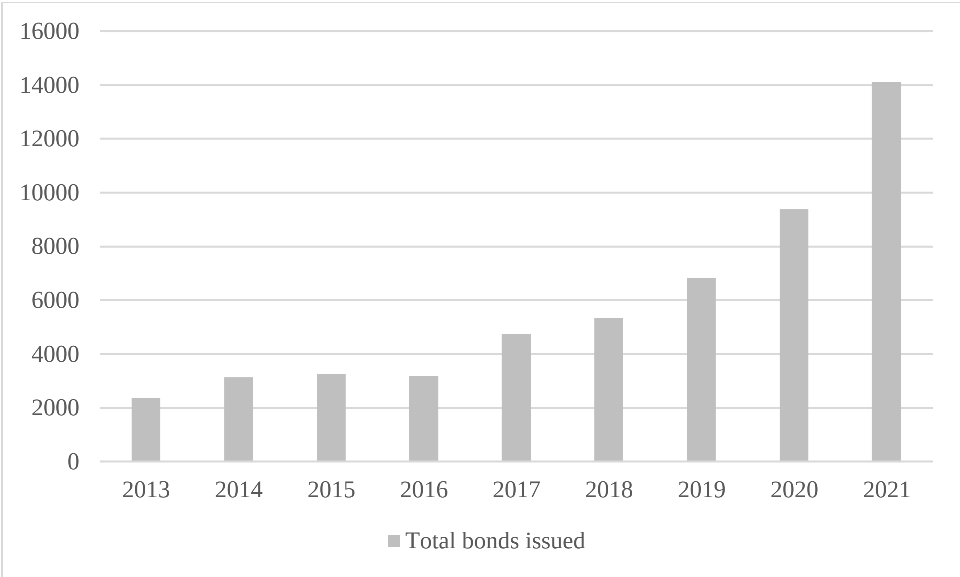
From 2016 to 2021, Figure 2 shows that the total amount of bonds issued strongly increased year over year. This stark increase is more dramatic when looking back at Figure 1 when only focusing on green bonds issued in our sampled regions. The dramatic year over year increase reflects the increasing popularity of green bonds amongst public companies. This development over time leads us to focus on the years between 2015 and 2021 when analysing corporate green bond issuances.

Figure 1: Corporate green bonds issued in Sweden, Western Europe, and the US between 2013 and 2021



Note: Figure 1 displays the total amount of corporate green bonds issued year over year from 2013 to 2021. The issuances are limited to the sampled regions Sweden, the US, and Western Europe (Germany, The Netherlands, France, Spain, and Italy).

Figure 2: Corporate green and conventional bonds issued in Sweden, Western Europe, and the US between 2013 and 2021



Note: Figure 2 displays the total amount of corporate conventional as well as green bonds issued year over year from 2013 to 2021. The issuances are limited to the sampled regions Sweden, the US, and Western Europe (Germany, The Netherlands, France, Spain, and Italy).

When looking at the different industries in our sample data, there are several interesting characteristics that we can derive. In detail, when looking at Figures 3 to 5, the industry distribution of the green bond issuing companies between 2015 and 2021 are displayed. Figure 3 shows the industry distribution for Sweden. Here, Biotech and Pharma is with 15 green bond issuing firms the largest industry followed by 3 companies within Asset Management and 3 companies in Chemicals. In total, the green bond issuing companies are distributed within 7 different industries. Figure 4 display the industry distribution for Western Europe (Germany, The Netherlands, France, Italy, and Spain). Asset Management is with 15 firms the largest industry followed by 3 companies within each Asset Management and Chemicals. In total, the green bond issuing companies are distributed within 13 different industries within our western European countries. Figure 5 displays the industry distribution for the sampled green bond issuing companies in the US. Here, Biotech and Pharma is being with 21 firms the largest industry followed by 4 companies within each Utilities and Chemicals. In total, the green bond issuing companies are distributed within 15 different industries in the US. In summary, within all regions, the green bond issuing industries are relatively diverse, whilst within each region, one dominating industry is the main issuer. For Sweden and the US, this is the Biotech and Pharma industry, whilst in Western Europe, it is Asset Management. This concentration of issuing firms within one industry might serve as a hazard for the trustworthiness of our results, as some firm-level effects might reflect industry characteristics rather than the characteristic of being a green bond issuing firm. Thus, we made several choices described in the following methodology chapter to overcome this problem, such as using clustered robust standard errors by industry. Further, the finance industry is somewhat special compared to other green bond issuing industries as the proceeds are indirectly used for green loans and not necessarily for green projects executed by the issuer. This might be problematic as the main issuing industry for Western Europe is Asset Management in our sample. Consequently, the robustness of our results are enhanced by excluding the finance industries. This will later be revisited in the chapter 8.

Figure 3: Green bond issuing industries in Sweden 2015-2021

Note: Figure 3 illustrates the total amount of green bond issuing firms per industry in Sweden between 2015 and 2021. Industries are as defined by Bloomberg's four-digit Industry Classification System.

Figure 4: Green bond issuing industries in Western Europe 2015-2021

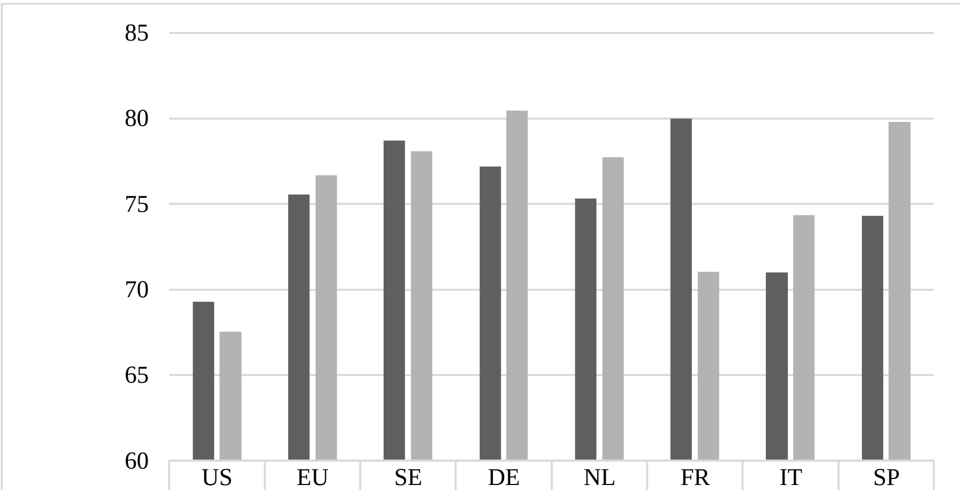
Note: Figure 4 illustrates the total amount of green bond issuing firms per industry in Germany, The Netherlands, France, Italy, and Spain between 2015 and 2021. Industries are as defined by Bloomberg's four-digit Industry Classification System.

Figure 5: Green bond issuing industries in the US 2015-2021

Note: Figure 5 illustrates the total amount of green bond issuing firms per industry in the US between 2015 and 2021. Industries are as defined by Bloomberg's four-digit Industry Classification System.

Finally, figure 6 displays the distribution of the EPI for the respective countries of interest. Out of all included countries, we can see that in 2020 the US is scoring the lowest with a score of 69.3. The average of the main green bond issuing European countries is 75.56 for the EPI in 2020. Among the included European countries, France has with 80 the highest score of all included European countries in 2020 and Italy has with a score of 71 the lowest in 2020. Of the three regional groups that are used for a country comparison in this study, Sweden has with a score of 78.7 the highest EPI in 2020. Compared to 2014, the US increased the strongest from a previous score of 67.52. Further, whilst the score increased for both the US and Sweden, it decreased for the average of the included European countries. That is due to the decrease of the score for all included European countries except for France, which has the strongest increase out of all included countries from 2014 to 2020.

Figure 6: Environmental Performance Index



	US	EU	SE	DE	NL	FR	IT	SP
EPI 2020	69.3	75.56	78.7	77.2	75.3	80	71	74.3
EPI 2014	67.52	76.684	78.09	80.47	77.75	71.05	74.36	79.79

Note: Figure 6 illustrates the Environmental Performance Index by Wendling et al. (2020) divided into the regions that are included in this study. EU is an average of Germany, The Netherlands, France, Italy, and Spain. For each region, the EPI is displayed for the years 2014 and 2020.

4.3. **Variable definition**

4.3.1. **Dependent variables**

In this paper, three different dependent variables are selected depending on the regression that is tested. For the Difference-in-Differences model, Price-to-Book is used as the dependent variable, it is measured by taking the firm's stock price at a point in time and dividing it by the book value per share to obtain the price to book ratio. The formula looks as follows:

$$Price\ to\ book = (Stock\ price)/(Book\ value\ per\ share)$$

where:

$$Book\ value\ per\ share = (Total\ assets - Total\ liabilities)/Shares\ outstanding$$

For the multivariate regression models, both WACC and average coupon rate are tested as dependent variables. WACC is the weighted average cost of capital reported for firms in the Bloomberg terminal's equity screening tool and is reported in percentage. WACC is affected by both equity capital markets and debt capital markets which makes it an interesting variable to study as it is connected to the other regressions in this paper. The WACC formula is as follows:

$$WACC = \frac{E}{V} * R_e + \frac{D}{V} * R_d * (1 - T_c)$$

Where *E* represents the firms market value of equity, *D* represents the firms market value of debt, *V* represents *E*+*D*, R_e represents the cost of equity, R_d represents the cost of debt, T_c represents corporate tax rate and $(1 - T_c)$ makes up the tax shield.

The average coupon rate is calculated as an average of the coupons for outstanding bonds connected to each ticker. The variable is based on the reported coupon rate from FactSet which represents the annual interest rate the issuer is obliged to pay to bondholders. The average coupon rate per firm in combination with the green bond dummy allows us to show the effect green bonds have on the firm's average coupon rate. The reason could be either that green bonds tend to have on average higher or lower coupon rates compared to conventional bonds, hence dragging the average coupon rate up or down. Or the green bonds could affect the coupon of the conventional bonds as well, due to a spillover and signalling effect. Possibly both, thus it is of relevance to study the average coupon rate per firm including both green and conventional bonds.

4.3.2. **Explanatory variables**

The main explanatory variable for this paper is green bond issuance. It is a dummy variable indicating 1 if a firm has at least one green bond outstanding and 0 if it only has conventional bonds outstanding.

4.3.3. **Control variables**

Previous studies referred to in the literature review do not use leverage as a control variable, one reason could be that they use a sample containing municipal bonds, hence it does not make sense to control for it. On the contrary, we exclude government bonds and municipality bonds and use strictly corporate bonds, thus leverage becomes more relevant. Furthermore, Flammer (2021) uses leverage, although only for matching her control sample, which implies that it commonly is expected to affect bond yields. It is also mathematically motivated as it affects the cost of capital in terms of WACC due to the construction of the WACC formula. Thus, it is of high importance for us to capture this effect in our models as well, hence the Debt to Assets ratio was used as a control for leverage. Debt to Assets simply takes total debt and puts it in relation to the total assets.

