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Stock Market Reaction to Green Bond Issuances

An event study on non-financial companies in the Nordic region

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ABSTRACT

With the growing importance of environmentally sustainable practices, green bonds have emerged as an important financial tool for financing environmentally friendly projects. The existing literature is divided between positive, negative and neutral impact green bond issuances have on the stock performance. In this thesis I investigate whether green bond issuances have an impact on stock performance in non-financial companies within the Nordic region, utilizing event study methodology within multiple event windows on 193 green and 198 conventional bonds issued between 2014-2024. Overall, results suggest that there is a varied impact on stock performance, where results for green bond issuances generally reveal positive CARs post-issuance, especially in longer event windows, while for conventional bond issuances CARs exhibit more variability primarily observed in pre-issuance period. Additionally, I explore whether the issuance of green bonds leads to significant changes in stock performance compared to conventional bonds. The analysis does not conclusively show significant differences, as I observe mixed results. This highlights the complexity and context dependence of market reactions to green bond issuances.

DISCLAIMER

In writing this thesis, I utilized R, a statistical software programme, for data analysis and event study. Some of the code was written with the assistance of ChatGPT, an AI language model. Code and data are both available upon request. Please contact the author for access to the material.

TABLE OF CONTENTS

1. INTRODUCTION

Climate change presents one of the biggest challenges our society faces today as it threatens communities and economies, poses risks for agriculture, food and water supplies.
It is no wonder that the world has recognized this problem and decided to work on a solution. In 2015 world leaders agreed on goals in the fight against climate change and created a framework for collective action. This has been compiled into the Paris Agreement which entered into force in November 2016 when governments agreed to a long-term goal of holding the increase in the global average temperature well below 2 degrees Celsius above pre-industrial levels (European Council, 2024) (United Nations Climate Change, 2024).

In order to deal with these challenges posed by climate change, collaboration and action from every sector of society is required. This means not only governments, but also corporations. As corporations significantly contribute to greenhouse gas emissions, they should also have a big role in dealing with the challenges and driving the change through using their resources and influencing the consumers to shift towards greener alternatives.

Large investments, especially in developing new technologies to reduce emissions, are necessary to fulfill the goals of the Paris Agreement and thereby fight climate change. According to McKinsey Global Institute, to achieve net-zero emissions by 2050 $9.2 trillion in annual average spending on physical assets would be required, which is $3.5 trillion more than today (McKinsey & Company, 2022). It is safe to say that in order to reach a green future, financing and investment are crucial. This is where green finance becomes important. According to the UN, green financing is increasing the level of financial flow from the public to sustainable development priorities, thereby taking the opportunity to bring both a financial rate of return and environmental benefit (UNEP, 2024). An example of a green finance tool are green bonds.

Green bonds represent a financial instrument that finances green projects and provides investors with regular or fixed income payments (World Bank Group, 2021). They share financial characteristics with conventional bonds but are distinctively earmarked to finance environmentally friendly and climate-related projects. OECD and EEA recognize bonds as a significant source of funding for reduction in greenhouse gas emissions, as green investments require significant upfront capital and long development periods (Jun et al., 2015) (European

Environment Agency, 2023). The first bond that was labeled green bond was issued in 2008 by the World Bank (CFA Team, 2024) but the explosive growth of green bonds started a few years later after the Green Bond Principles got published by International Capital Market Association in 2014, and the corporations and municipalities joined development banks in issuing green bonds (Olsen-Rong, 2015). Having set the guidelines for issuing the green bonds has served as a foundation for a more formal certification process which started from 2015 and a strengthened green bond market.

Problem Formulation

Green bonds have become increasingly more popular. This could be because investors have been changing their strategy where they not only consider getting financial returns but also making an environmental impact through their investment. Despite the popularity of green bonds and the explosive growth of the green market, there exists little understanding as to how issuing green bonds affects corporate financial performance, especially in the context of stock performance. The effects could range from positive, negative or even neutral. As described in the *Literature review*, the positive effects are based on the theory that investors value environmental commitment, so when a firm issues green bonds, it can enhance its reputation and attract a lot of investors conscious about sustainability. Negative effects come from the premise that investors might perceive the green bond issuances as a sign of increased risk which in turn can lead to negative stock performance in the short-term following green bond issuance. Effects could also be neutral, if the issuance of green bonds does not significantly alter investor behavior or perceptions because investors might see the issuance of green bonds as a continuation of an already existing firm’s sustainability strategy, rather than new impactful information.

In this thesis I wish to investigate the following question:

“Does issuing green bonds have an impact on a firm's stock performance? Evidence from Non-Financial Industries”

I will be focusing on the Nordic region, an area which is known for being one of the world's greenest with a high Environmental Performance Index. In 2022 Denmark has scored the highest worldwide with a score of 77.9 implying the highest level of environmental performance, while Finland and Sweden take third and fifth place respectively. (Statista, 2022)

Another important focus of my research is on non-financial industries. I chose to concentrate on these sectors in order to conduct a more detailed analysis and attain a deeper understanding of how green bond issuances influence stock prices within industries where the direct environmental benefits, such as emissions reduction, are more evident and can be easily conveyed to investors. When a non-financial firm issues green bonds, this might signal their commitment to sustainable development and efficiency in their operations because environmental issues are integral to business operations. This in turn can enhance investors' confidence about the firm's future growth potential.

The aim of this research is to contribute to the empirical literature on green bonds and stock performance and to grasp how the market responds to green bonds focusing on the Nordic region. This would in turn enable issuers, regulators and investors in particular to better understand green financing and aid them in making informed decisions when investing in companies, which issue green bonds.

The thesis is structured in several sections. Section 2 provides an overview of the green bond market and green bond principles. Section 3 consists of existing literature review followed by methodology in Section 4, consisting of data description, hypotheses and event study method. In Section 5 I present the findings and results which I analyze and discuss in Section 6. Section 7 explains my limitations and the final section, Section 8, offers the conclusion, main findings and recommendations for further research.

1. GREEN BOND MARKET OVERVIEW

Green bonds are a relatively recent debt instrument used to finance green projects that have a very unique goal of improving environmental impact. This specific goal is what differentiates them from conventional bonds. The market for green bonds emerged in 2007-08 with the first issuances. In the beginning the market was mainly dominated by supranational entities such as European Investment Bank and World Bank. From 2014 there was an increase in diversification of issuers and investors and a more active participation from the private sector like corporations, which was started due to publication of Green Bond Principles. (Jun et al., 2015)

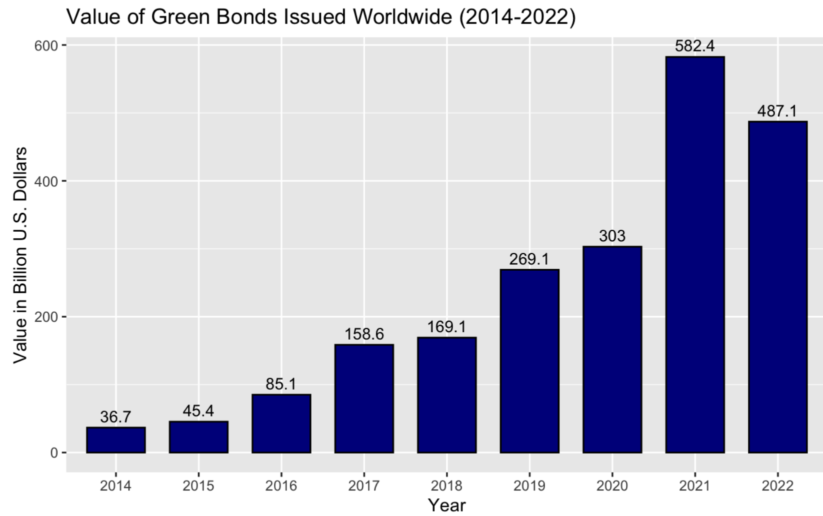

Figure 1. Green bonds issued worldwide, (Statista, 2023)

The value of green bonds that has been issued worldwide has been increasing dramatically. From *Figure 1* it can be seen that in 2014 there were $36.7 billion worth of green bonds issued, while in 2021 this amount reached $582.4 billion, an astonishing 1,486.92 % increase. This amount then slightly decreased by 16.36 % in the following year and reached $487.1 billion. From 2014 to 2022 the leading country in issuing green bonds with $380 billion was the U.S., followed by China and then Germany (Statista, 2023).

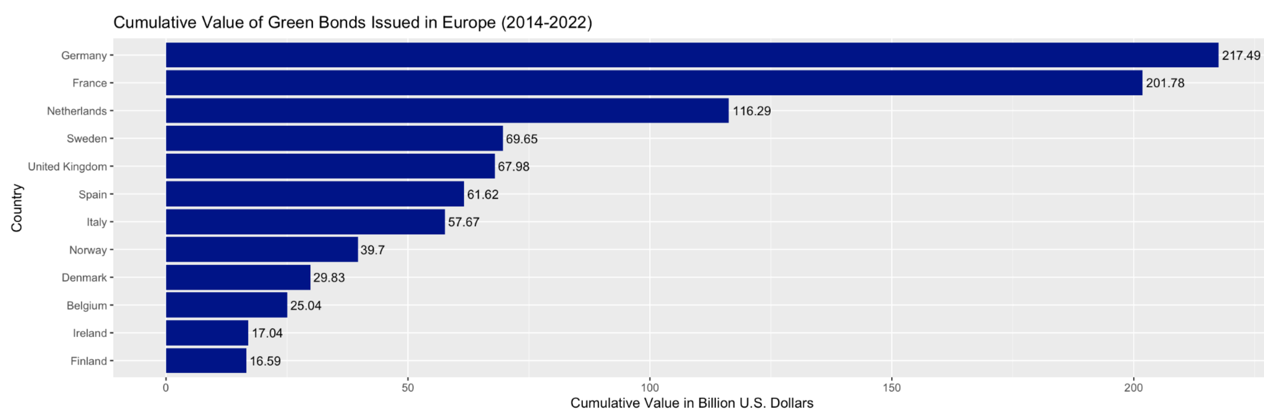

Figure 2. Green bonds issued in Europe, (Statista, 2023)

When it comes to Europe, Germany takes the lead in issuing the green bonds, with $217.49 billion worth in green bonds issued by 2022. As illustrated in *Figure 2* the Nordic countries represent a relatively substantial segment of the European market. Within this group, Sweden ranks fourth overall in Europe, with $66.65 billion worth in green bonds. It is followed by Norway with $39.7 billion, Denmark $29.83 billion and Finland $16.59 billion.

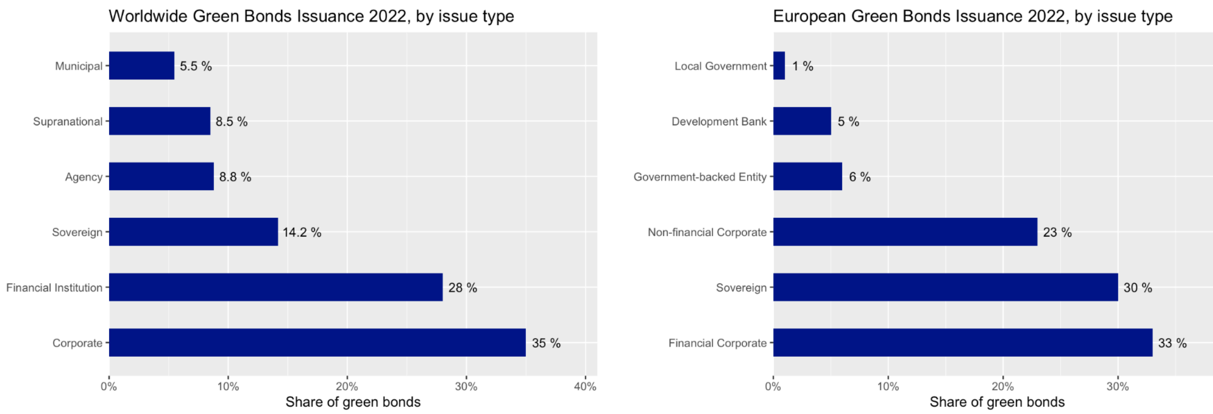

Figure 3. Comparison of worldwide and European distribution of green bonds by issue type in 2022, (Statista, 2023) (Statista, 2023)

Green bonds can be issued by either the public or private sector, just like conventional bonds. If we examine the issuance of green bonds by type, some distinct patterns emerge when comparing worldwide and European markets. From *Figure 3* it can be seen that the worldwide market is dominated by corporate green bonds with 35%, followed by green bonds issued by financial institutions with 28% and sovereign issuance with 14.2% of total bonds issued respectively. This might be an indication that corporations are more engaged in environmentally friendly projects compared to the government initiatives. On the other side, in the European market financial corporations issue the most green bonds, 33% of total issuance. Sovereign issuers follow with 30%, which is significantly higher than the global percentage. This suggests that compared to the worldwide market, government and financial institutions are more proactive and aggressive in promoting green finance. Non-financial corporations issued 23% of total green bonds issued in 2022.

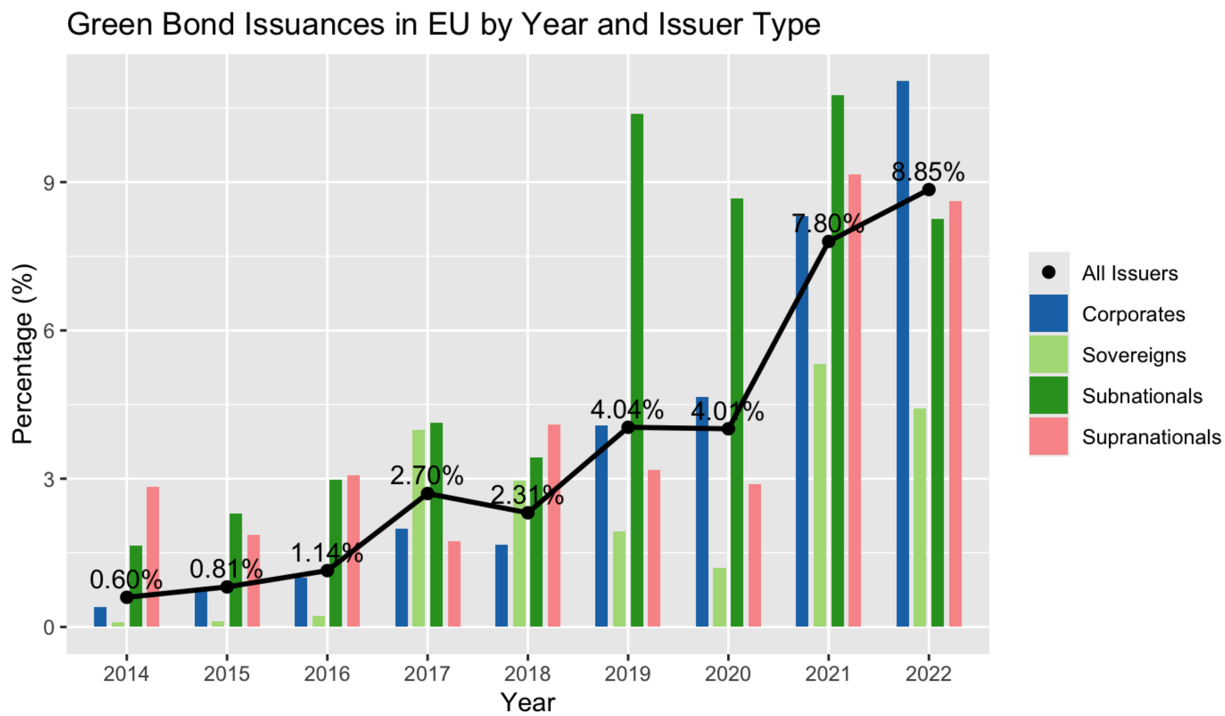

Figure 4. Green bond issuance of total bond issuance in EU, (EEA, 2023)

Figure 4 represents the green bond of total bond issuances in the EU by various types of entities. It can be concluded that the green bond market is still relatively small compared to the total bond market and that the rates at which different entities issue green bonds vary. The most interesting and rapid increase is seen by corporate entities, from 0.41% in 2014 to 11.04% in 2022, an overall increase of 10.63 percentage points. Green bond issuance by subnational and supranational entities have also had a substantial increase, while sovereign government issuance has had a slower increase and a fall in 2022. Overall green bond issuance in the EU from 2014 to 2022 increased from 0.6% to 8.85% of total bonds issued, which corresponds to a 8.25 percentage point increase. This indicates an increasing demand to finance green projects, which is driven by the need to transition to a green economy. (EEA, 2023) (World Bank Group, 2021)

2.1 Green Bond Certification

As I previously mentioned, Green Bond Principles were an important milestone in the development of the green bond market. As there are various definitions of what makes a bond green, Green Bond Principles serve as voluntary guidelines which promote transparency and consistency in the green bond market. Their main aim is to clarify the process for an issuance of green bonds but also to help green bond investors to evaluate bond's environmental impact. Green bond principles clarify four areas: 1. The Use of Proceeds, 2. The Process for Project Evaluation and Selection, 3. The Management of Proceeds and 4. The Reporting.

The first category of the principles offers guidance on eligibility of green projects. For a bond to be considered green, the project needs to lead to environmental benefits. Some of the categories recognized for eligibility of green projects are for example renewable energy, pollution prevention or sustainable water management. The second category focuses on encouraging transparency in issuing green bonds by saying that the issuer should clearly present the objectives of the green project to investors. The third category refers to the fact that the net proceeds of green bonds should be tracked by the issuer in an appropriate manner. And in the last category of principles it is encouraged to keep information on the use of proceeds over the life of the bond. (ICMA, n.d.)

Green Bond Principles are not mandatory but they are used by the issuers and green certifiers. There can be made a distinction between self-labeled and third-party labeled green bonds. The former represents a bond that is declared green only by an issuer who can use Green Bond Principles as a guideline but it is also possible that the issuer follows other principles. On the other hand, green bonds can be certified by a qualified third-party that is an independent assessor. According to (Hyun et al., 2021) obtaining a green label matters. Green labels are used to attract investors by mitigating information asymmetry between issuer and investor. This lowers environmental risk and for that reason investors pay a higher price for it. By obtaining a green label, issuers benefit with lower financing cost compared to similar green bonds.

2.2 Greenwashing

Despite its rapid growth and having a vital role in fighting climate change , the green bond market faces several commonly raised challenges. The biggest threat to the development of the green bond market is the lack of a commonly accepted definition of what makes a bond green. OECD recognizes the need for a broad international alignment on common standards and certification methodologies (OECD, 2021). Despite the existence of voluntary Green Bond

Principles, issuers can still self-label their bonds green and use the proceeds for different purposes than green projects. This is called greenwashing. Greenwashing is a term initially used by an environmentalist Jay Wasterveld in 1986 for corporations that claim that they care for the environment while in fact they contributed to its degradation (Fernandez, 2023). According to (Maino, 2022) greenwashing misleads market actors and ultimately leads to a less green economy. Green bonds may come with a tax benefit advantage. To incentivize issuers and investors to participate in the green bond market different tax policies, which vary from country to country, were implemented. This gives issuers a bigger incentive to choose green labeled bonds over conventional bonds in order to reap tax benefits. For example, in the U.S., municipal green bond issuers enjoy lower interest rates and cash rebates from the government (Climate Bonds Initiative, 2024).

3. LITERATURE REVIEW

There exists a large and growing amount of literature focusing on ESG and performance. It has been shown by (Flammer, 2013), (Klassen & Mclaughlin, 1996) and (Krüger, 2015) that when a company demonstrates environmentally friendly behavior, the stock market responds positively. There is however, a limited amount of academic research on the green bond performance due to the fact that green bonds are a relatively new financial instrument as the first green bond was issued in 2008.

Green bonds can be seen as one of the tools, significant to both issuers and investors, to show eco-friendly behavior, as the use of their proceeds goes to financing environmentally friendly projects. From the investor perspective, who according to (Baulkaran, 2019) are mainly large institutional investors, green bonds offer an opportunity to diversify their portfolios, enhance ESG scores and fulfill green investment mandates (Reboredo, 2018). Studies by (Tang & Zhang, 2018) and (Gianfrate & Peri, 2019) suggest that issuing green bonds can come with benefits such as a bigger investor base and reduced cost of capital.

A big part of the existing literature has focused on bond pricing and the differences between green and conventional bonds' cost of capital. (Ehlers & Packer, 2017) and (Hachenberg & Schiereck, 2018) found that green bond issuers benefit from lower borrowing rates when compared to conventional bond issuers, which is perceived as value enhancing by the market. They also discovered that in Europe, the stock market reacts more favorably to green bond announcements than conventional bond announcements. (Hyun et al., 2018) found that green bonds that have been certified by a third party have a significant green bond premium, and highlighted that green bond standards are important for market development.

Recently, literature has shifted focus from bond pricing to the impact of green bond announcements on firm performance. Academic world is split when it comes to a firm's performance after the issuance of green bonds. On one side there are researchers like Flammer, Tang and Zhang, who find that the market reacts positively, while on the other side, researchers like Wang and Wang and Labelle et al. suggest the opposite. (Labelle et al., 2020) provide an explanation for competing views.

The idea behind a positive market reaction is that the issuer’s business model might undergo positive evolution in the long run, in the sense that the issuer might have a lower exposure to environmental risks, and become more attractive to a growing community of green investors. On the other hand negative market reaction might arise because green bonds are yet an unknown financial tool. If a firm announces that it wishes to finance its business transition with green bonds, investors might see it as uncertainty whether the new business model would be as profitable as the previous one. (Labelle et al., 2020)

Then there are also researchers like (Zerbib, 2019) and (Xi & Jing, 2021) that do not fit in categories of positive or negative impact on stock performance but find neutral or varying impact. (Zerbib, 2019) indicates that there are no substantial yield differences between green and conventional bonds, thus suggesting that green bond issuances have a minimal impact on stock prices of issuing companies and implying that green bond issuances are not significantly reflected in stock prices. (Xi & Jing, 2021) found that the stock price effect of green bond issuances vary due to multiple factors such as the nature of the issuance, the type of the company and the company’s ownership and size.