A relationship between firm size and stability has been established by economists already in the 1960s (Ferguson, 1960). More stable firms impose less risk to bond investors, which should be reflected in the bond coupons in effective markets. Thus, we aspire to control for this effect by including a control variable for size. It is measured by multiplying the firm shares outstanding with the current stock price to get the current market capitalization, which is used as a proxy for size.

A control variable at the country level, the Environmental Performance Index by Wendling et al. (2020) is included. The index is published every two years, which is why the published data from 2020 and 2014 respectively is used, as the Index does not change substantially on a year over year basis. Moreover, the index from 2020 includes most of the published data from the years 2017 and 2018, which is why the dramatic drop in air pollution due to the Covid-19 pandemic is not reflected in the score, which in turn serves the purpose of this study, as this effect would not reflect the environmental awareness of a country but the reaction to external, global events. The index includes 32 performance indicators within 11 issue categories[4] to score 180 countries on environmental health and ecosystem vitality. The index is measured on a scale from 0 to 100, with 0 being the worst and 100 being the best. It is thought to mirror environmental policy implementation at a national scale, which is why we utilize the index as a proxy for environmental awareness on a country and society level. The environmental

[4] The issue categories include Air Quality, Sanitation & Drinking Water, Heavy Metals, Waste Management, Biodiversity & Habitat, Ecosystem Services, Fisheries, Climate Change, Pollution Emissions, Agriculture and Water Resources.

awareness of a country is likely to influence the relationship between the average coupon and the green bond dummy variable, hence the index is used as a proxy for environmental awareness on a country level. Since a country with higher environmental awareness is assumed to have more investors with a taste for green investments, which could be reflected in a higher valuation of green bond issuers and lower coupon of bonds for the green bond issuers, we decide to measure the EPI score as a control variable for all models. When controlling for the EPI of a country, we can make sure that the green bond dummy variable (and its respective green signal) is affecting the dependent firm-level outcomes such as PB value, average bond coupon and WACC, and not predominantly by the environmental performance of the respective countries.

4.4. Summary statistics

Table 1 displays the summary statistics for the sample divided by green bond conventional bonds, as well as for the whole sample. The dependent variable of the DiD model, Price-to-Book, has a mean of 4.44 for the whole sample. For green bond issuers, the mean PB is with 2.76 lower than the mean PB of conventional bond issuers, which is 4.65. When looking at the dependent variables of the multivariate regression models, table 1 displays that the WACC has a mean of 7.73 for the whole sample implying that the average cost of capital within the sample is 7.73%. Furthermore, the WACC of the sampled firms ranges between 1.48% and 14.31%. Whilst green bond issuers have a slightly lower mean WACC of 6.88% compared to 7.83% of conventional bond issuers, there is no big difference between the two groups. The second dependent variable average coupon rate has a mean of 3.81% for the whole sample. Although it ranges between 0.0625% and 12% the standard deviation remains moderate at 1.85. Interestingly, green bond issuers have with 2.78% a lower mean bond coupon rate compared to the mean coupon rate of 3.93% of conventional bond issuers. This could be a reflection of the maximum coupon rate of 12% of conventional bond issuers, which is roughly double the maximum coupon rate of 5.88% of green bond issuers.

When looking at the remaining variables, table 1 displays that the mean total asset size of all issuers is 21717.31m USD. Here, green bond issuers are with a mean of 47404.48m USD larger than the sampled conventional bond issuers, which have a mean total asset size of 18617.96m USD. The same can be observed for the total debt. In detail, the mean total debt of the whole sample is 7555.31m USD, whilst for green bond issuers, the mean total debt is with 15526.89m USD larger than for conventional bond issuers, which have a mean total debt of 6591.93m USD.

However, the mean Debt-to-Assets of the whole sample is 39.83% for the whole sample and does not diverge as much when comparing the two groups of green (37.95%) and conventional (40.05%) bond issuers.

Further, the ROA for the whole sample of firms is with a mean of 4.38% representative of both, green (4.92%) and conventional (4.31%) bond issuing firms. The same holds for the ROE for the whole sample with a mean of 15.10%, with a slightly higher ROE for the green (16.43%) and slightly lower ROE for the conventional (14.92%) bond issuers. The mean market capitalization of the whole sample is 24976.39m USD, which is closer to the mean of the conventional bond issuer, which is 23913.50m USD than to the mean market capitalization of the green bond issuer, which is 33793.94m USD.

Table 1: Summary Statistics for the sampled green and conventional bond issuing companies in the US, Sweden, Germany, The Netherlands, Spain, France, and Italy

Variable	Green bond dummy	N	Mean	Median	SD	Min	Max
WACC (%)	0	1500	7.83	7.85	2.12	2.48	14.31
Total Debt (mUSD)	0	1523	6591.93	2730.00	11653.64	4.07	80350.00
Total Assets (mUSD)	0	1523	18617.96	6870.00	34667.57	44.59	256560.00
Debt-to-Assets (%)	0	1523	40.05	38.25	19.00	5.30	107.15
ROA (%)	0	1514	4.31	4.31	9.74	-37.66	34.48
ROE (%)	0	1407	14.92	13.07	32.18	-103.57	148.82
PB	0	1429	4.65	2.60	6.53	0.41	42.66
Market Capitalization (mUSD)	0	1557	23913.50	5315.00	52753.12	17.05	341680.00
Average Coupon (%)	0	1557	3.93	3.81	1.88	.0625	12.00
WACC (%)	1	171	6.88	6.62	1.93	2.48	14.31
Total Debt (mUSD)	1	173	15526.89	7385.00	20586.92	4.07	80350.00
Total Assets (mUSD)	1	173	47404.48	19580.00	67848.61	45.80	256569.00
Debt-to-Assets (%)	1	173	37.95	39.79	15.76	5.30	107.15
ROA (%)	1	172	4.92	4.44	5.92	-37.66	27.35
ROE (%)	1	170	16.43	12.00	18.75	-20.26	145.57
PB	1	170	2.76	2.05	3.81	0.41	39.11
Market Capitalization (mUSD)	1	174	33793.94	12615.00	57173.61	33.97	341680.00
Average Coupon (%)	1	174	2.78	2.94	1.17	0.60	5.88
WACC (%)	Total	1671	7.73	7.71	2.12	2.48	14.31
Total Debt (mUSD)	Total	1696	7555.31	2960.00	13200.31	4.47	80350.00
Total Assets (mUSD)	Total	1696	21717.04	7540.00	40552.43	44.59	256560.00
Debt-to-Assets (%)	Total	1696	39.83	38.66	18.68	5.30	107.15
ROA (%)	Total	1686	4.38	4.32	9.40	-37.66	34.48
ROE (%)	Total	1577	15.10	12.98	30.92	-103.57	148.82
PB	Total	1599	4.44	2.48	6.31	0.41	42.66
Market Capitalization (mUSD)	Total	1731	24976.39	5785.00	53311.41	17.05	341680.00
Average Coupon (%)	Total	1731	3.81	3.67	1.85	0.0625	12.00

Note: This table displays the summary statistics N (total number of observed firms), Mean, Median, Standard Deviation, the Minimum as well as the Maximum for selected descriptive variables for our sampled bond issuing companies in Sweden. The Table is grouped by the Green bond dummy variable, displaying a 0 when the company is a conventional bond issuer and 1 of the company at least issued one green bond between 2015 and 2021. Total indicates the display of the two groups together. The variables included in the table are (a) WACC (weighted average cost of capital for the issuing firm, measured in percentage) (b) Total Assets (total amount of current assets of the issuing company measured in million USD) (c) Total Debt (total amount of outstanding debt of the issuing company measured in millions of USD) (d) Debt-to-Assets (total amount of outstanding debt divided by the total amount of current assets of the issuing company measured in percentage) (e) ROA (net income divided by total current assets of the issuing company) (f) ROE (net income divided by the shareholders' equity of the issuing firm) (g) PB (current stock price divided by the current book value per share of the issuing company) (h) Market Capitalization (total value of all shares of stock of the issuing firm measured in million USD) (i) Average Coupon (accumulated coupons of all outstanding bonds divided by the number of outstanding coupons per issuing company measured in percentage).

All variables are Winosrized on the 1st and 99th percentile.

4.5. **Pearson's Correlation Matrix**

Table 2 displays the correlation matrix of all our variables. As displayed in the matrix all variables except Total Assets, Total Debt and ROA are significantly correlated with the dependent variable Price-to-Book. Of the significantly correlated variables, WACC, ROE, Market Capitalization and Debt-to-Assets have a positive correlation with Price-to-Book, however, only ROE, Market Capitalization and Debt-to-Assets make sense. As a higher WACC normally isn't seen as positive, although the correlation is seemingly weak, it is questionable that it would increase the Price-to-Book ratio. Further, EPI score, Average Coupon and Green bond dummy are negatively correlated with the Price-to-Book ratio, indicating that higher EPI scores, green bonds and higher Average Coupon rates would drive down the valuation of a firm, however only the latter makes sense.

For our dependent variable Average Coupon, all variables except WACC, ROE and ROA are significantly correlated. Only Debt-to-Assets is positively correlated with the Average coupon rate, which is economically reasonable as higher leverage imposes greater risk, hence bond holders would expect a higher return on their investment. Moreover, Market Capitalization, Price-to-Book, Total Assets, Total Debt, EPI score and the Green bond dummy variable are negatively correlated with our dependent variable Average Coupon rate.

Lastly, our dependent variable WACC is significantly correlated with all variables except for the Average Coupon rate. Of the significantly correlated variables, Market Capitalization, Price-to-Book, ROE, and ROA are positively correlated. However, these correlations should be treated with caution as they do not make any sense economically. Further, Total Debt, Total Assets, Debt-to-Assets, EPI score and Green bond dummy are negatively correlated with our dependent variable WACC. Implying that as leverage goes up WACC decreases, which is in line with the mathematical implications of the WACC formula. Moreover, as the EPI score and the Green bond dummy are negatively correlated as well it seems as sustainability efforts result in a lower WACC.

A correlation table can also be used to get an indication of whether the sample has problems with multicollinearity (Brooks, 2008). Although it's difficult to say exactly at what correlation threshold one should consider multicollinearity, one should at least give attention to especially high correlations. In our sample we find two correlation pairs with considerably high correlations, firstly Total Assets and Total Debt has a correlation coefficient of 0.9153, secondly, ROA and ROE have a correlation coefficient of 0.7836. These correlations would indicate a possibility of multicollinearity within the sample, however since STATA is used for running the regressions, which automatically drops variables that cause collinearity issues, we are confident it has not compromised the results.