The first comprehensive empirical study on green bonds was written just four years ago by (Tang & Zhang, 2018). Utilizing an event study methodology with event windows of [-5,10] and [-10,10] days around the announcement date, they used a market model to calculate CARs and included several control variables such as firm size and book-to-market ratio. Their overall finding is that when a firm issues green bonds, it is beneficial to its shareholders - both stock turnover and liquidity increase and improve significantly. They suggest that every green bond issuance will contain valuable information and that the stock market should respond in every case. They argue that unlike issuing conventional bonds, when issuing green bonds, firms convey additional information on the use of the proceeds and the future environmentally beneficial projects, which benefits investors and in turn positively impacts the stock market. However, they do not find a significant premium for green bonds.

In 2020 (Labelle et al., 2020) published an article where they investigated corporate green bond issuances employing a similar event study approach like (Tang & Zhang, 2018), but with shorter event windows of [0,1], [-1,1], [-5,5] days, and found that the market reacted negatively to their announcement. Additionally they found that investors react in the same manner for green bonds as for conventional bonds. They also included control variables for industry and market conditions.

In 2021 research by (Flammer, 2021) on corporate green bonds found that investors responded positively to the issuance announcement. This reaction is stronger for first-time issuers and bonds certified by third parties. (Flammer, 2021) also found that issuers improved their environmental performance post-issuance and experienced an increase in ownership by green investors. She used several event windows such as [-5,10], [-10,6], [-20,-11], market model and Fama and French three factor model to calculate CARs.

(Wang & Wang, 2022) explored the relationship between environmental, social and governance performance and green bond issuance and found that if a firm practices decent ESG practices it increases its propensity in green bond issuance and issues more green bonds. They also investigate financial performance and conclude that there is a negative effect of financial performance in issuing green bonds when combining the effect of ESG performance.

Investigating the impact of green bonds on corporate performance in Chinese listed companies, (Tan et al., 2022) found that green bonds can significantly increase corporate performance and suggest promoting green bonds to help achieve green recovery.

In 2023 (Makpotche et al., 2023) looked into long-run performance following corporate green bond issuance and found some evidence that in the long run corporate green bond issuers tend to outperform similar control firms. Additionally, they found that the stock market responded positively to the signal of firm's commitment towards the environment.

Comparing green bond and conventional bond impact and issuance performance, (Kanamura, 2020) finds that green bond investment performance is superior to conventional bond investment performance but the superiority decays over time. (Reboredo, 2018) indicates that even though green bonds offer diversification benefits due to their low co-movement with traditional financial assets, there are no significant price spillover effects. (Alonso-Conde & Rojo-Suárez, 2020) find that green bond financing delivers higher returns than conventional financing.

There has also been a discussion in literature on why companies choose to issue green instead of conventional bonds, given the constraints green bonds come with, such as administrative costs and restrictive investment policy. (Flammer, 2021) offers three potential rationales for issuing green bonds and their implications, namely signaling, greenwashing and cost of capital.

According to the signaling theory, when a company issues a green bond, it sends a signal to the public that they are committed to the environment, thus implying a positive shareholder reaction to environmental engagement, improved environmental performance post issuance, and an increased attractiveness to investors sensitive to the environment. Signals are necessary for investors to be able to distinguish between environmentally oriented companies and those who are not. It is argued by the theory that signals are likely to be credible if they are costly to be repeated. In the case of issuing green bonds, signals are likely to be credible because companies use substantial amounts of money for green projects. Moreover, complying with the green bond standards and getting third-party certification uses a lot of resources and effort from managers. (Flammer, 2021)

4. METHODOLOGY

The aim of the methodology section is to provide an extensive explanation of the data collection procedure and methods used to investigate the research question and hypotheses. The structure is as follows. Firstly, I describe the data I used, starting with data collection and followed by data description. Secondly, I outline my hypotheses and give an individual explanation for each. Lastly, I write about the event study theory and method utilized in this thesis.

4.1 Data

Data Collection

I utilized two different platforms to gather data, specifically Refinitiv Eikon and FactSet. I found that many research papers use Bloomberg database as it offers more extensive information on green bonds, i.e. announcement dates. However, due to inability to access the database, I had to turn to Refinitiv Eikon, which still proved a valuable source for information on green bonds, but with no announcement dates. The FactSet database was helpful for obtaining stock prices and market benchmarks. In addition to gathering green corporate bonds issued in Denmark, Sweden, Finland, and Norway from 2014 to March 2024 by publicly traded companies, I also collected data on the company's stock prices. Furthermore, I gathered traditional bonds issued during the same timeframe by these companies to explore whether issuing green bonds results in noticeably different abnormal returns for relevant stocks compared to issuing conventional bonds.

After gathering all the green and conventional bonds within the specified time period, I proceeded to clean and prepare the data for analysis. This process involved multiple rigorous steps. My first task was to isolate the financial and nonfinancial sectors and focus primarily on nonfinancial corporations. Once I had created a sample of only nonfinancial corporate green bonds, I began collecting stock prices. However, not all of the companies from my list of green bond issuers had available stock data due to some becoming private or bankrupt. As a result, my sample of green bonds was further reduced.

To establish a market benchmark, I collected OMX Nordic 40 prices for the same time period as the stock prices (2012-2024). This allowed me to ensure sufficient data for event study estimation periods. OMX Nordic 40 was chosen for its coverage of the Nordic region, which is central to my thesis. This index comprises actively traded stocks in that area (FactSet, 2024).

In further preparing and cleaning the data, it was important to ensure that the event dates of both green and conventional bond issuances were not too close together to differentiate the specific effects of issuing green bonds from those of traditional bonds. The close proximity of these elements could influence one another and potentially undermine the event study. I introduced a minimum one-month gap between the issues. Finally, I ensured that all the dates in my market prices, stock prices, and event dates aligned. It was revealed that some events occurred on non-trading days. As a solution, I opted to adjust the event date to the nearest preceding trading day. After harmonizing the dates, I obtained clean data on green and conventional bonds that I could work with in order to test my hypotheses.

Descriptive Statistics

Bonds

Having first collected the data on all green and conventional corporate bonds, there have been 425 green and 3003 conventional bonds issued in the Nordic area from 2014-2024 respectively. If interested, readers can see the distribution per each year, per nation and per sector in *Appendix*, but here I will focus on describing the data after it has been adjusted and cleaned, like previously described, to perform event study.

Data for performing event study consists of 193 green and 199 conventional corporate bonds in non financial sectors issued in the time period from 2014 to March 2024 in the Nordic region. In *Table 1* it can be seen that Sweden seems to be the leader in issuing bonds with 140 and 168 green and conventional bonds issued respectively. This would imply that around 72% of the green bonds from the data have been issued in Sweden. Denmark has issued the least corporate green bonds in the non-financial sector in the region, but it comes second in issuing conventional bonds, however only with 7% of the total conventional bonds.

Table 1. Cleaned data. Bonds issued per nation from 2014-2024, source: Author's own creation based on data from (Refinitiv Eikon, 2024)

Bonds per nation

Nation	Green Bonds	Conventional Bonds
Denmark	11	14
Finland	20	9
Norway	22	8
Sweden	140	168
Total	193	199

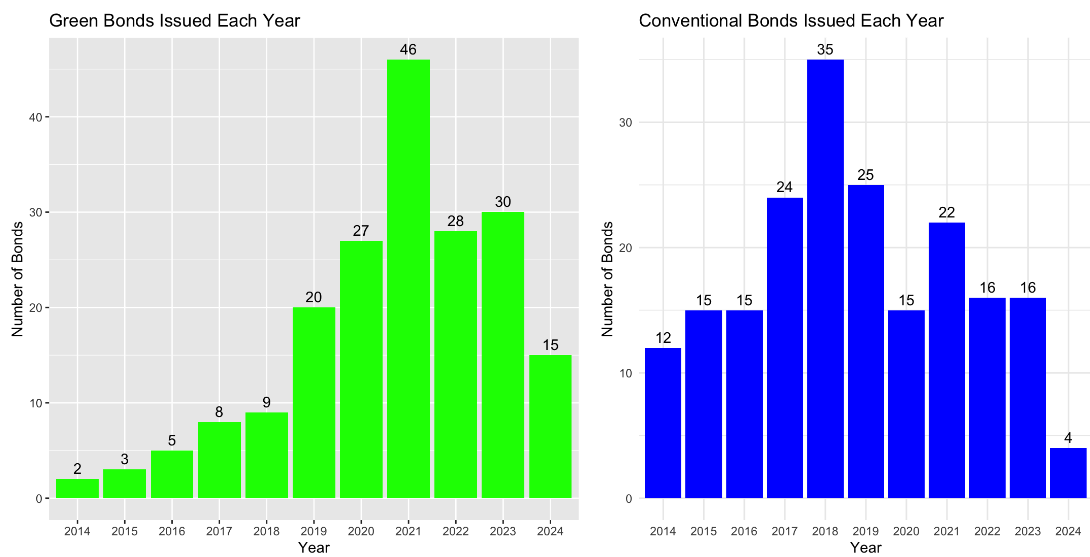

Figure 5. Cleaned data. Green and conventional bonds issued in Nordic area from 2014- March 2024, source: Author's own creation based on data from (Refinitiv Eikon, 2024)

Figure 5 represents a visual on the distribution of bond issuances per year. Looking at the green bonds, one can notice a general growth trend in the issuances. From 2014 to 2023 there is an overall 150% increase. 2021 seems to be an outlier with a 70% increase in issuances from 2020. This could be because in 2020 there was an important event for sustainability, namely the approval of the European Green Deal principals for a climate neutral goal by 2050. Positive trend can also be confirmed looking at the last year in the time period. In only 3 months, there have already been 15 bonds issued.

Conventional bonds on the other hand, unlike green bonds, do not seem to have an overall pattern. From 2014 to 2018 there was a rise in the number of conventional bonds issued, with a peak in 2018 with 35 bonds. However, from there onwards, there seems to be a decline in issuances. Another interesting observation is that there is less fluctuation in the numbers of conventional bonds issued annually compared to green bonds. This could indicate that conventional financing methods may be becoming less popular for the non-financial sector, possibly due to changes in investor preferences.

Table 2. Descriptive statistics for Non-financial Green and Conventional bonds after data cleanup, source: Author's own work

Non-financial Green Bonds

Statistic	Maturity	Proceeds	Coupon
Mean	7.841	134.681	2.890
SD	17.822	184.070	1.907
Min	1.501	10.900	0.125
Max	106	890.972	8.750
Skewness	4.710	2.228	0.869
Kurtosis	21.103	4.145	0.418
N Valid	193	193	54

Non-financial Conventional Bonds

Statistic	Maturity	Proceeds	Coupon
Mean	9.184	179.991	2.153
SD	18.866	238.965	1.340
Min	1.860	11.462	0.125
Max	99.900	1,711.833	6.250
Skewness	4.216	2.526	0.937
Kurtosis	16.730	9.024	0.387
N Valid	198	199	84

I have further analyzed the data by checking statistics on maturity, proceeds and coupon for both green and conventional bonds in non-financial sectors. *Table 2* represents descriptive statistics based on these variables.