Table 2: Pearson's Correlation Table

	(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**	**(k)**
(a) Market Capitalization (mUSD)	1.000										
(b) Price-to-Book	0.127***	1.000									
(c) Total Assets (mUSD)	0.692***	-0.0046	1.000								
(d) Total Debt (mUSD)	0.6251***	0.0006	0.9153***	1.000							
(e) WACC (%)	0.1011***	0.1126***	-0.0968***	-0.1681***	1.000						
(f) ROE (%)	0.2302***	0.2302***	0.0978***	0.1035***	0.0851***	1.000					
(g) ROA (%)	0.2466***	0.0287	0.0927***	0.0643**	0.1518***	0.7836***	1.000				
(h) Debt-to-Assets (%)	-0.1281***	0.1158***	-0.1177***	0.0739***	-0.2769***	-0.0188	-0.1746***	1.000			
(i) EPI score	-0.1371***	-0.1027***	-0.0200	-0.0551**	-0.1832***	-0.0990***	-0.0446	-0.2101***	1.000		
(j) Average Coupon (%)	-0.1692***	-0.0494*	-0.1596***	-0.1235***	-0.0257	-0.0440	-0.0443	0.2382***	-0.3305***	1.000	
(k) Green bond dummy	0.0574**	-0.0578**	0.2201***	0.2100***	-0.1401***	0.0155	0.0201	-0.0350	0.2066***	-0.1932***	1.000

Note: Pearson's Correlation Matrix. The correlations apply to the whole sample. The variables included in the table are (a) Market capitalization (total value of all shares of stock of the issuing firm measured in million USD) (b) Price-to-Book (current stock price divided by the current book value per share of the issuing company) (c) Total Assets (total amount of current assets of the issuing company measured in million USD) (d) Total Debt (total amount of outstanding debt of the issuing company measured in millions of USD) (e) WACC (weighted average cost of capital for the issuing firm, measured in percentage) (f) ROE (net income divided by the shareholders' equity of the issuing firm) (g) ROA (net income divided by total current assets of the issuing company) (h) Debt-to-Assets (total amount of outstanding debt divided by the total amount of current assets of the issuing company measured in percentage) (i) EPI score (Environmental Performance score, country-level) (j) Average Coupon (accumulated coupons of all outstanding bonds divided by the number of outstanding coupons per issuing company measured in percentage) (k) Green bond (dummy variable that has the value of 1 if a company issued at least 1 green bond between 2015 and 2021 and 0 if a company issued only conventional bonds between 2015 and 2021)

*** p<0,01, ** p<0,05, * p<0,1

5. Methodology

In this chapter, we start by discussing the overall scientific approach of this study. We then continue to explain the applied methodology in detail by introducing the Difference-in-Differences methodology, as well as the matching methods that we used for our sample. The second part of this chapter focuses on the multivariate regression models, as well as the matching of firms for the multivariate regression models and statistical tests.

5.1. **Scientific Approach**

This paper is built upon the deductive research methodology to investigate how green bonds influence the equity and debt capital markets. The deductive method is described by Bell, Bryman & Harley (2019) as a process using previously existing theories within the field to develop hypotheses. The paper is based on the theory of information asymmetry as well as the signalling theory and is further the foundation for our hypotheses. Testing of hypotheses is suitable for this type of paper as it involves investigating relationships between various variables to find out whether they exist or not. The formulated hypotheses are then tested with both a Difference-in-Differences regression and two multivariate regressions to generate results on which conclusions can be drawn. The hypotheses will be either rejected or accepted, on which we further analyse and compare to previous empirical findings and theories to land on a conclusion (Bell, Bryman & Harley, 2019). This method is commonly used when implementing a quantitative approach, as it allows for flexibility in developing the hypotheses to study the indented area.

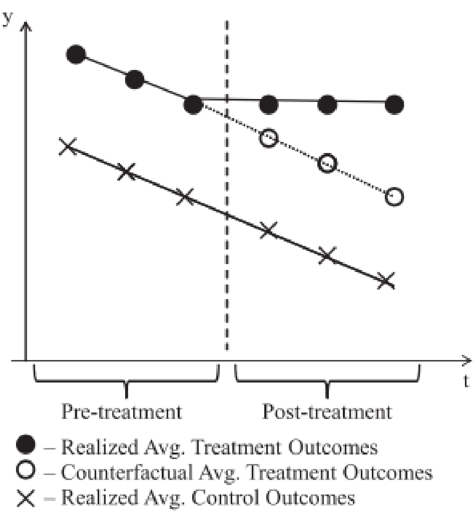
A quantitative research method is used to collect data and produce results as a foundation for conclusions made in this paper. It is described as a method of quantification and conversion of data to measurable numbers, whilst also being the commonly used approach when using a deductive research method (Bell, Bryman & Harley, 2019). Since the research in this paper is based on regression analysis, a large dataset is needed to produce statistical results and analysis of good quality. Furthermore, the chosen Difference-in-Differences and multiple regression models require quantitative data as inputs. The quantitative method is also a good and efficient method of collecting data if it’s constructed in an objective matter (Bell, Bryman & Harley, 2019), for instance, bond coupons, which is of relevance for this paper.

5.2. **Difference-in-Differences**

To compare the long-term stock performance of green bond issuers with the stock performance of conventional bond issuers in the respective countries, we decide to use a Difference-in-Differences methodology.

Several key assumptions as identified by Roberts & Whited (2013) hold for our sample design. Firstly, the zero correlation or "parallel trends" assumption can be assumed to be fulfilled. In detail, this assumption describes the condition that "in the absence of treatment, the average change in the response variable would have been the same for both treatment and control groups." (Roberts & Whited, 2013, p. 526). The following Figure from Roberts & Whited (2013) illustrates this assumption:

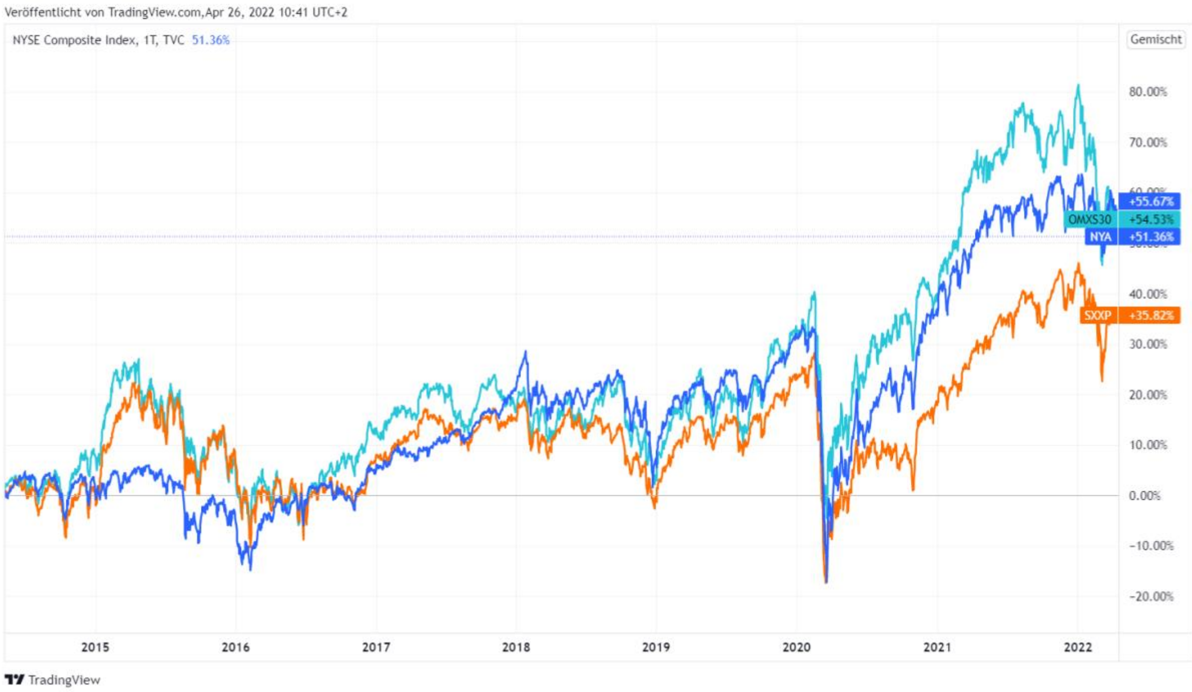
Figure 7: Difference-in-Differences Intuition; Source: Roberts & Whited (2013, p. 527)



Applied to our paper, the "Realized Average Treatment Outcomes" (illustrated by the filled black circles) are defined as the green bond issuing firms. The "Counterfactual Average Treatment Outcomes" refers to the stock price of the green bond issuing firms if they would have issued a conventional instead of a green bond. Finally, the "Realized Average Control Outcomes" refer to the stock price of the firms that issued a conventional bond between the years 2015 and 2021. The pre-and post-treatment periods would respectively refer to 2015 and 2021 in our sample.

Following Roberts & Whited's (2013) assumptions for a DiD methodology and as illustrated by Figure 7, the average parallel trend assumption of the control and the treatment group is described. This assumption beholds that, within the pre-treatment period, the control, as well as the treatment group, need to follow a parallel trend. In our case, y is the stock price, which commonly follows on average a parallel trend across industries and countries. The following Figure 8 of an international comparison of the included markets, proxied by the NYSE, the STOXX Europe 600 and the OMX Stockholm 30 index illustrates that this assumption holds for our model: (chart comparing NYSE, STOXX and Nasdaq Stockholm between 2015 and 2021)

Figure 8: Stock market trend comparison of Sweden, Europe, and the US 2015-2022



Note: Figure 8 displays in orange the STOXX 600 index as a proxy for the Western European firms, in blue the NYSE Composite index as a proxy for the US firms and turquoise the OMX 30 index as a proxy for the Swedish firms between 2015 and 2022.

In Figure 8, it is shown that the stock market trend across the US, Europe and Sweden follows on average a parallel pattern, which supports our decision to use a Difference-in-Differences methodology. Moreover, we can apply further assumptions for a DiD methodology as illustrated by Roberts & Whited (2013) figure 1. Firstly, the average outcome of the treatment and control firms must be different. This assumption is fulfilled as firms generally trade for different prices, thus making it fair to assume that there is a stock price difference between the green bond issuing firms and the conventional bond issuing firms. Second, the trend of y for the treatment and control groups is the same over time. In Roberts & Whited's (2013) illustration, y is trending downwards, whilst in our case, as displayed in Figure 8, the stock prices are generally trending upwards. Lastly, the kink occurring between the pre-and post-treatment group for the realized average treatment outcomes can be applied to our sample as, following Flammer's (2021) signalling effect of green bond issuances, the issuance should be expected to cause an immediate positive reaction of the investors. This results in an upward alteration of the trend, suddenly and long-term disrupting the pre-treatment stock price pattern of the treatment group firms. Moreover, we assume that the prerequisites for a DiD method still hold when using the Price-to-Book ratio as the variable is based on stock prices.

To measure the effect green bond issuances, have over time, the Difference-in-Differences method is utilized. It allows us to capture the Price-to-Book ratio difference between two points in time for firms that issue green bonds, whilst also comparing it to a control group (conventional bond issuers) to see if there is an actual difference, hence the name Difference-in-Differences. This method is also found in previous empirical studies within the field (Flammer, 2021), further motivating the approach. As a general regression equation example for the Difference-in-Differences method consider the following:

$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 XZ + \varepsilon$$

Where Y is the dependent variable, β represents the coefficient, X Represents the time variable, Z represents the treatment group variable, XZ is the interaction variable of $X * Z$ and ε is the error term intended to capture unobservable effects.