When it comes to maturity, the mean is 7.84 and 9.18 years for green and conventional bonds respectively. Standard deviations are high for both bonds, which indicates a wide variation in maturities spanning from 1 to over a 100 years. Skewness and kurtosis are again high for both bonds but slightly higher for green bonds, which indicates significant outliers where most of the bonds have a shorter maturity with a few extreme maturity values pulling the mean upwards. Proceeds for green and conventional bonds are substantial, with means at $134.68 and $179.99 million respectively, which indicates that substantial funding is directed to both types of bonds, however less for green bonds. Standard deviation, range and kurtosis of proceeds for conventional bonds is much higher than that of green bonds, indicating that conventional bonds involve projects that are larger in scale and possibly objectives, unlike environmentally focused projects that are funded by green bonds.

Coupon statistics for green bonds are slightly higher than that of conventional bonds with means equaling 2.89% and 2.15% respectively. Floating coupons are dominant in both bonds, 67% of green bonds have a floating rate, while for conventional bonds that would be 54%.

Sectors

If we dive deeper and dissect the issuances per sector, a similar pattern is seen between green and conventional bonds. From *Figure 6* one can notice that the dominant sector is the real estate sector, consisting of around 65% of the total issuances for both bonds. This does not come as a complete surprise because of the extensive capital requirements real estate needs for land and construction. Bond financing, be it green or conventional, provides a long-term financing that can support this need. Energy and Power, Materials and Industrials sectors follow in green bond issuance with around 9% of total green bond issuance each. As these sectors typically involve activities that have significant environmental impacts, green bond financing could be used for funding cleaner operations. For the conventional bonds Industrial and Telecommunication sector follow with 13% and 7% of total conventional bonds issued respectively. Choosing financing with conventional bonds over green bonds might imply that these sectors have a need for a broader range of capital expenditures and not only specific sustainable projects green bonds are earmarked for.

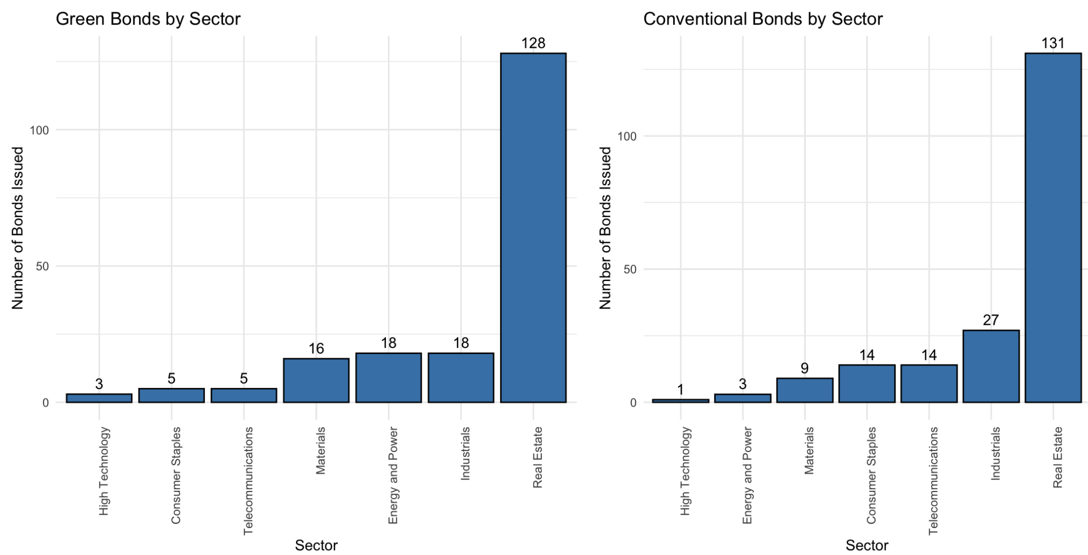

Figure 6. Cleaned data. Green and Conventional bonds issued per sector from 2014-2024, source: Author's own creation based on data from (Refinitiv Eikon, 2024)

In order to run a robustness check for the event study across different sectors, I had to address the issue of insufficient bond issuances within each sector. As a solution, I merged several sectors together in order to ensure that each combined sector had at least 20 observations. Consequently, I ended up with three broad sectors from the original seven.

The first sector includes 31 green bonds, which I named Technology and Industry because they are the most prevalent. It comprises High Technology, Telecommunications, Consumer Staples, and Industrial sectors. These can be merged as they all involve extensive use of technology and infrastructure. Additionally, Consumer Staples can be aligned with Industrials because it often involves industrial activity in terms of production and distribution.

In the second sector, I merged the Energy and Power and Materials sectors, combining them into the Resource and Infrastructure sector. This new sector encompasses physical resource utilization and infrastructure development, totaling 34 green bonds.

Lastly, I decided to treat real estate as a separate sector because of its substantial number of green bonds, which puts it well above the threshold for analysis.

Table 3. Descriptive statistics for Green bond sectors after data cleanup, source: Author's own creation

Green Technical & Industrial sector

Statistic	Maturity	Proceeds	Coupon
Mean	11.689	194.151	3.778
SD	21.639	190.502	2.133
Min	2.773	17.165	0.875
Max	100	549.520	8.750
N Valid	31	31	13

Green Resource & Infrastructure sector

Statistic	Maturity	Proceeds	Coupon
Mean	14.327	335.030	2.611
SD	27.858	288.260	1.856
Min	2.518	32.546	0.125
Max	106	890.972	7.660
N Valid	34	34	16

Green Real Estate sector

Statistic	Maturity	Proceeds	Coupon
Mean	5.186	67.060	2.607
SD	12.081	69.577	1.744
Min	1.501	10.900	0.695
Max	99.900	421.946	6.745
N Valid	128	128	25

Table 3 shows statistics on green bonds for each of the sectors. It can be seen that sectors show variability in each of the bond characteristics, which might reflect the differences in the nature of the projects which are being financed. Looking into the Technology and Industrial sector, it exhibits high fluctuations in maturities, with a mean of 11.69 years and a standard deviation of 21.64, proceeds, with a mean of $194.15 million and standard deviation of 190.5, and coupon rates, with a mean of 3.78% and standard deviation of 2.13.

Resource and Infrastructure shows even higher variability with the highest mean proceeds of $335.03 million and standard deviation of 288.26, but also the longest maturity with a mean of 14.33 years and a standard deviation of 27.86. Compared to Technology and Industrials, it has a slightly lower mean coupon rate.

The Real estate sector stands out with lower maturity mean of 5.19 years and a standard deviation of 12.08, lowest proceeds of $67.06 million and a standard deviation of 1.74 and the lowest standard deviation on the coupon rate which is also smaller than the Technology and Industrial sector. This suggests that compared to the other two sectors, Real estate is more uniform while the others are more heterogeneous.

Table 4. Descriptive statistics for Conventional bonds sectors after data cleanup, source: Author's own creation

Conventional Technology & Industrial sector

Statistic	Maturity	Proceeds	Coupon
Mean	8.449	321.046	2.520
SD	10.527	246.014	1.490
Min	2	13.521	0.125
Max	60.562	927.538	5.875
N Valid	55	56	38

Conventional Resource & Infrastructure sector

Statistic	Maturity	Proceeds	Coupon
Mean	7.044	316.356	2.922
SD	3.492	463.843	1.348
Min	3	17.909	1.500
Max	16	1,711.833	5.285
N Valid	12	12	6

Conventional Real Estate sector

Statistic	Maturity	Proceeds	Coupon
Mean	9.689	107.201	1.689
SD	22.167	165.942	1.018
Min	1.860	11.462	0.200
Max	99.900	1,176.997	6.250
N Valid	131	131	40

I also provide descriptive statistics of the same sectors but for conventional bonds in *Table 4*. Just like with the green bonds, Real estate again stands out as a more homogeneous sector with lower standard deviations in each bond characteristics, much lower proceeds and coupon

rates but higher mean maturity. The Technology and Industrial and Resource and Infrastructure sectors show high variability in proceeds and coupon rates for both green and conventional bonds, which makes them potentially more risky than the Real estate sector.
It is noteworthy however, that in examining descriptive statistics of both green and conventional bonds across different sectors, the Real estate sector has a significantly higher number of observations compared to other two sectors, which suggests a greater consistency in the bond characteristics. Another thing to keep in mind is that the Resource and Infrastructure sector in conventional bonds has only 12 observations making it a significant limitation which might affect the reliability of the findings for this sector and making definite conclusions about the characteristics of the sector's conventional bonds. Despite the small sample size, observations from this sector are still valuable for providing insights into the sector and a more comprehensive understanding of the overall conventional bond issuances. By including these observations I maintain a complete dataset which allows for comparison with other sectors. However, findings for this sector should be interpreted with caution and I would recommend future research with larger samples to confirm my preliminary insights.

Time period split

The next subsample I have created involves splitting the time period into two phases. The first period ranges from 2014 to 2020, and the second time period from half through 2021 to 2024. There are several reasons I have decided to implement this split. Firstly, the first quarter of 2020 had seen an economic downturn as indicated by Eurostats business cycle clock (Eurostat, 2024). Additionally, global economies still had lingering effects of the Covid-19 pandemic. To check for the presence of an economic downturn, I also examined my chosen benchmark market returns. For this reason, I plotted the returns and rolling standard deviation and observed a big spike in volatility during 2020, which confirmed the economic downturn. For readers who are interested, visual representation is found in *Appendix*.

At the same time however, green finance has been rapidly developing driven by the need for a sustainable future. This contrast of economic volatility and the growth of green finance makes a compelling reason to analyze the impact of green bonds across these two distinct periods.

Table 5 shows descriptive statistics on green bonds issued in the two aforementioned time periods. Both periods show high variability in maturities with standard deviation of 14.16 and

17.95 for first and second period respectively, while their mean amounts to 6.63 and 7.42 years respectively. This suggests that the most recent bonds may include more long-term investments.

Proceeds also show high variability with the second period having higher mean and standard deviation, potentially indicating that green bonds issued in this period fund larger projects.

Coupon rates are higher in the second period with 3.71% compared to 2.8%, but have a lower standard deviation. This suggests that the cost of borrowing might have increased but the rates are more consistent in the most recent period.

It is also important to notice that compared to the first period where there were only 47 green bonds issued, in the second period the number of observations is much higher accounting for 98 bonds. This points to an increase in issuance of green bonds in recent years.

Table 5. Descriptive statistics for Green bonds issued in two time periods, source: Author's own creation

Green bonds issued from 2014-2020

Statistic	Maturity	Proceeds	Coupon
Mean	6.630	98.500	2.800
SD	14.160	114.880	2.750
Min	2	17.160	0.740
Max	99.900	549.520	8.750
Skewness	6.080	2.270	1.300
Kurtosis	37.110	4.540	-0.050
N Valid	47	47	11

Green bonds issued from 2021-2024

Statistic	Maturity	Proceeds	Coupon
Mean	7.420	140.410	3.710
SD	17.950	199.890	1.420
Min	1.500	10.900	0.880
Max	106	890.970	6.740
Skewness	4.760	2.080	-0.110
Kurtosis	21.590	3.230	-0.590
N Valid	98	98	28

Firm and market returns

Finally, I provide descriptive statistics in *Table 6* and distribution for firm and market returns in Figure 7.

Compared to market returns, firm returns show higher standard deviation, which reflect diverse performance of individual firms. Both firms' and market's mean returns, 0.01119% and 0.02921% respectively, are close to zero. Higher kurtosis and a wider range in firms' returns indicates more extreme values and points to more significant losses and gains compared to the market. Smaller standard deviation and kurtosis in market returns indicates more stability.

Table 6. Descriptive Statistics of Returns across all firms and market, source: Author's own creation based on data from (FactSet, 2024)

Returns across all Firms and Market

Type	Mean	SD	Min	Max	Median	Skewness	Kurtosis
Firms	0.0001119	0.0238427	-0.5512816	0.5379712	0.0002411	-0.1489189	15.7195798
Market	0.0002921	0.0121768	-0.1208812	0.0633205	0.000662	-0.5453943	5.6691911

The histogram for aggregated returns across all firms show that there is a high frequency of returns clustered around zero. It has a tall peak and long tails on both sides. This means that most firms have small returns, but there are significant outliers on positive and negative sides, implying more extreme returns than in a normal distribution. Market returns on the other hand are more concentrated and less spread out then the firm returns. Their histogram has thinner tails compared to the firm's histogram, meaning less extreme values relative to the firms, which is also indicated by a lower kurtosis.

Figure 7. Histograms of Returns across all firms and market respectively, source: Author's own creation based on data from FactSet (FactSet, 2024)

4.2 Hypotheses

My following hypotheses are motivated by the increasing importance of green finance and the growing investor interest in sustainability. Through them I aim to investigate the impact of green bond issuances on the stock performance of non-financial firms in the Nordic region, which scores high in the Environmental Performance Index.

Hypothesis 1:
"Issuing green bonds has a positive effect on the stock performance of Nordic companies in non financial industries."

In a region such as Nordics, where there is high awareness towards being environmentally responsible, when a firm issues a green bond, it is a possible signal that the firm is committed to sustainability. This may increase attractiveness to investors and thus positively impact stock performance. Hypothesis is grounded on signaling theory and on the findings by (Flammer, 2021) and (Tang & Zhang, 2018) who suggest that financial performance may be increased by issuing green bonds.

Hypothesis 2:
"Issuing green bonds leads to significantly different abnormal returns compared to issuing conventional bonds in the same companies in non financial industry in the Nordic region."

With hypothesis 2 I wish to examine how the market responds differently to green bonds compared to conventional bond issuances. Investors who focus on sustainability may be more attracted to green bonds, as green bonds focus on funding specific environmental projects, thus causing a difference between abnormal returns compared to conventional bonds. This hypothesis is based on conflicting results from studies on green bonds. For example, (Labelle et al., 2020) and (Wang & Wang, 2022) found that the market reacts negatively to the announcement of corporate green bonds, adding to the complexity of understanding market reactions because other studies suggest positive market reactions. By testing this hypothesis I wish to contribute to understanding of how green bonds impact stock performance relative to the traditional financing methods.

4.3 Event Study Methodology

My thesis aims to explore whether there is a positive impact on a firm's stock performance when the firm issues green bonds. To achieve this, I have chosen to employ an event study method. Following financial theory on semi-strong form of the efficient market hypothesis, capital markets should reflect all available information about firms in the firm’s stock price. Based on this premise one can assess how a specific event affects a firm's prospects by measuring its impact on the firm’s stock price. For conducting such analysis event study methodology has been developed as a method that examines the stock price reaction around an announcement of an event. The absence of the announcement dates in my data necessitates the use of the next available proxy which is the issuance date. I recognize that relying on issuance dates could result in measuring a delayed response in stock prices because the markets may have already factored in some of the impact by then. That's why I intend to use a broader estimation window of 20 days and more to capture potential earlier reactions.

The concept of the event study focuses on analyzing how stock prices change in response to new information. It involves aggregating this concept over similar events across different companies, using returns, as normalized price changes, instead of actual prices for comparability. In an event study, we examine whether there is a difference between the stock's returns at time "t" and the expected return, which is called abnormal return, or if there is no change. Abnormal return is expressed in the following equation:

$$AR_{it} = R_{it} - \widehat{R_{it}}$$

Where AR_{it} is abnormal return at time t, R_{it} is the actual return at time t and $\widehat{R_{it}}$ is the expected return at time t. In order to get to the abnormal returns, it is essential to estimate the expected returns.

The method is based on the estimation period prior to the event that is being analyzed. It estimates what the normal return should be at the day of the event and several days prior and after the event. This window is called an event window, while the estimation period is called an estimation window. According to (MacKinlay, 1997) estimation window and event window should not overlap. According to the *Figure 8*, event day falls on day 0, estimation window is the period between T_0 and T_1, event window period between T_1 and T_2 and post event window between T_2 and T_3.

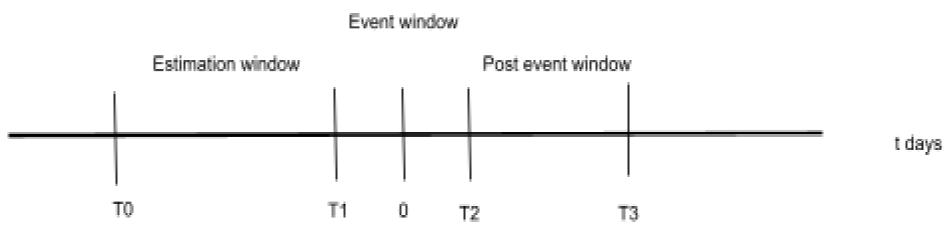

Figure 8. Timeline of an event study (MacKinlay, 1997)

Event studies on green bonds like (Flammer, 2021) and (Tang & Zhang, 2018) took it a step further and made sure that there is a time gap between the estimation window and the event window and use 200 trading days to 21 days prior to event date and 320 trading days to 50 days prior to the event respectively.

Having acquired an understanding of the estimation process and event windows, to the best of my capabilities I attempted to conduct an event study using 250 trading days of estimation period ending 10 days prior to the events. However, the software package I utilized to conduct the event study in R, had a default setting where the estimation window extended from the beginning of the data to the event window. This resulted in longer than desired estimation periods for some events.

There are several models one can use to estimate expected returns, but in this thesis I use two statistical models, namely Constant mean model and Market model.

Constant mean model is one of the simplest models where the expected return is just the mean return.

$$R_{it} = \mu_i + \xi_{it}$$
$$E(\xi_i) = 0 \qquad Var(\xi_{it}) = \sigma^2_{\xi_i}$$

Where μ_i is the mean of firm i, R_{it} is the daily return of firm i at time t and ξ_{it} is a disturbance term for firm i at time t with expectation of zero and variance $\sigma^2_{\xi_i}$. Abnormal returns would therefore be defined as follows

$$AR_{it} = R_{it} - \mu_i$$

Even though the constant mean model is simple and easy to implement because it requires only data on historical stock returns, it has several disadvantages. As it assumes a constant expected return during the event window which is equal to its historical returns, it does not account for other factors, such as firm size or market movements, that might have an impact on stock returns. For these reasons it is also less accurate in estimating abnormal returns compared to more complex models that account for these factors.

Market model is a model which relates a return of any security to the market portfolio.

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$
$$E(\varepsilon_{it}) = 0 \qquad Var(\varepsilon_{it}) = \sigma^2_{\varepsilon_i}$$

Where R_{it} is daily return of firm i at time t, R_{mt} is the return of the market at time t, ε_{it} is the error term with an expected value of zero and variance $\sigma^2_{\varepsilon_i}$.

α_i and β_i are model parameters that get estimated with OLS regression in an estimation window. α_i is the intercept term that represents the average stock return not explained by market movements. Additionally, it shows the expected return on the stock when the market return is zero. If it is positive that means that stock is expected to outperform the market. If it is negative it is expected to underperform.

β_i is the slope term that represents sensitivity of stocks return to the market return. If its value is 1, that means that stock moves together with the market, so 1% increase or decrease in market return also leads to 1% increase or decrease in stock return. If its value is less than 1, stock is less volatile than the market. Opposite holds true if its value is larger than 1. If beta is negative, stock moves in the opposite direction of the market.

ε_{it} represents the residual that captures idiosyncratic or firm specific risk, which can be diversified through portfolios, not accounted for by the market return. It is the difference between the actual return of the security and the return predicted by the model. A large ε_{it} might be an indication that the Market Model is not sufficient to fully capture the relationship between stock return and market return, thereby indicating a more complex model is needed to explain stock's return.

Just like the constant mean model, the market model is also relatively simple to use and easy to understand. Additionally, it requires fewer data inputs compared to more complex models. On the other hand, it assumes that the relationship between stock returns and market returns is constant over time and even though it accounts for market movement, it still does not take into account other risk factors that might have an impact on stock return.

Having estimated α_i and β_i with the market model, expected returns for each time t can be estimated with the following equation:

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

Next step is to estimate daily abnormal returns for each company by subtracting expected return from the actual return.

$$AR_{it} = R_{it} - \widehat{R_{it}}$$

I get cumulative abnormal returns for the event window by aggregating the abnormal returns for each company i at time t.

$$CAR_i(T_1, T_2) = \sum_{t=T_1}^{T_2} AR_{it}$$

It is also possible to get average abnormal returns for all firms i for the event window with N events

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it}$$

That are used to calculate cumulative average abnormal return in the event window with N events

$$CAAR(T_1, T_2) = \frac{1}{N}\sum_{T_1}^{T_2} AAR_t$$

To be able to draw conclusions from CAAR, testing for significance is important. Following the literature, I perform a t-test to test significance of CAAR

$$t_{CAAR_{0,t}} = \frac{CAAR_{0,t}}{\widehat{S}_{CAAR,0}}$$

$$\widehat{S}^2_{CAAR,O} = \frac{1}{N-1}\sum_{i=1}^{N} (CAR_i - CAAR)^2$$

In the following section, I will provide a detailed application of this methodology on the main sample. This will involve comparing green bonds and conventional bonds, as well as conducting robustness checks on sectors and time subsamples using the data described in the *Data* section. In the time period subsample I have split the data in the way that the observations for the estimation window for the second period start from mid 2020 and the event dates of green bond issuances from mid 2021 for the reasons described in the *Data* section.