In this paper, we used the standard structure of a Difference-in-Differences regression equation and fitted the appropriate variables for the purpose. The dependent variable is the Price-to-Book ratio of the firms in the sample, the time variable was based on year data and the dummy indicating whether a firm has green bonds outstanding is used to separate the treatment and control groups. Moreover, the interaction term is a combination of the year and green bond dummy variable and finally, the error term is capturing unobservable effects. Consequently, the following Difference-in-Differences models that we are calling models 1, 2, 3 and 4[5] are defined:

$$Price\ to\ book = \beta_0 + \beta_1 Year + \beta_2 Green\ Bond\ dummy + \beta_3 Year * Green\ Bond\ dummy + \varepsilon$$

5.2.1. **Hausman test**

Table 3: Hausman test

Hausman test
H0: Random effects is the preferred model H1: Fixed effects is the preferred model
chi2(1) = 2.71 Prob > chi2 = 0.0997
This table includes the Hausman test, used to determine whether Random or Fixed effects is the better estimator

When estimating empirical models there are unobserved effects that the model fails to consider. To mitigate this problem and account for the unobserved effects, one can either use Random Effects or Fixed Effects (Wooldridge, 2012), thus adding robustness to the estimates. The Hausman test allows the user to estimate the better fit of either the Random Effects or the Fixed Effects model (Wooldridge, 2012). The result of the conducted Hausman test with a P-value of 0.0997 implies that we fail to reject the null hypothesis on a 5% level, meaning that both model estimates are too close to make a difference (Wooldridge, 2012). In a situation where the null hypothesis is failed to be rejected, Random Effects models are applied as they are generally more efficient in this specific case (Wooldridge, 2012). Economically, applying the random effects can further be supported considering the construction of our sample. As the included countries of issuances do not represent all countries, the effect of the issuance of green bonds could have different effects in countries that were not part of our sample. By applying random effects, we allow for the variability of the green bond effect on the firm level across countries.

[5] The different numbering of the models refers to the different geographical regions that are defined in this paper. Thus, model 1 is referring to Sweden, 2 to the US, and 3 to the selected European countries Germany, France, The Netherlands, Spain, and Italy, while model 4 is referring to the combined sample of countries listed above.

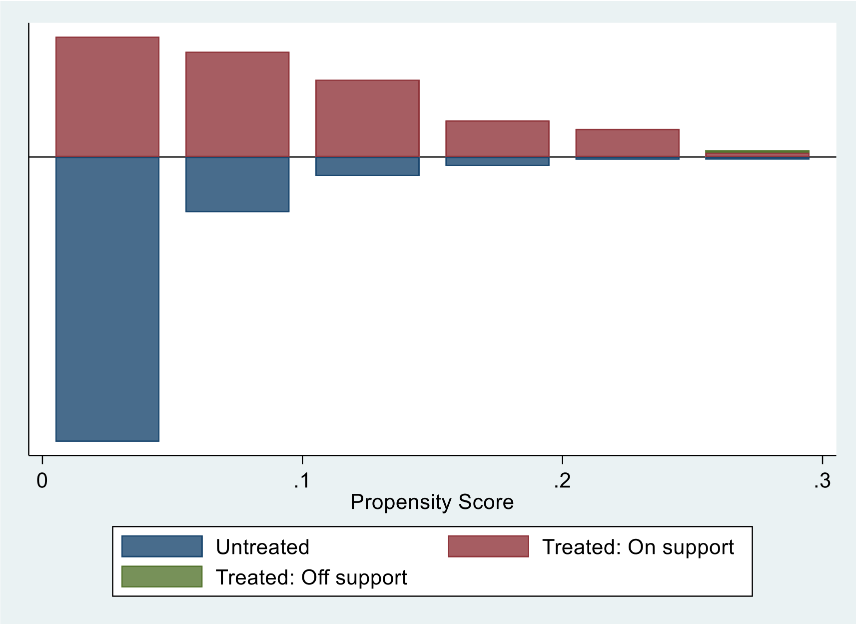
5.2.2. **Matching**

For all Difference-in-Differences models, we are using a matching methodology to create a subset of sampled firms in addition to using the whole sample[6]. As our sample consists of a much larger control group, we would like to avoid any biased interpretation when comparing a large group of conventional bond issuers with a relatively small group of green bond issuers. Further, other scholars such as Flammer (2021) use a matching methodology when comparing green with conventional bond issuing firms. Thus, we use the argument for making our DiD results more comparable with Flammer's (2021) study about corporate green bonds, as another motivation for the application of a matching methodology. As such, we are using partially the same matching variables as Flammer (2021). Further, the issue of endogeneity is addressed by applying this matching method. Since the issuance of green bonds is endogenous to firm-level developments, unobservables may influence the relationship between green bond issuance and the PB ratio. Comparing green bond issuers with similar conventional bond issuers allows us to simulate how the PB ratio would have evolved if no green bond had been issued.

We use the Propensity Score as described by Roberts & Whited (2013) to analyse the level of biasedness of our sample. In other words, we are illustrating how many green bond issuing firms are matched with similar conventional bond issuing firms. Figure 9 shows in blue the number of untreated firms (conventional bond issuers) and in red the treated firms (green bond issuers). The firms are matched based on market capitalization (in million USD), ROA, BICS and country. Figure 9 shows that no green bond issuing firm is off support, which means that at least one matched conventional bond issuer for each green bond issuer is part of the sample. The relatively balanced construction of our sample reflects that we collected the firms based on the largest market capitalization.

[6]The models using the whole sample are denoted with the letter "a" (i.e., model 1a) and the models using the matched sample with the letter "b" (i.e., model 1b). We choose to display both, matched and unmatched, results to improve transparency.

Figure 9: Propensity Score matching for DiD firm sample



Note: Figure 9 displays the amount of conventional bond issuing firms in blue (Untreated) and green bond issuing firms in red (Treated). The red (Treated) firms are "On support", which means that they are matched to the nearest conventional bond issuing firm based on market capitalization in million USD, as well as BICS. In green, the green bond issuing firms without support (without a matched conventional bond issuing neighbour firm) are displayed (no green bond issuing firm is unmatched).

5.3. **Multivariate Regression Models**

For the multiple regression, an OLS model is used with cross-sectional data. It is used to estimate the effect green bonds have on both WACC and average coupon rate. Moreover, the OLS method is commonly used and was also found in previous studies (Flammer, 2021; Pastor, 2021).

The following multivariate regression models that we are calling models 5, 6, 7 and 8[7] are defined:

$$Average\ Coupon = \beta_0 + \beta_1 Green\ Bond\ dummy + \beta_2 Debt\ to\ Assets + \beta_3 Market\ Capitalization + \beta_4 EPI + \varepsilon$$

[7] The different numbering of the models refers to the different geographical regions that are defined in this paper. Thus, model 5 is referring to Sweden, 6 to the US, 7 to the selected European countries Germany, France, The Netherlands, Spain and Italy, and 8 refers to all regions combined in one model.

Additionally, we are defining the following multivariate regression models that we are calling models 9, 10, 11 and 12[8]:

$$WACC = \beta_0 + \beta_1 Green\ Bond\ dummy + \beta_2 Debt\ to\ Assets + \beta_3 Market\ Capitalization + \beta_4 EPI + \varepsilon$$

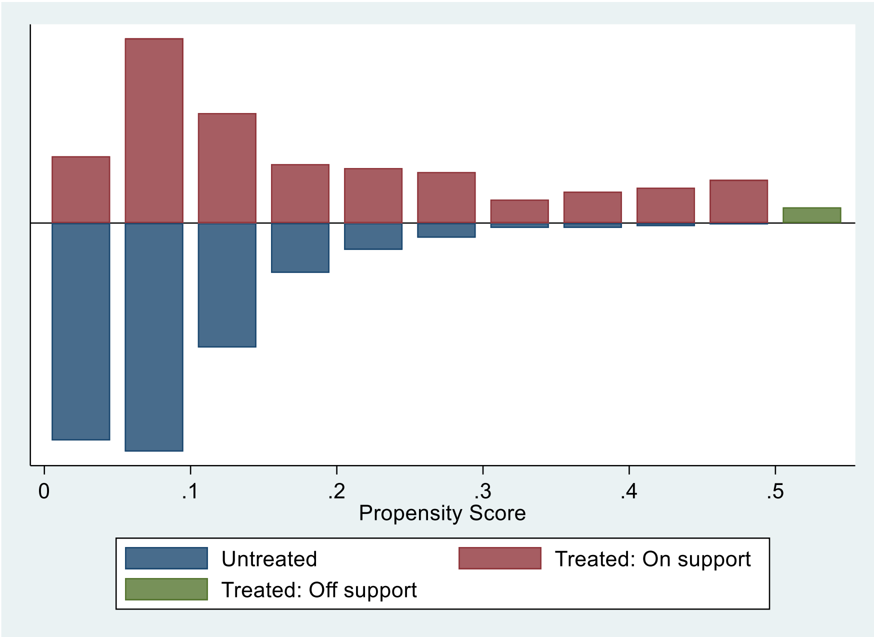
5.3.1. **Matching**

Similar to the Difference-in-Differences models, a matching methodology for the multivariate regression models is applied. Whilst the reasons for matching remain the same as mentioned under 5.2.2., we would like to stress that especially for the multivariate regression models, the endogenous character of the green bond dummy variable remains a challenge. As mentioned by Flammer (2021), the issue of unobservables influencing the firm-level and in our case as well as country-level variables might best be addressed by introducing an instrumental variable for the issuance of green bonds. However, since the issuance of green bonds is not random, it is hard to find such an instrument variable (Flammer, 2021). Thus, we rely on the matching methodology to build a comparable setting for our analysis.

However, we now match on different criteria that we precieve as more relevant for the defined multivariate regression models. As we are looking at WACC and Coupon as the dependent variables, we match the green and conventional bond issuing firms on leverage, asset size, BICS and country. Figure 10 illustrates the number of green bond issuers in red and conventional bond issuers in blue, respectively compared to each other based on the propensity score derived from the selected matching variables. Here, we have a small number of green bond issuing firms (marked in green in Figure 10) that have no matching conventional bond issuing firms. This will be reflected in the reduced number of observations in the matched models.

[8] The different numbering of the models refers to the different geographical regions that are defined in this paper. Thus, model 9 is referring to Sweden, 10 to the US, 11 to the selected European countries Germany, France, The Netherlands, Spain and Italy, and 12 refers to all regions combined in one model.

Figure 10: Propensity Score matching for OLS Sub-Sample



Note: Figure 10 displays the amount of conventional bond issuing firms in blue (Untreated) and green bond issuing firms in red (Treated). The red (Treated) firms are "On support", which means that they are matched to the nearest conventional bond issuing firm based on the total assets in million USD, market capitalization in million USD, as well as BICS. In green, the green bond issuing firms without support (without a matched conventional bond issuing neighbour firm) are displayed.

5.3.2. **Statistical tests**

An important criterion for the multivariate regression models to accurately estimate the relationship between the dependent variable and the explanatory variables is for the sample to be homoscedastic. If the sample contains heteroskedasticity the variance of the error term will be increasing as the values of the explanatory variables increase. This implies that the estimations would become less trustworthy as explanatory variables increase in value (Wooldridge, 2012). To test for heteroskedasticity in the sample a White's test was conducted with the null hypothesis being that the data is homoscedastic. In table 4 the results from the White's test are displayed. With a p-value of 0.0000 we reject the null hypothesis on the 1% level. This suggests that our data is heteroskedastic, which suggests that further adjustments need to be made for the model to accurately estimate the coefficients.

Table 4: White's test for Homoskedasticity

White's test			
H0: Homoskedasticity Ha: Unrestricted heteroskedasticity			
chi2(13) = 214.61 Prob > chi2 = 0.0000			
Cameron & Trivedi's decomposition of IM-test			
Source	chi2	df	p
Heteroskedasticity	214.61	13	0.0000
Skewness	14.14	4	0.0069
Kurtosis	2.55	1	0.1103
Total	231.30	18	0.0000

In this table, the White test is shown, used to identify heteroskedasticity in the data.

To mitigate the problem of heteroskedasticity, cluster-robust standard errors are introduced to the estimation models. Allowing us to adjust the standard errors and hindering the multivariate regression models from being rendered useless, meaning the method can still be used to estimate accurate coefficients (Wooldridge, 2012). Furthermore, the standard errors are clustered by Bloomberg's four-digit industry classification system (BICS), to control for unobserved effects caused by industry (Wooldridge, 2012).

6. Empirical results

In this chapter, we will start by introducing our empirical results from the Difference-in-Differences model and the multivariate regression models. Following, we will revisit our hypotheses and accept or reject them based on the empirical results.

6.1. **Model results**

6.1.1. **Difference-in-Differences model**

In table 5 we display the results of the Difference-in-Differences model, with and without propensity score matching. Model 1a isolating the Swedish market produced no significant results. Model 1b as such, generated no significant results either when propensity score matching was introduced. Moreover, model 2a yielded no significant results for the US market, and when propensity score matching was introduced in model 2b, the results yielded no significance either. Like the results from the US market, the European market did not yield significant results, neither with nor without propensity score matching, as can be seen in the results for models 3a and 3b. Moreover, estimating the relationship for the whole sample including both the Swedish market, the US market and our selection of the European market, we did not find any significant results either. This includes both the estimate using propensity score matching and the one without, as shown in models 4a and 4b.

Table 5: Difference-in-Differences results for all regions, with a matched and unmatched sample and random effects

Model	1a	1b	2a	2b	3a	3b	4a	4b
Matched	No	Yes	No	Yes	No	Yes	No	Yes
Region	**SE**	**SE**	**US**	**US**	**EU**	**EU**	**SE, US, EU**	**SE, US, EU**
VARIABLES	PB (log)	PB (log)	PB (log)	PB (log)	PB (log)	PB (log)	PB (log)	PB (log)
Green bond	0.189	0.126	0.059	0.042	0.068	0.008	0.012	0.036
	(0.244)	(0.432)	(0.114)	(0.357)	(0.218)	(0.282)	(0.125)	(0.223)
p-value (diff. in means)	0.447	0.774	0.607	0.908	0.752	0.978	0.925	0.872
N Treatment	26	26	71	71	73	73	170	170
N Control	59	22	1100	71	270	66	1429	159
BICS clusters	20	15	20	20	20	20	20	20
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This regression table reports the results for the Difference-in-Differences models for Models 1, 2, 3 and 4 with 2015 as the pre-treatment and 2021 as the post-treatment period. The dependent variable is the Price-to-Book ratio (calculated as Price/ Book Value per Share) of the bond issuing firm. The dependent variable is Winsorized on the 1st and 99th percentile, as well as logged. The independent variable is green bond, which is a dummy variable that has the value of 1 if the company issued a green bond and 0 if the company issued a conventional bond between 2015 and 2021. Model 1 displays the DiD regression results for Sweden, Model 2 for the US, and Model 3 for the EU (Germany, The Netherlands, France, Spain, and Italy). Model 4 represents the cross-country results. Model 4 controls for the variable EPI (Environmental Performance Index, country level). For Models 1a, 2a, 3a and 4a the non-matched sample is used and for Models 1b, 2b, 3b and 4b the matched sample is used. The firms are matched based on ROA (net income divided by total current assets of the issuing company, %), total assets, market capitalization and industry (BICS) within each region (SE, US, and EU). All Models are using random effects. Treatment refers to the group of companies that issued a green bond between 2015 and 2021 and Control refers to the firms that issued a conventional bond between 2015 and 2021. The number of firms differs between Treatment and Control for the matched Models 1b, 3b and 4b due to the matching method of one to many (1: N) and the construction of the sample for these regions. The number of observations differs between non matched and matched as the whole sample is used for the unmatched model and only the matched firms are included for the matched models.

Cluster-robust standard errors in parenthesis.
ATET estimate is adjusted for panel effects and time effects.
*** p<0.01, ** p<0.05, * p<0.1

6.1.2. **Multivariate regression models**

In this paper we test eight multivariate regressions models, from which each is tested twice, once applying propensity score matching and once without. The results of the multivariate regressions with average coupon and WACC as dependent variables are found in tables 6 and 7 respectively.

Introducing the results from table 6 and our regressions estimating the relationship between green bonds and a firm's average coupon rate, model 5a and model 5b both produce significant results, however, model 5a on the 1% level and model 5b on the 5% level. Focusing on the matched results, model 5b had a coefficient of -0.923, meaning that firms issuing green bonds on average have a coupon rate that is 0.92% lower than that of firms only issuing conventional bonds, for the Swedish debt capital markets. In model 5b significance was not found for the control variable leverage, however, market capitalization controlling for firm size was significant at the 1% level, with a coefficient of -0.677. This indicates that if firm size increases by 1%, the average coupon rate will decrease by 0.0068%. Moreover, the US debt capital market only gave significant results in model 6a which did not include propensity score matching, this result was significant at the 10% level with a coefficient of -0.307. Although the results from model 6b were not significant at any level for the main explanatory variable, it was for the control variable market capitalization with a coefficient of -0.342. As such, similar to the Swedish debt capital markets, as firms increase in size, their average coupon rate decreases, although not to the same extent. Model 7a and 7b estimate the relationship for the selected European markets, however only model 7a, which did not include the matching method, gave significant results for the explanatory variable. The results from model 7a were significant at the 1% level with a coefficient of -0.431. In model 7b only the control variable market capitalization was significant, at a 5% level, with a coefficient of -0.172, indicating an although weaker, similar relationship as for the Swedish and US markets. Finally, the regressions representing the collective markets, both gave significant results, although model 8a at the 1% level and model 8b at the 10% level. Focusing on model 8b including propensity score matching, it had a coefficient of -0.312 implying that on average green bond issuing firms had a 0.31% lower average coupon rate for our sample including Swedish, the US and selected European debt capital markets. Similar to models 5 to 7, the control variable for leverage was not significant, however, market capitalization was, with a coefficient of -0.215 at a 1% level. Furthermore, the country-specific variable used in model 8 yielded a significant result at the 1% level both with and without propensity score matching. In model 8b it gave a coefficient of

-0.199, implying that when EPI score increases by 1, the average coupon rate decreases by 0.20%, meaning that the EPI score of the country/market a firm finds itself in, affects the average coupon rate of its bonds.

Table 6: Multivariate regression results with Coupon as the dependent variable for all regions, matched and unmatched

Model	5a	5b	6a	6b	7a	7b	8a	8b
Matched	No	Yes	No	Yes	No	Yes	No	Yes
Region	**SE**	**SE**	**US**	**US**	**EU**	**EU**	**SE, US, EU**	**SE, US, EU**
VARIABLES	Coupon (%)	Coupon (%)	Coupon (%)	Coupon (%)	Coupon (%)	Coupon (%)	Coupon (%)	Coupon (%)
Green bond	-0.847***	-0.923**	-0.307*	-0.390	-0.431***	-0.450	-0.436***	-0.312*
	(0.245)	(0.362)	(0.175)	(0.230)	(0.083)	(0.325)	(0.101)	(0.159)
Debt-to-Assets (%)	0.027***	0.006	0.017**	0.010*	0.001	-0.001	0.014***	-0.001
	(0.008)	(0.009)	(0.006)	(0.005)	(0.004)	(0.009)	(0.006)	(0.004)
Market Capitalization (log)	-0.576***	-0.677***	-0.316***	-0.342***	-0.323***	-0.172**	-0.328***	-0.215***
	(0.084)	(0.163)	(0.316)	(0.096)	(0.036)	(0.061)	(0.054)	(0.049)
EPI score							-0.207***	-0.199***
							(0.030)	(0.028)
Constant	6.439***	8.064***	6.297***	6.908***	5.516***	4.229***	25.356***	22.581***
	(0.810)	(1.466)	(0.889)	(1.066)	(0.353)	(0.773)	(3.424)	(2.743)
Observations	88	29	1255	172	353	100	1696	301
BICS clusters	16	8	20	20	20	17	20	20
R-squared	0.503	0.447	0.152	0.214	0.237	0.121	0.255	0.253

Note: This regression table displays the results of the OLS regression models 5 to 8 for the different regions (Models 5-7) as well as for all countries (Models 8). The dependent variable is Coupon (measured as the average coupon of all bonds of a given company between 2015 and 2021, the variable is Winsorized on the 1st and 99th percentile) for all Models. The independent variables are (1) Green bond (dummy variable that has the value of 1 if a company issued at least 1 green bond between 2015 and 2021 and 0 if a company issued only conventional bonds between 2015 and 2021) (2) Debt-to-Assets (total amount of outstanding debt divided by the total amount of current assets of the issuing company measured in percentage, the variable is Winsorized on the 1st and 99th percentile) (3) Market Capitalization (total value of all shares of stock of the issuing firm measured in million USD, the variable is Winsorized on the 1st and 99th percentile, as well as logged) and (4) EPI score (Environmental Performance Index score, country level). Models 5a, 6a, 7a and 8a display the results for the unmatched sample. Models 5b, 6b, 7b and 8b display the results for the matched sample. The firms are matched based on leverage (total debt), total assets, market capitalization and industry (BICS) within each region (SE, US, EU).