5. RESULTS

This section consists of findings for event study presented by two models, namely constant mean model and market model for the main sample, consisting of 193 green and 199 conventional bonds respectively, and then for subsamples, which are the three sectors and two time periods. Following the literature, I employed several event windows to estimate CARs, but for the purpose of this thesis and limitations due to using issuance dates, I made sure that the windows are longer than 2 weeks. Time intervals covered are [-14,15], [-19,20], [-29,30] and [-39,40]. I provide both visual and numerical findings. In the graphs readers can see cumulative abnormal returns for each day of the event window. Blue line represents the returns while the dashed lines represent confidence intervals, which suggest if the returns are significant or not. In the tables there will be presented numerical values for returns and confidence intervals together with standard errors and t-test statistics. Since the smallest event window has more than 30 observations, for practical purposes numerical values will be provided in a table as a summary, consisting of significant days and days I deemed important to include. Most of the event windows and models that reveal significant and relevant findings will be presented and illustrated in detail, while for some findings, readers will be referenced to *Appendix* for further detail and graphical representation.

Section is structured as follows: I start by providing results for the main sample where the constant mean model for green and conventional bonds is compared to the market model for each of the event windows. I proceed in the same way for subsamples, starting with the time period between 2014-2020, followed by the time period between 2021-2024 and finally each sector.

5.1 Main sample

15-day event window

This window comprises 14 days prior to the event and 15 days post event date. Estimated with the constant mean model one significant CAR is found for green and one for conventional bonds. When it comes to green bonds, the event window of 15 days shows a negative trend in the pre issuance period, as can be seen from *Figure 9*. Around the event date CARs remain close to zero, while a slight positive trend in CARs after the issuance date is observed peaking around day 11, however the changes are statistically insignificant, with the exception of day -9 which shows a significant negative return a mean of -0.0086 as shown in *Table 7*.

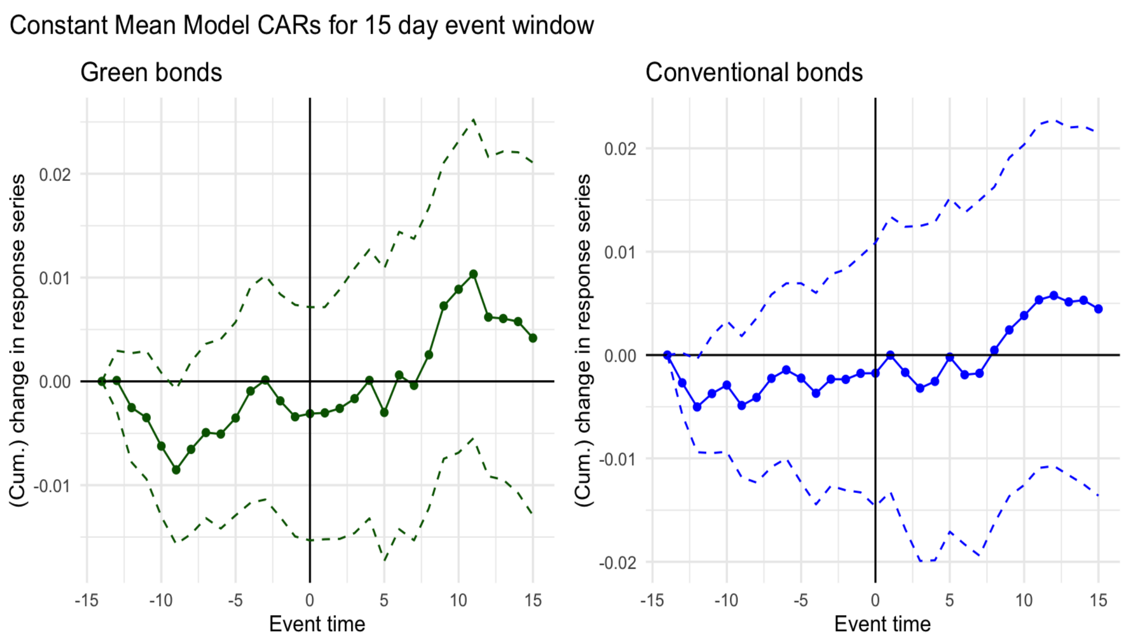

Figure 9. Constant Mean Model CARs for green and conventional bonds with 15 day event window, source: Author's own creation

Table 7. Summary table for Constant Mean Model CARs for a 15 day window event for green and conventional bonds including confidence intervals, standard errors and a t-test

CAR Constant Mean Model 15 day window - Summary table

Green Bonds						**Conventional Bonds**					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-13	-0.0001	-0.0035	0.0028	0.0016	-0.0766	-12	-0.0050	-0.0100	-0.0001	0.0025	-2.0039* *
-10	-0.0064	-0.0136	-0.0001	0.0034	-1.8857	0	-0.0018	-0.0154	0.0104	0.0066	-0.2657
-9	-0.0086	-0.0165	-0.0018	0.0037	-2.3226* *						
-5	-0.0036	-0.0135	0.0053	0.0048	-0.7446						
0	-0.0036	-0.0161	0.0082	0.0062	-0.5838						
5	-0.0039	-0.0190	0.0101	0.0074	-0.5314						
11	0.0091	-0.0071	0.0245	0.0080	1.1366						
15	0.0031	-0.0141	0.0198	0.0086	0.3606						

Similarly to green bonds, CARs for conventional bonds show a negative trend pre issuance, with a statistically significant negative CAR observed on day -12 with a mean of -0.005 and a t-statistics of -2.0039. Post issuance CARs remain relatively flat with a slight upward trend starting from day 7, however not significant. Compared to green bonds, the post issuance trend for conventional CARs does not show pronounced change.

Market model shows some distinctive patterns especially in the post issuance period for both types of bonds where the trend is negative as evident from *Figure 10*. While green bonds show some signs of recovery post-trend, conventional bonds remain negative, which indicates different patterns in stock performance dynamics between two types of bonds around issuance dates. However, the post issuance period has no statistically significant CARs. In the pre issuance period the market model estimates significant negative returns for both types of bonds. For green bonds, significant CARs are found on day -9, just like with the conventional mean model, but also on days -8 and -7. For the conventional bonds, the market model estimates three additional significant CARs compared to the constant mean model. They fall on day -13, -12, -11 and -9, all negative and statistically significant. This shows that green and conventional bonds had a negative significant CAR on day -9.

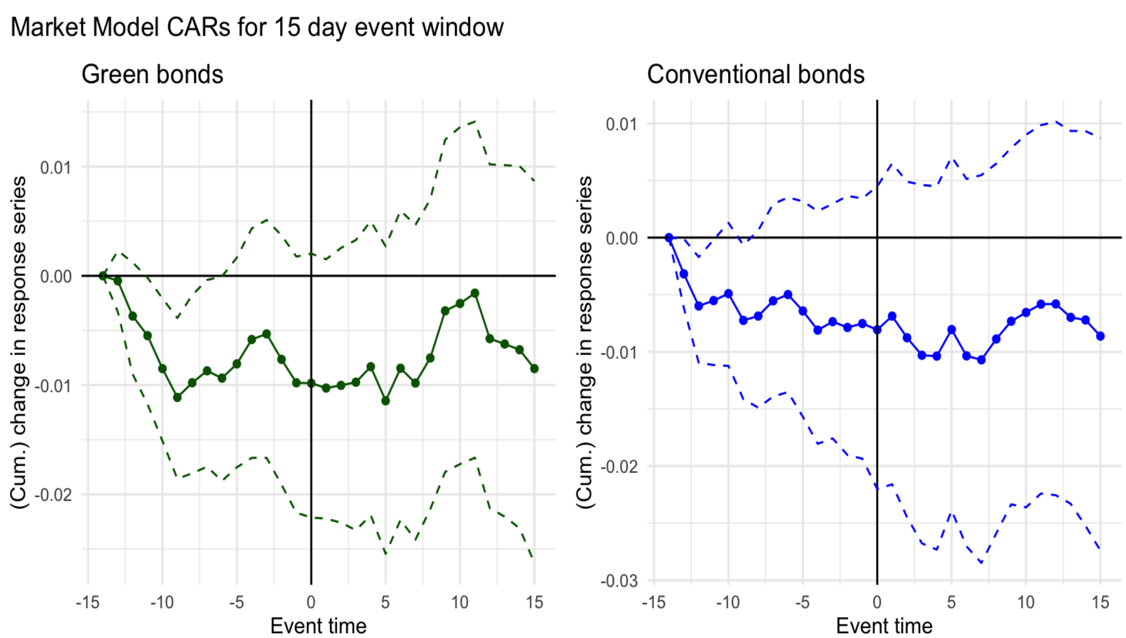

Figure 10. Market Model CARs for green and conventional bonds for 15 day window, source: Author’s own creation

Table 8. Summary table for Market Model CARs for a 15 day window event for green and conventional bonds including confidence intervals, standard errors and a t-test

CAR Market Model 15 day window - Summary table

Green Bonds						Conventional Bonds					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-13	0.0001	-0.0027	0.0031	0.0015	0.0575	-13	-0.0032	-0.0061	-0.0001	0.0015	-2.0567**
-9	-0.0085	-0.0158	-0.0014	0.0037	-2.3143**	-12	-0.0060	-0.0109	-0.0017	0.0024	-2.5389**
-5	-0.0035	-0.0135	0.0060	0.0050	-0.7085	-11	-0.0055	-0.0112	-0.0002	0.0028	-1.9729**
0	-0.0031	-0.0157	0.0086	0.0062	-0.5031	-9	-0.0072	-0.0141	-0.0007	0.0034	-2.1081**
5	-0.0030	-0.0163	0.0106	0.0068	-0.4373	-4	-0.0081	-0.0180	0.0023	0.0052	-1.559
11	0.0103	-0.0053	0.0259	0.0080	1.2994	0	-0.0081	-0.0220	0.0045	0.0068	-1.1937
15	0.0042	-0.0122	0.0221	0.0088	0.4762	7	-0.0107	-0.0285	0.0055	0.0087	-1.2355
						11	-0.0058	-0.0224	0.0098	0.0082	-0.7086
						15	-0.0086	-0.0274	0.0087	0.0092	-0.9359

20 day event window[1]

For green bonds the 20 day event window shows a more pronounced fluctuation pattern compared to a 15 day event window. Before the issuance date, the CARs fluctuate around zero, with no significant observations. Similarly to the 15-day window, post issuance, there is a more positive upward trend in mean CARs. This is where statistically significant CARs can be seen. By days 10 and 11 post issuance, CARs at 0.0156 and 0.018 are observed respectively with a statistical significance at the 5% level. By day 20, the mean CAR is still positive but has decreased, meaning that at this point no significant CAR is found. Results from the 20 day event window suggest a positive market reaction following the issuance of the green bonds with statistically significant CARs seen on day 10 and 11.

Turning to conventional bonds, the constant mean model reveals a positive significant CAR on day -16 at 0.0048 and -14 at 0.007, which is an indication of a positive change in stock performance before the bond issuance on that day. Post issuance CARs do not exhibit

[1] For more details on constant mean model check Appendix

significant changes, and compared to green bonds the overall trend seems to be slightly positive but not as pronounced as in green bonds.