Cluster-robust standard errors in parenthesis
*** p<0,01, ** p<0,05, * p<0,1

When looking at the multivariate regression models with WACC as the dependent variable, we can see from table 7 that model 9a yielded no significant results, however, when applying propensity score matching in model 9b we find a significant relationship between firms having green bonds outstanding and their WACC at the 5% level. With a coefficient of -0.894, the results indicate that firms with green bonds outstanding on average have a WACC that is 0.894% lower than similar firms with only conventional bonds outstanding in Sweden. Model 9b also yielded significance for the control variable leverage. With a coefficient of -0.125 and a 1% significance level, it implies that when firms increase their Debt-to-Assets ratio by 1% their WACC decreases by 0.125% in the Swedish market. For the US market, we get significant results on the 5% level in both model 10a and 10b, however, when propensity score matching is introduced in model 10b the coefficient decreases slightly, resulting in a coefficient of -0.934 for model 10b. Implying that firms in the US with green bonds outstanding have a lower WACC, compared to firms with conventional bonds. Moreover, the results from the regression model representing the European market gave significance at the 10% level for model 11a which does not apply propensity score matching, with a coefficient of -1.458. When the matching method is applied in model 11b no significant results were found. Furthermore, model 12a and model 12b yielded significant results on the 5% level in both cases, with a coefficient of -1.293 for model 12a and -1.398 for 12b. Implementing the matching method in this instance did not affect the significance negatively and strengthened the coefficient. However, focusing on the results including propensity score matching, the implication of the results is that firms issuing green bonds on average have a 1.398 percentage points lower WACC than firms that solely have conventional bonds for the collective sample. Out of the control variables used in model 12b, only Debt-to-Assets were significant, which gave a weak coefficient of -0.040, however at a 1% significance level. Neither market capitalization nor EPI score indicated any influence on WACC in this case.

Table 7: Multivariate regression results with **WACC** as the dependent variable for all regions, matched and unmatched

Model	9a	9b	10a	10b	11a	11b	12a	12b
Matched	No	Yes	No	Yes	No	Yes	No	Yes
Region	**SE**	**SE**	**US**	**US**	**EU**	**EU**	**SE, US, EU**	**SE, US, EU**
VARIABLES	WACC (%)	WACC (%)	WACC (%)	WACC (%)	WACC (%)	WACC (%)	WACC (%)	WACC (%)
Green bond	-0.800	-0.894**	-1.122**	-0.934**	-1.458*	-0.686	-1.293**	-1.398**
	(0.744)	(0.380)	(0.399)	(0.413)	(0.766)	(0.714)	(0.533)	(0.569)
Debt-to-Assets (%)	-0.091***	-0.125***	-0.017**	-0.039***	-0.040***	-0.027*	-0.022***	-0.040***
	(0.018)	(0.018)	(0.006)	(0.012)	(0.010)	(0.015)	(0.006)	(0.008)
Market Capitalization (log)	0.169	0.047	0.126*	-0.103	0.192**	0.141	0.169***	-0.004
	(0.147)	(0.124)	(0.071)	(0.085)	(0.073)	(0.137)	(0.057)	(0.117)
EPI score							-0.093**	-0.098
							(0.036)	(0.081)
Constant	9.398**	12.142**	7.494***	10.457***	6.730***	6.136***	11.424***	16.509*
	(1.349)	(1.027)	(0.768)	(0.969)	(1.738)	(1.292)	(3.148)	(8.211)
Observations	88	40	1224	131	353	113	1671	284
BICS clusters	16	11	20	20	20	19	20	20
R-squared	0.439	0.729	0.064	0.173	0.138	0.061	0.124	0.199

Note: This regression table displays the results of the OLS regression models 8 to 11 for the different regions (Models 9-11) as well as for all countries (Models 12). The dependent variable is WACC (weighted average cost of capital of a given company and measures in %, the variable is Winsorized on the 1st and 99th percentile) for all models. The independent variables are (1) Green bond (dummy variable that has the value of 1 if a company issued at least 1 green bond between 2015 and 2021 and 0 if a company issued only conventional bonds between 2015 and 2021) (2) Debt-to-Assets (total amount of outstanding debt divided by the total amount of current assets of the issuing company measured in percentage, the variable is Winsorized on the 1st and 99th percentile) (3) Market Capitalization (total value of all shares of stock of the issuing firm measured in million USD, the variable is Winsorized on the 1st and 99th percentile, as well as logged) and (4) EPI score (Environmental Performance score, country-level). Models 9a, 10a, 11a and 12a display the results for the unmatched sample. Models 9b, 10b, 11b and 12b display the results for the matched sample. The firms are matched based on leverage (total debt), total assets, market capitalization and industry (BICS) within each region (SE, US, EU).

Cluster-robust standard errors in parenthesis
*** p<0,01, ** p<0,05, * p<0,1

6.2. **Hypothesis testing**

6.2.1. **Hypotheses 1 and 2**

For testing hypothesis 1, we are using the Difference-in-Differences models as defined in chapter 5.2. Further, due to our result from the Hausman test, we rely on random effects in all our models, as explained in section 3.2.1.. Moreover, we chose to display the results of our matched as well as unmatched sample, as described in chapter 5.3.1., to improve transparancy. For models 1 to 4 in table 5, we do not find any significant results independent of whether the sample is matched or not. This will be further discussed in the following analysis chapter 7. For rejecting or accepting our hypothesis 1, we trust the result of our matched models 1b, 2b, 3b and 4b. That is due to reasons of comparability with previous studies (Flammer, 2021) as well as higher trustworthiness and robustness of our matched results. Hypotheses 1 and 2 is concerning the effect of local differences reflected in the equity market of green bond issuing firms:

H1: Green bond issuing firms are valued differently from conventional bond issuing firms long-term.

H2: If any, this valuation difference is dependent on the country of issuance.

As displayed in table 5, the coefficients of the explanatory variable green bond dummy in models 1b to 4b are not significant. Thus, we cannot derive that green bond issuing firms outperform conventional bond issuing firms in any of the markets in terms of the Price-to-Book ratio between 2015 and 2021. Hence, neither can we say that there exists a difference in valuation of green compared to conventional bond issuing firms, nor that this relationship would vary between the country of issuance long-term. Consequently, we reject hypotheses 1 and 2.

6.2.2. **Hypotheses 3 and 4**

For testing our hypotheses 3 and 4, we use the multivariate regression models as defined in chapter 5.3. Like the models applied to test our hypotheses 1 and 2, we choose to apply clustered-robust standards errors as well as display the results using our matched and unmatched sample. Unlike in our DiD models, we find diverging results depending on whether we use the matched or unmatched sample for our multivariate regression models. To test our hypotheses 3 and 4, we rely on the matched results for the same reasons as explained in 6.2.1..

Hypotheses 3 and 4 are concerning the difference between the prices of green and conventional bonds in the Swedish, US, and Western European debt capital markets:

H3: The average coupon of bonds is different between green bond issuing and conventional bond issuing firms.

H4: If any, this coupon difference is dependent on the country of issuance.

Derived from table 6 and the models 5b, 6b, 7b and 8b we accept our hypotheses 3 and 4. In detail, derived from model 5b and the green bond dummy coefficient, we can see that green bond issuers had an average coupon that is 0.923 percentage points lower than the average coupon of conventional bond issuing firms in Sweden between 2015 and 2021. This result is significant at the 5% level. From models 6b and 7b we can derive that the green bond dummy coefficient is not significant, which means that there is no significant difference between the coupon of green bonds and conventional bonds in the US and the selected western European countries. Thus, suggesting that this coupon difference is dependent on the country of issuance. Consequently, we accept our hypotheses 3 and 4.

6.2.3. **Hypotheses 5 and 6**

For testing our hypotheses 5 and 6, we use the multivariate regression models as defined in chapter 5.3. As explained before, here, we too choose to apply clustered-robust standards errors as well as display the results using our matched and unmatched sample. To test our hypotheses 5 and 6, we too rely on the matched results for the same reasons as explained in 6.2.1.. Hypotheses 5 and 6 are concerning the difference in WACC between the green and conventional bond issuing firms dependent on the country of issuance:

H5: Green bond issuing firms have a different cost of capital compared to conventional bond issuing firms.

H6: If any, this difference in cost of capital is dependent on the country of issuance.

Derived from table 7 and the models 9b, 10b, 11b and 12b we accept our hypotheses 5 and 6. In detail, derived from model 9b and the green bond dummy coefficient, we can see that green bond issuers had a WACC that is 0.894 percentage points lower than the WACC of conventional bond issuing firms in Sweden between 2015 and 2021. We find the same relationship for model 10b and the US market with a 0.934 percentage points lower WACC of green bond issuers. Both results are significant on the 5% level. From model 11b we can derive that the green bond dummy coefficient is not significant, which means that there is no significant difference between the WACC of green and conventional bond issuers in the selected western European countries. Thus, suggesting that the cost of capital difference is dependent on the country of issuance. Consequently, we accept our hypotheses 5 and 6.

7. Analysis

In this chapter, we analyse the main empirical findings. We divide this section into first looking at the effect of corporate green bonds on the equity capital markets and secondly the effect of corporate green bonds on the debt capital markets of the respective countries. Finally, we conclude by interpreting the WACC of the green and conventional bond issuing firms.

7.1. **Green bonds and the Equity Capital Markets**

Our results for the matched sample as displayed in table 5 and models 1b, 2b, 3b and 4b contrast the results from Flammer (2021), when she analysed stock performance of corporate green bond issuing firms and conventional bond issuing firms internationally between the years 2013 and 2018. Whilst Flammer finds a positive stock market reaction during the announcement of green bond issuance, as well as a higher long-term valuation of green bond issuing companies in terms of stock price, we find no evidence for the long-term superior valuation of green bond issuers with our sample of firms, regardless of which market we look at. Whilst Flammer is applying an event study methodology, focusing on stock prices, we are comparing the Price-to-Book ratio difference between the years with a Difference-in-Differences methodology which could explain the different results. Furthermore, the difference in results could reflect the different construction of the sample. Moreover, whilst Flammer is only including firms that issued green bonds before 2018, we include issuances up until 2021. As the green bond market was drastically growing within the last three years as shown in chapter 4.2, we can assume that we include several firms that did not issue a green bond before 2018. Moreover, due to the comparative nature of this study, we chose to divide the models 1 to 3 according to the different geographical regions of interest. This separation of the sample could have caused the divergence of results from Flammer's paper as well. However, we address this potential challenge by estimating model 4 which includes our complete sample. Despite this, we get no significant results. Additionally, Flammer is using a larger set of variables as a base of her matching methodology, which could have also caused the difference in results.

In conclusion, we find no long-term difference in the valuation of green bond issuing firms in comparison with conventional bond issuing firms, in Sweden, the US and our selected European markets. Consequently, we can interpret it in the following way: Investors in the Swedish, US and selected European equity markets neither reward nor punish the issuance of green bonds in the stock market long term. If we assume that the green bond issuance reflects a credible signal for a green strategy of the issuing firm as described in chapter 2.1. and as found by Flammer (2021), we can interpret that a sustainable corporate strategy is not rewarded with higher Price-to-Book ratios by investors in the studied markets. Another interpretation could be that the issuance of a green bond is not perceived as a credible signal for the greenness of the issuer by the market, which would contrast Flammers (2021) findings further. If one follows this interpretation, it implies that investors might reward firms with a sustainable strategy. However, this outperformance would not be reflected in our results as we could focus on the wrong explanatory variable. An alternative interpretation could be that the market already has sufficient information about the firms' environmental commitments, thus making the green bond issuance irrelevant from the perspective of the information asymmetry theory.