Market model for the 20-day event window shows no significant CARs for either type of bonds, indicated by a zero in every CARs confidence interval. CARs mainly fluctuate around zero.

30 day event window

To get a deeper understanding of the effect green bond issuance has on stock performance, I extend the event window even further, to 30 days prior and post event date. The change in CARs estimated with the constant mean model for green bonds can be seen side by side with CARs for conventional bonds in *Figure 11* below.

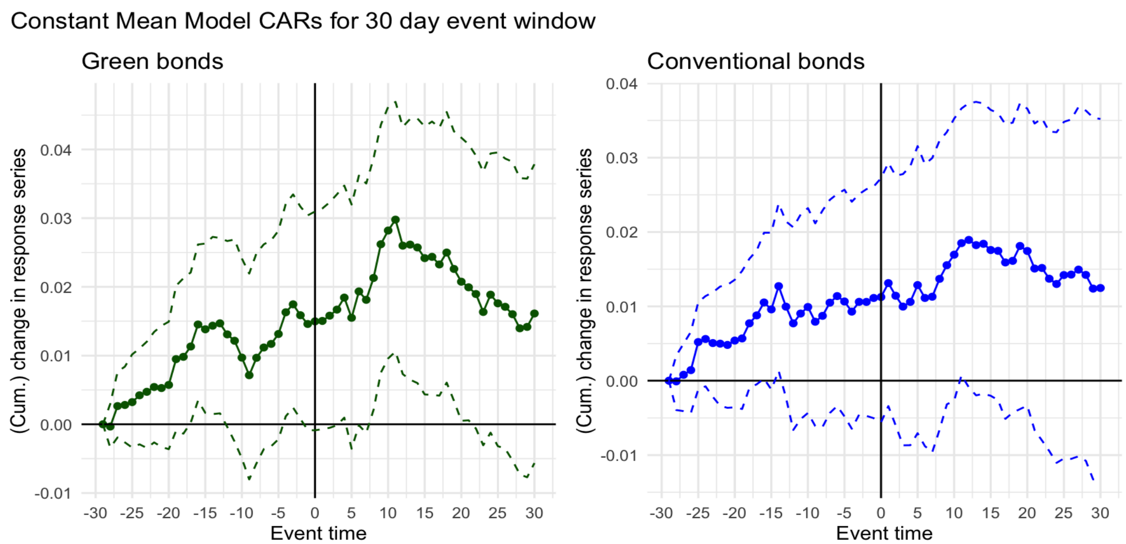

Figure 11. Constant Mean Model CARs for green and conventional bonds using a 30 day window, source: Author's own creation

Table 9. Summary table for Constant Mean Model CARs for a 30 day window event for green and conventional bonds including confidence intervals, standard errors and a t-test

CAR Constant Mean Model 30 day window - Summary table

Green bonds						**Conventional bonds**					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-17	0.0113	0.0008	0.0214	0.0053	2.1536**	-16	0.0105	0.0006	0.0204	0.0050	2.0856**
-16	0.0151	0.0038	0.0274	0.006	2.5147**	-14	0.0127	0.0011	0.0247	0.0060	2.1063**
-14	0.0149	0.0026	0.0281	0.0065	2.301**	0	0.0112	-0.0058	0.0278	0.0086	1.3121
-12	0.0131	0.0013	0.0259	0.0063	2.0777**	11	0.0185	-0.000003	0.0364	0.0093	1.9937**
-4	0.0163	-0.0002	0.0317	0.0081	2.0089**						
-3	0.0175	0.0007	0.0330	0.0082	2.1184**						
0	0.0150	-0.0020	0.0310	0.0084	1.7779						
4	0.0184	-0.0003	0.0355	0.0091	2.0214**						
6	0.0193	0.0006	0.0363	0.0091	2.1203**						
10	0.0282	0.0090	0.0464	0.0095	2.9592**						
11	0.0298	0.0099	0.0482	0.0098	3.0451**						
19	0.0226	0.0011	0.0426	0.0106	2.1365**						
20	0.0208	0.0024	0.0426	0.0103	2.0229* *						

Looking at the green bonds' CARs, there is a fluctuating pattern pre and post issuance. First significant CAR is observed on day -17 with a mean of 0.0113 and a t-statistic of 2.1536, as evident from *Table 9*. The positive significant CARs continue up to day -12, where the mean CAR is 0.0131. There are positive significant CARs observed again on days -4 and -3 at 0.0163 and 0.0175 respectively. On the issuance day 0 the CAR is 0.015, however not statistically significant. Post issuance positive CARs persist, with the first significant CAR observed on day 4 with a mean of 0.0184. Significant CARs spam from day 6 all the way up to day 19 with a peak at day 11 with a mean of 0.0298 and a t-statistic of 3.0451. On the last significant day the mean CAR is 0.0226.

Unlike green bonds, conventional bonds show a relatively stable positive trend pre and post issuance date. As shown in *Table 9*, there are 2 days pre issuance that have significant CARs, namely day -16 and day -14, with a mean CAR of 0.0105 and 0.0127, and a t-statistic of 2.0856 and 2.1063 respectively. Day 0 is not statistically significant, but days 11 and 12 post issuance exhibit positive statistical significance with mean CARs of 0.0185 and 0.0189.

The data for green bonds suggest a consistent positive CAR trend pre and post issuance, where 22 days have statistically positive CARs. On the other hand conventional bonds also display a positive trend before and after issuance event, but with only 4 days with statistically significant CARs. Additionally, just like in the 15-day event window in the market model, there are days where both types of bonds have significant CARs simultaneously. On days -16, -14 and 11 positive significant CARs are observed for both bonds.

When it comes to the market model for the 30-day event window, similarly to the 20 day window, the CARs for green bonds, as well as for conventional bonds fluctuate around zero with no statistically significant values. Even though mostly positive, CARs for green bonds start to move towards negative values after the peak on the 11th day post issuance ending in a mean CAR of -0.0106 on day 30 post issuance, again not a statistically significant value.
Just like green bond CARs, CARs for conventional bonds in the 30 day event window are mainly positive pre issuance, however the difference lies post issuance where they are mostly negative excluding day 11 and 12 post issuance. Another similar pattern can be noticed between green and conventional CARs post issuance, namely a drop in the values after day 11 post issuance. Mean CAR for conventional bonds for day 30 post issuance is the lowest value in the whole event window equal to -0.0144, remaining statistically insignificant.

40 days event window

This window holds the most days with significant CARs for green bonds in the constant mean model, where even the issuance date 0 is significant. Green bonds show a more pronounced and continued significant positive trend compared to conventional bonds that primarily have significant CARs seen on day -16, -14 and post issuance days 11 and 12. This suggests a notable difference in the pattern of significant stock performance changes around the issuance events for the two types of bonds.

Green bond CARs demonstrate significant fluctuations throughout the 40 day event window as evident from *Figure 12*. Positive significant trends are consistent from day -19 leading up to day -11, and continuing again from day -5 through event date 0 and until day 11, which is also the peak of the event window with a mean of 0.0328. From day 11 post issuance there is a drop in CARs, where CARs are significant up to day 22, which has a mean CAR 0.0218, however still not reaching a value below the mean of event date 0 of 0.0165, indicating a positive stock performance.

Figure 13 shows a positive trend pre issuance for conventional bonds. On day -16, the mean CAR is 0.0127 with a t-statistic of 2.1109, which indicates a positive and a statistically significant change. This is also observed on day -14 with a mean CAR of 0.0149 and a t-statistic of 2.1649. On the issuance date 0, mean CAR is positive but not significant. Post issuance dates 11 and 12 show statistical significance with a mean CAR of 0.0209 and 0.0212 respectively. Several days where green and conventional bonds have simultaneous positive CARs are observed again. Just like in the 30- day event window, days -16, -14 and 11 are positive and significant for both types of bonds.

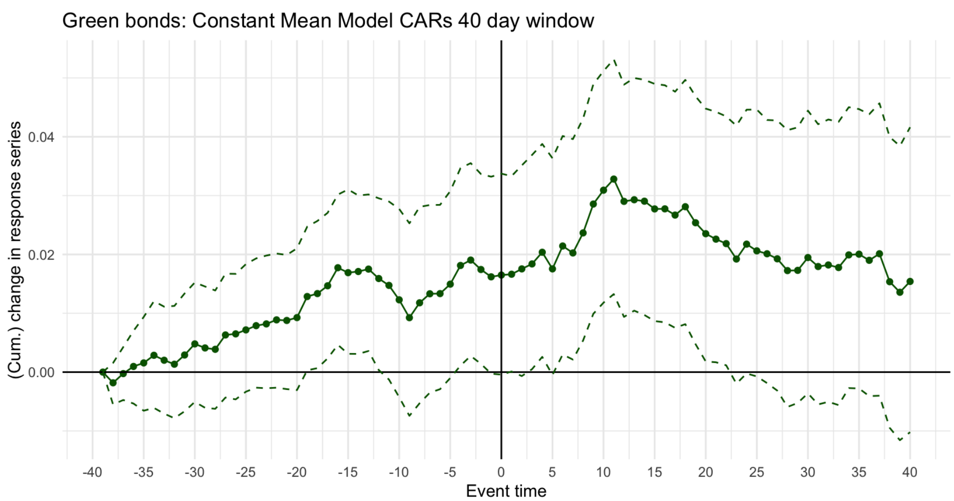

Figure 12. Constant Mean Model CARs for green bonds using a 40 day window, source: Author's own creation

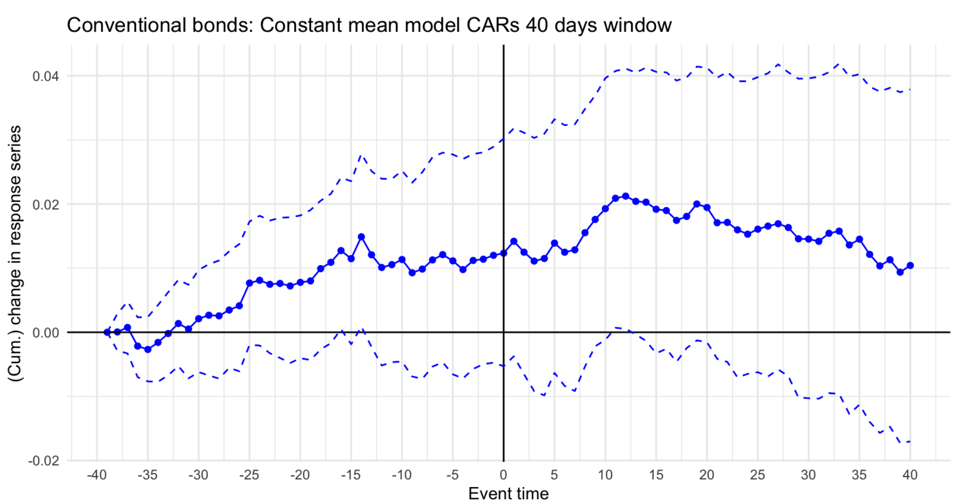

Figure 13.: Constant Mean Model CARs for conventional bonds using a 40 day window, source: Author's own creation