7.2. **Green bonds and the Debt Capital Markets**

Comparing the results with that of previous papers, we find it to be in line with some, while it contrasts with others. Baker et al. (2018), Zerdib (2019), as well as Karpf & Madel (2017), found that green bonds were issued at a premium which is in line with what we find when looking at the complete sample in model 8b. In contrast, when comparing the results of Flammer's (2021) and Larcker & Watts's (2020) papers, they find no significant premium for green bonds. One reason for this, as mentioned before, could be the time frame studied in this paper. We use firms that issued green bonds between 2015 and 2021, whilst their data is slightly older. Flammer (2021) uses an international sample, ranging from 2013 to 2018 where the US makes up for the largest portion of the firms, whilst also including the largest green bond issuers from Europe. This makes her dataset more like the dataset in this paper despite the slightly different time frame. However, even though the datasets are somewhat similar we measure average coupon rate, rather than bond premiums, which probably explains the contrasting results we get when regressing the regions altogether. Instead, we find that green bond issuing firms have lower average coupon rates than conventional bond issuing firms at a 10% significance level (see table 7). Similar to the reasoning under 7.1., another reason could be that there have been several more green bonds issued in the years after Flammer's study was conducted, and Sweden and its Swedish krona has since become the fourth largest green bond issuing currency, most likely influencing the regression results when not dividing by region (Ferlin & Fryxell, 2020). Thus, it highlights the importance of not being too general geographically speaking. Flammer (2021) even mentions in her paper that her findings of no coupon difference between green and conventional bonds might not be representative of the future. This thought is built on a discussion by Larcker and Watts (2020), which suggests that the same price of green and conventional bonds in earlier papers could be a result of firms picking low-hanging green bond fruits in the form of profitable green investment projects. As the green bond market is maturing, investors might settle for lower coupons for green bonds as corporate green projects get less profitable due to the reduction of profitable green project choices.

When looking at the treatment of green bonds in the debt capital markets of the respective countries, we find that there is a significantly lower average coupon for green bond issuing firms in Sweden on the 5% significance level. Specifically, our findings suggest that Swedish investors are willing to trade off 0.923 percentage points of bond yield if the firm has green bonds outstanding, as displayed in table 7 and model 5b. The reason for this could be rooted in Sweden's long history of including sustainability in its educational system (Hansson, 1993; Breiting & Wickenberg, 2010). Hence, we assume this should be reflected in the country's attitude toward sustainability and the environmental awareness amongst the Swedish society. This is further supported by the EPI scores presented in Figure 6, where Sweden is one of the frontrunners in terms of environmental friendliness. Thus, when firms have green bonds outstanding, and with that transmitting a credible signal about their sustainability efforts, it bridges a gap regarding the information available about a firm's environmental profile. Mitigating the information asymmetry on the debt capital markets assumably attracts investors concerned about the environmental impact of their portfolio, and our results indicate that these investors are willing to sacrifice return for sustainability. This explains why green bond issuing firms are treated differently in the Swedish debt capital markets, in terms of average coupon rates. Moreover, we see from table 6 that the R-Square of model 5b is 0.447, which is much higher than the R-Squares of the other matched models. Consequently, suggesting a good fit of the model for the Swedish market.

Whilst we find significantly lower coupon rates for Swedish green bond issuing firms, we find no significant difference for the US or the EU in general. In contrast, Baker et al. (2018) found a premium for green bonds. However, they were investigating mainly US municipal and a few corporate green bonds, which could be a reason why our results differ when we isolate the US market. Further, they use data between the years 2010 and 2016, hence their data is older than what is used in our sample, which could also explain why we do not find a premium for US green bonds. From a theoretical point of view, there could be a difference in how the signalling effect of having green bonds outstanding is perceived by the debt capital markets in different regions. If the signal is not perceived as credible as mentioned earlier, it serves no purpose of mitigating information asymmetry, thus it will not be of any value for investors. Furthermore, as indicated in figure 6, the EU and especially the US do not perform as well as Sweden in the Environmental Performance Index. Since we use this index as a proxy for attitude towards sustainability, we assume the environmental aspect is of less importance in these regions. This means that regardless of the credibility of the signal and consequent information asymmetry reduction, it might not be of value to the investor, potentially resulting in their unwillingness to sacrifice bond yields for sustainability. This suggests that Swedish investors are favouring green bond issuing companies reflected by the average lower coupon, whilst the US and Western European investors do not differentiate between the coupon of bonds issued by green or conventional bond issuing firms.

For the control variable Debt-to-Assets, we only found significance for the US market, at a 10% significance level. The coefficient was positive meaning as leverage increases, the average coupon rate does so accordingly, this was expected as increased leverage introduces more risk which should be reflected in the coupon rate. Furthermore, market capitalization yielded a negative coefficient for Sweden, the US and the selected European markets. In detail, at the 1% significance level for Sweden and the US and at the 5% level for the selected European markets. Consequently, suggesting that the average coupon rate decreases as firm size increases. This could be explained by the signalling theory, with the implication that larger firm sizes credibly signal stability, hence lower risk, which in turn could be expected to lower the coupon rate of the issued bonds. Based on these results it seems as if firm size is more important than leverage for determining the average coupon rate of a firm. This could be explained by the construction of our sample. As we select the firms by the largest market capitalization in each market, we should consider that this relation would most likely be different for smaller and more volatile firms, where leverage would induce more risk. Furthermore, our control variable EPI score was highly significant in model 8b with a negative coefficient, meaning that the average coupon rate could partially be explained by the sustainability culture of a country, whilst the green bond issuance continues to stay significant. This suggests that the average lower coupon rate of green bond issuers depends on the signalling effect of the green bond issuance and not predominantly on the general environmental performance of the country of issuance. Further, this result suggests that more environmentally sustainable countries tend to have lower coupon rates, which potentially could be the result of more green bond issuances with lower coupons in those markets.

7.3. **Implications for the weighted average cost of capital**

We continue by focusing on our models in which we include WACC as the dependent variable as displayed in table 7. From table 7 and the matched models 9b and 10b, we can see that green bond issuing firms in Sweden, as well as the US, have a significantly lower WACC on the 5% significance level, compared to their conventional bond issuing neighbours. Whilst Swedish green bond issuing firms on average have a WACC that is roughly 0.894 percentage points lower than the WACC of matched conventional bond issuing firms, the difference is a little larger in the US. Here, the average difference is a 0.934 percentage points lower WACC. This suggests, that in both regions, in the US as well as Sweden, green bond issuing companies have cheaper access to capital. If we again interpret the issuance as a credible signal for the greenness of the issuing firms, we could assume that both, the US as well as the Swedish debt and equity capital markets favour environmentally friendly firms. However, derived from our previous findings when looking at specifically the Price-to-Book ratio of the issuing firms, we can assume that this difference is not rooted in the equity capital market as we reject our hypotheses 1 and 2. Moreso, we find that Swedish green bond issuing firms on average have a lower coupon than their neighbouring conventional bond issuing firms. Consequentially, we can derive that the on average lower WACC likely reflects the lower coupon of bonds and thus cheaper access to financing in the Swedish debt market. However, this effect only translates for the Swedish market as we find significantly lower coupons for green bond issuers in Sweden but not in the US. Thus, it suggests a reflection of the taste for sustainable investments in the Swedish investor society. This assumption is further supported by the highest R-Square of all models for the Swedish model 9b. The R-Square of 0.729 suggests a good fit of the model in the Swedish market and thus, similar as explained in chapter 7.2, stresses the uniqueness of the Swedish debt capital market, suggesting a reflection of investors' tastes for environmentally friendly projects.

The on average lower WACC for green bond issuing firms in the US, seen in model 10b in table 7, can neither be explained by equity capital markets nor debt capital markets, as no significance is found for the green bond dummy variable in either model 2b or 6b. Thus, the effect of green bonds is not explainable by the applied models. Further, when studying the effect of green bond issuances in Europe, we do not find a significant difference in the WACC or coupon rate between green and conventional bond issuers. As the European and the Swedish markets are arguably more comparable as explained at the beginning of this paper, we suggest that this finding is further reason to believe that the Swedish investors are favouring sustainable investments, which is reflected in the Swedish debt capital market. Lastly, model 12b including all markets studied in this paper, yielded significant results on the 5% level. The results of model 12b can be explained by the significant results of the models 9b and 10b, as the Swedish and the US market make up the larger portion of the total sample. This again shows the importance of not being geographically too general when studying green bonds, as the local attitude towards sustainability seems to influence the effects green bonds have on the firm level.

That is further reflected when looking at the country-level variable EPI. Here, we find no significance for model 12b as displayed in table 7. This finding suggests that the environmental performance of a country does not influence the WACC of the local firms. However, previously in model 8b in table 6, we find that the EPI score affects the average coupon rate of the firms. Here, it could be expected to affect the WACC as well, due to the coupon rate being part of the construction of this variable, however, this is not the case. We suggest that this effect is primarily tied to the Swedish market. As displayed in figure 6, Sweden was one of the environmental performance leaders of 2020 and further the only market in which green bonds affected the average coupon rate of the issuing firms. This further explains why the EPI score did not yield significance for the whole sample.

8. Robustness tests

In this section, we are testing the robustness of our main model results. First, we test the robustness of our DiD models by changing the post-treatment period to 2019 instead of 2021. Second, by excluding the financial industries first for the Difference-in-Differences models and subsequently for the multivariate regression models.

8.1. **Robustness of the Difference-in-Differences analysis**

The selection of different regions such as the selected European countries and the comparison with regions that were of the core interest (Sweden and the US) can be perceived as incorporated robustness of this study. Roberts & Whited (2013) propose to use multiple treatment and control groups. This ensures the reduction of biases and noise that is connected to just one comparison. The design of this study already incorporates this robustness test, as we chose to include the main green bond issuing western European countries to control for any biases and to filter out any European effect that might distort any results of a DiD analysis for solely Sweden in comparison with the US.

Following Roberts & Whited's (2013) list of tests for internal validity, we will conduct our DiD analysis for different years to ensure that no external macro events are influencing our coefficients. In detail, we leave the pre-treatment period as 2015, but change the post-treatment period to 2019. We chose 2019 as this will allow us to filter out any effect of the Covid-19 pandemic, which started to have its effect on the global stock market at the beginning of 2021. As displayed in table 8, the difference in means between the PB ratio of green bond issuing firms and conventional bond issuing firms remains equally insignificant within the selected regions as well as across them. Thus, indicating that our results are robust when changing the period.

Table 8: Matched DiD RE Results for Sweden, the EU, and the US with 2015 as the pre-treatment period and 2019 as the post-treatment period

Model	**1b19R**	**2b19R**	**3b19R**	**4b19R**
Matched	**Yes**	**Yes**	**Yes**	**Yes**
Region	**SE**	**EU**	**US**	**SE, EU, US**
VARIABLES	PB (log)	PB (log)	PB (log)	PB (log)
Green bond	0.099	0.066	0.026	0.049
	(0.283)	(0.298)	(0.295)	(0.227)
p-value (diff. in means)	0.730	0.825	0.932	0.829
N Green bond issuers (Treatment)	19	43	49	111
N Conventional bond issuers (Control)	18	51	45	114
BICS clusters	15	20	20	20
Time effects	Yes	Yes	Yes	Yes
Panel effects	Yes	Yes	Yes	Yes

Note: This table displays the DiD models 1b19R to 4b19R, 19R describing that those models serve the purpose of testing the robustness of the original models 1b to 4b. The displayed models are identical to the matched models in table 6 except that the post-treatment period has been changed from previously 2021 to now 2019. The pre-treatment period remains with 2015 the same.

Cluster-robust standard errors in parenthesis.
ATET estimate is adjusted for panel effects and time effects.

Further, Flammer (2021) points out that corporates within the financial industry are substantially different from other corporates that are issuing green bonds, as the proceeds are not invested into green projects but in green loans. As displayed in Figures 3 to 5 in chapter 4.2., especially in the US the Asset Management industry is the largest, which could be problematic. To filter out the effect of the financial industries, we are dropping all companies that belong to either Asset Management, Banking, or Institutional Financial Services for the matched sub-sample used for the Difference-in-Differences analysis. Subsequently, we are conducting the DiD analysis with the reduced matched sub-sample. In detail, we drop 244 firms within Asset Management, 309 within Banking and 92 within Institutional Financial Services. As in table 9 displayed, we can see that our main findings are robust when excluding the financial industries. In detail, we can see that Swedish green bond issuing firms have no significantly different Price-to-Book ratio compared to Swedish conventional bond issuing firms. Simultaneously, we find no significant difference between the PB mean increase or decrease for green and conventional bond issuers in the EU or the US.

Table 9: Matched DiD RE Results for Sweden, the EU, and the US 2015-2021 without Financial Industries

Model	**1bR**	**2bR**	**3bR**	**4bR**
Matched	**Yes**	**Yes**	**Yes**	**Yes**
Region	**SE**	**EU**	**US**	**SE, EU, US**
VARIABLES	PB (log)	PB (log)	PB (log)	PB (log)
Green bond	0.016	0.062	0.050	0.049
	(0.258)	(0.353)	(0.401)	(0.215)
p-value (diff. in means)	0.952	0.863	0.905	0.821
N Green bond issuers (Treatment)	23	52	66	141
N Conventional bond issuers (Control)	20	62	60	142
BICS clusters	17	17	17	17
Time effects	Yes	Yes	Yes	Yes
Panel effects	Yes	Yes	Yes	Yes

Note: This table displays the DiD models 1bR to 4bR, R describing that those models serve the purpose of testing the robustness of the original models 1b to 4b. The displayed models are identical to the matched models in table 6 except that the Finance Industries are excluded.

Cluster-robust standard errors in parenthesis.
ATET estimate is adjusted for panel effects and time effects.

8.2. **Robustness of the multivariate regression analysis**

For the same reasons mentioned in chapter 8.1., we are conducting the multivariate regression analysis with Coupon and WACC as the dependent variables without including the Financial Industries. Again, we are dropping all companies that belong to either Asset Management, Banking, or Institutional Financial Services for the full sample used for the multivariate regression analysis. Subsequently, we are conducting the multivariate regression analysis with the reduced matched sample. In detail, we drop 182 firms within Asset Management, 124 within Banking and 64 within Institutional Financial Services.

As in table 10 displayed, we can see that the essential results for the regression analysis with the coupon as the dependent variable do not change in essence. Thus, it leads us to believe that our original findings are robust when excluding the financial industries.

Further, as displayed in table 11, we find that the essential results for the regression analysis with WACC as the dependent variable do not change as well. Moreso, we can see that the coefficients for the green bond dummy in Sweden and the US get stronger compared to the models including the financial industries. Thus, supporting our conclusions from the analysis further.

Table 10: Multivariate regression results with **coupon** as the dependent variable for all regions, matched and excluding the Finance Industries

Model	**5bR**	**6bR**	**7bR**	**8bR**
Matched	**Yes**	**Yes**	**Yes**	**Yes**
Region	**SE**	**US**	**EU**	**SE, US, EU**
VARIABLES	Coupon (%)	Coupon (%)	Coupon (%)	Coupon (%)
Green bond	-0.974**	-0.420	-0.523	-0.263*
	(0.421)	(0.237)	(0.384)	(0.174)
Debt-to-Assets	0.012	0.073*	-0.004	-0.002
	(0.032)	(0.005)	(0.012)	(0.007)
Market Capitalization (log)	0.643**	0.388***	0.188**	-0.221***
	(0.173)	(0.122)	(0.065)	(0.055)
EPI score				-0.202***
				(0.031)
Constant	8.956***	6.985***	4.729***	22.868***
	(1.486)	(1.086)	(0.873)	(3.058)
Observations	26	132	89	247
BICS clusters	7	17	16	17
R-squared	0.417	0.193	0.119	0.249

Note: This table displays the models 5bR to 8bR, R describing that those models serve the purpose of testing the robustness of the original models 5b to 8b. The displayed models are identical to the matched models in table 7 except that the Finance Industries are excluded.

Robust standard errors in parenthesis
*** p<0,01, ** p<0,05, * p<0,1

Table 11: Multivariate regression results with **WACC** as the dependent variable for all regions, matched and excluding the Finance Industries

Model	**9bR**	**10bR**	**11bR**	**12bR**
Matched	**Yes**	**Yes**	**Yes**	**Yes**
Region	**SE**	**US**	**EU**	**SE, US, EU**
VARIABLES	WACC	WACC	WACC	WACC
Green bond	-0.954**	-1.220**	-0.518	-0.928**
	(0.489)	(0.428)	(0.779)	(0.383)
Debt-to-Assets	-0.129***	-0.044***	-0.032*	-0.044***
	(0.023)	(0.014)	(0.015)	(0.011)
Market Capitalization (log)	0.059	-0.147*	0.152	0.085
	(0.124)	(0.078)	(0.153)	(0.090)
EPI score				-0.042
				(0.058)
Constant	12.203**	11.478***	6.834***	10.615*
	(1.000)	(1.125)	(1.352)	(5.511)
Observations	37	114	86	237
BICS clusters	10	17	16	17
R-squared	0.693	0.202	0.079	0.221

Note: This table displays the models 9bR to 12bR, R describing that those models serve the purpose of testing the robustness of the original models 9b to 12b. The displayed models are identical to the matched models in table 8 except that the Finance Industries are excluded.

Robust standard errors in parenthesis
*** p<0,01, ** p<0,05, * p<0,1

9. Limitations

One limitation is the sample construction. As we include fewer variables due to limited data availability in our matching methodology, when comparing to Flammer's (2021) study, we fail to exactly reproduce her results, making comparison difficult. Furthermore, we use with the Price-to-Book ratio as our dependent variable a different proxy for the valuation of the issuers compared to the stock price that Flammer (2021) uses. Further, with the average coupon rate of all bonds outstanding, we use a different proxy for the debt capital market reaction to a corporate green bond issuance, whereas Flammer (2021) solely looks at the coupons of the green bonds.

Another limitation of the DiD models is the reduction of firms in the control and treatment groups after matching, which results in a sample size, especially for Sweden, that could be too small to produce representative results for the Swedish market.

Moreover, due to the limited time and data constraints of this study, we only test the EPI as the control variable at the country level. Whilst this index is a comprehensive composure of a variety of environmental issues, it does not allow us to filter out more specific control variables that influence the coupon or valuation difference of green and conventional bond issuers dependent on the country of issuance. Furthermore, the index is used as a proxy for the attitude of a country's society towards environmental issues, whilst being an index measuring a country's environmental performance in absolute terms (i.e., CO_2 emission or waste reduction). A different control variable that is directly measuring the attitude on the society level of a country such as the media index of Ardia et al. (2020) could have measured the environmental attitude of a country more accurately.

Furthermore, a different selection of countries resulting in a larger cross-country sample could have changed the outcome of our main models.

10. Conclusion

In summary, we find no evidence for a different investor valuation of green bond issuing firms in comparison to their close conventional bond issuing neighbours across and within the respective countries of interest. Thus, suggesting that the equity capital markets do not reflect the taste of investors for environmentally sustainable projects in terms of the Price-to-Book value of the issuing firms. Furthermore, we find evidence for a significantly lower average bond price of green bond issuers compared to conventional bond issuers in Sweden, whilst we do not find the same relationship for the US, or the selected European countries. Further, we find a significantly lower WACC for green bond issuing firms, although when isolating the markets this relationship only holds for Sweden and the US. Moreover, this relationship could be traced back to the debt capital markets (in the form of lower bond coupons of green bond issuers) for Sweden, however, no explanation was found for the US.

Whilst we find a difference in the coupon of green bonds compared to conventional bonds between countries and specifically significantly lower coupons in Sweden, our explanation of why this difference exists is based on the sustainability attitude on the country level. Future research could focus on testing more nuanced control variables that can potentially more precisely explain the green and conventional bond coupon differences between countries.

Further, future research could look at different countries to see if the discovered difference in bond coupon is unique to the Swedish market.

Several stakeholders can profit from our findings. For one, policymakers can use these findings to inform their decision on introducing incentives within green finance to improve the environmental performance of their respective countries. Further, policymakers within education can retrieve that education on environmental issues can influence the sensibility towards environmental issues for a country, which translate into a willingness of investors to trade off wealth for a good environmental cause (in the form of corporate green projects financed by green bonds). For corporates, our findings suggest that the financing of green projects is cheaper in countries with a higher environmental performance, which could be a reason to expand operations internationally. Moreover, our findings support the concept that the issuance of green bonds can function as a credible signal for the environmental friendliness of the issuers. Consequently, it is a tool that corporates can utilize to reduce information asymmetry by credibly communicating environmental commitment.

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Appendix

Table 12: Variable Definition Table

Dependent variables	**Description**	**Source**
Stock price (Local currency)	Price of the firms stock at a given point in time	(a)
Average coupon rate (%)	An average coupon rate based on all bonds outstanding for the individual firm	(b)
WACC (%)	Weighted average cost of capital, based on the following formula: $WACC = \frac{E}{V} * R_e + \frac{D}{V} * R_d * (1 - T_c)$	(a)
Explanatory variables	**Description**	**Source**
Green bond dummy	Variable indicating 1 if the firm has a green bond(s) outstanding and 0 if not	(b)
Control variables	**Description**	**Source**
Leverage (%)	Debt to assets is used as a measure for leverage, calculated by: Total debt / Total assets	(a)
Market capitalization (USD)	Used as a proxy for firm size, calculated by: Firm's shares outstanding * Current share price	(a)
Environmental performance index	Measuring the environmental performance of a country based on 32 performance indicators. Proxy for attitude towards sustainability	(c)
Matching variables	**Description**	**Source**
Leverage (%)	Debt to assets is used as a measure for leverage, calculated by: Total debt / Total assets	(a)
Total assets	Total assets is measuring the value of a firms total assets in USD	(a)
Market capitalization (USD)	Used as a proxy for firm size, calculated by: Firm's shares outstanding * Current share price	(a)
BICS code	BICS code is the Bloomberg Industry Classification System code, assigned to each firm based on industry belonging	(a)

Source (a): Bloomberg Terminal
Source (b): FactSet
Source (c): Wendling, Emerson, Sherbinin and Etsy et al. (2020)