Table 10. Summary table for Constant Mean Model CARs for a 40 day window event for green and conventional bonds including confidence intervals, standard errors and a t-test

CAR Constant Mean Model 40 day window - Summary table

Green Bonds						**Conventional bonds**					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-19	0.0128	0.0018	0.0245	0.0058	2.2123**	-16	0.0127	0.0005	0.0241	0.0060	2.1109**
-16	0.01857	0.0058	0.0308	0.0064	2.9121**	-14	0.0149	0.0009	0.0279	0.0069	2.1649**
-14	0.0179	0.0045	0.031	0.0068	2.6505**	0	0.0123	-0.0053	0.0302	0.0091	1.3623
-11	0.0147	-0.00002	0.0291	0.0074	1.9867**	11	0.0209	0.0007	0.0407	0.0102	2.0453**
-5	0.0149	0.0004	0.0303	0.0076	1.9605**	12	0.0212	0.0005	0.0411	0.0103	2.052**
0	0.0165	0.0011	0.0322	0.0079	2.0804**						
11	0.0328	0.0132	0.0518	0.0099	3.3301**						
22	0.0218	0.0013	0.0431	0.0107	2.0487**						

While the constant mean model reveals significant CARs, the market model on the other hand shows that overall there are no statistically significant CARs for the 40 day event window neither for green nor for conventional bonds. CARs for green bonds exhibit a fluctuating pattern pre and post issuance. Before the issuance CARs are relatively stable around zero with no significant deviations. After the issuance CARs still fluctuate but reach a peak at day 14, after which there is a significant decline where CAR reaches -0.0256 by day 39 approaching statistical significance but not quite reaching it. With conventional bonds on the other hand, there is a relatively stable pattern of CARs around zero, with a downward trend in the post issuance.

Constant Mean Model and Market Model comparison

Comparing two models used to perform event study on green and conventional bonds starting with a 15 day event window, results show that both models exhibit negative trends in CARs before the issuance date, however the constant mean model shows less statistically significant days for both types of bonds compared to the market model. The difference is noticed post issuance. Constant mean model indicates a slight positive trend for green bonds, which is not so pronounced in the market model. For conventional bonds, both models show negative CARs with no significant recovery post issuance.

In a 20 day event window, the market model does not show any significant CARs for either bond type. Mean CARs fluctuate around zero throughout the event window for both bonds. Constant mean return model shows statistically significant positive CARs for green bonds on days 10 and 11 post issuance, while for conventional bonds there are significant positive CARs on days -16 and -14 pre issuance, but the post issuance CARs remain insignificant and are also less pronounced than the green bond CARs.

In a 30 day event window distinct differences in the patterns and statistical significance of the CARs between market and constant mean return model emerge for both types of bonds. In the market model, CARs for either green or conventional bonds do not show statistically significant values, with fluctuation around zero. Constant mean model for green bonds shows a more pronounced pattern with several significant CARs pre and post issuance, where the highest mean is observed on day 11 post issuance, which is also observed in the market model, however in the market model it is statistically insignificant, while in the constant mean model, it is significant with most of the event window. For conventional bonds, the constant mean model shows a relatively stable positive trend pre and post issuance with a few statistically significant CARs on days -16 and -14 pre issuance and on days 11 and 12 post issuance. While in the market model the highest conventional bond mean CAR is on day -14 with a value of 0.0068, in the constant mean model it is day 12 with mean CAR of 0.0189 with statistical significance.

5.2 Time Period 2014-2020 Subsample

In this subsample constant mean model and market model will be described separately and then compared, as most of the results from the market model were not significant.

Constant Mean Model

15 and 20 day window

The results for the 2014-2020 period using the constant mean model over both 15 day and 20 day event windows reveal fluctuations in CARs for both types of bonds, where there are no results that are statistically significant. Green bonds in the pre issuance period seem to fluctuate around 0 with the lowest mean CAR on day -9 with -0.003 in a 15 day window and -0.0044 on day -9 in a 20 day window. In the post issuance period, the mean CAR exhibits a positive but insignificant trend for both windows. Conventional bonds on the other hand show a negative trend pre issuance with the lowest mean CAR on day -9 with -0.0056 in the 15 day window and -0.0026 in the 20 day window. Just like green bonds in the post issuance event window, conventional CARs follow a positive yet insignificant trend.

30 day window

From *Figure 14* it is visible that the 30 day event window reveals several significant days for both green and conventional bonds, but with different timing and persistence of CARs. When it comes to green bonds, significant CARs are observed in the period post issuance, which is exhibiting a positive trend. Period pre issuance also shows a positive trend, however it does not hold any significant CARs. First statistically significant CAR is on day 10 with a mean of 0.0279 and a confidence interval between 0.0035 and 0.0530. This significant trend continues from days 10 to 18 and starts again from day 23. The highest CAR is observed on day 26, with a mean of 0.0364. The significant CARs persist up until day 29, where mean CAR equals 0.0337.

Conventional bonds also exhibit positive trends through the whole 30 day event window, but there are significant CARs noted both before and after the issuance date. On day -25 mean CAR is 0.0056 with a confidence interval between 0.0002 and 0.0108, indicating statistical significance. Days -18 and -14 are also statistically significant at 5% level. Post issuance there are several days in between day 10 and 30 observed as significant. On day 10 mean CAR is 0.0192. The positive trend continues and peaks on day 30 with a significant mean CAR at 0.0263.

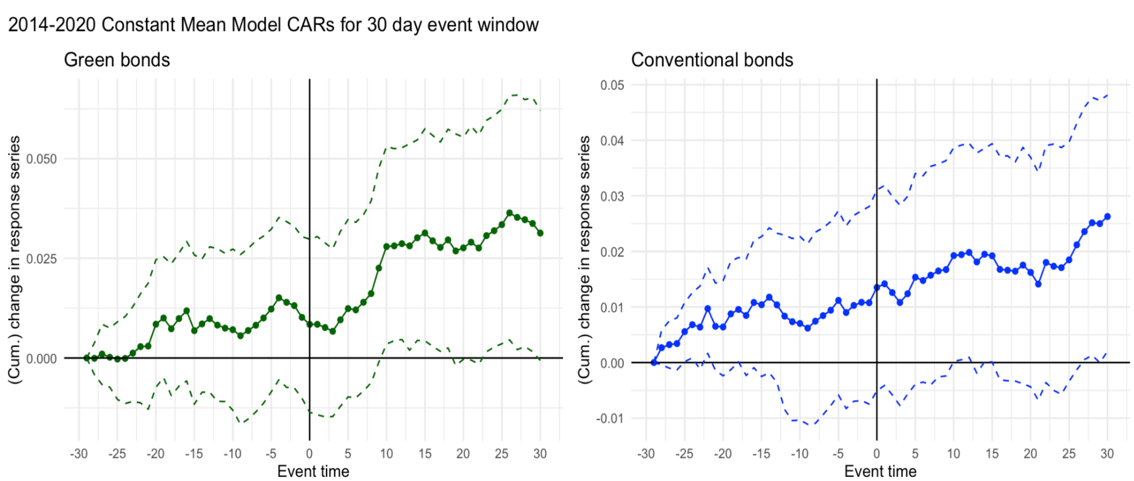

Figure 14. Green and conventional bonds issued from 2014-2020 Constant Mean Model for a 30 day window

Table 11. Summary table for Constant Mean Model CARs for a 30 day window event for green and conventional bonds issued 2014-2020 including confidence intervals, standard errors and a t-test

CAR 2014-2020 Constant Mean Model 30 day window - Summary table

Green Bonds						Conventional Bonds					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-4	0.0151	-0.0055	0.0352	0.0104	1.4543	-25	0.0056	0.0002	0.0108	0.0027	2.0486* *
0	0.0084	-0.0136	0.0298	0.0111	0.7615	-22	0.0097	0.0017	0.0171	0.0039	2.464* *
3	0.0067	-0.0147	0.0274	0.0107	0.6244	-18	0.0096	0.0001	0.0189	0.0048	1.9958* *
10	0.0279	0.0035	0.0530	0.0126	2.2109* *	-14	0.0118	-0.0018	0.0242	0.0067	1.7686
11	0.0281	0.0043	0.0525	0.0123	2.2884* *	0	0.0135	-0.0051	0.0311	0.0092	1.4663
12	0.0287	0.0046	0.0528	0.0123	2.3367* *	10	0.0192	0.0002	0.0387	0.0098	1.9608* *
13	0.0281	0.0019	0.0537	0.0132	2.13* *	11	0.0194	0.0005	0.0391	0.0099	1.9699* *
14	0.0302	0.0044	0.0547	0.0128	2.3509* *	12	0.0198	0.0009	0.0395	0.0098	2.0172* *
15	0.0314	0.0043	0.0575	0.0136	2.3102* *	14	0.0195	0.0001	0.0386	0.0098	1.9884* *
16	0.0294	0.0029	0.0558	0.0135	2.1774* *	27	0.0236	0.0005	0.0460	0.0116	2.0342* *
17	0.0277	0.0017	0.0542	0.0134	2.0704* *	28	0.0252	0.0013	0.0477	0.0118	2.1242* *
18	0.0296	0.0025	0.0574	0.0140	2.1176* *	29	0.0250	-0.00002	0.0472	0.0120	2.0765* *
23	0.0307	0.0016	0.0596	0.0148	2.0733* *	30	0.0263	0.0020	0.0481	0.0118	2.2345* *
24	0.0319	0.0028	0.0608	0.0148	2.1569* *						
25	0.0335	0.0036	0.0624	0.0150	2.2289* *						
26	0.0364	0.0046	0.0658	0.0156	2.3293* *						
27	0.0353	0.0021	0.0659	0.0163	2.1661* *						
28	0.0347	0.0029	0.0648	0.0158	2.1952* *						
29	0.0337	0.0016	0.0653	0.0163	2.0763* *						

40 day window

Over a 40 day window constant mean model shows a significant number of days with statistically significant CARs for both types of bonds as visible from *Figures 15 and 16*, however with different timing and persistence. Green bonds show significant positive CARs predominantly post issuance spanning from day 9 to day 40. There is one significant CAR observed in days pre issuance day, namely day -4 with a mean CAR 0.0197 and confidence interval between 0.0014 and 0.0374. In the post issuance window on day 9 the mean CAR is

0.0272. Upward trend continues through the days following day 9, reaching 0.0360 by day 15. The highest CAR observed within the window is on day 26 with a mean 0.0410.

Significant CARs for conventional bonds are observed both before and after the issuance day starting at day -31 with a mean CAR of 0.0072 and a confidence interval in a range of 0.0012 and 0.0131. Positive trend persists and the mean CAR increases to 0.0247 at the event date 0. The highest mean CAR is observed on day 40 at 0.04 and t-statistic of 3.4846.

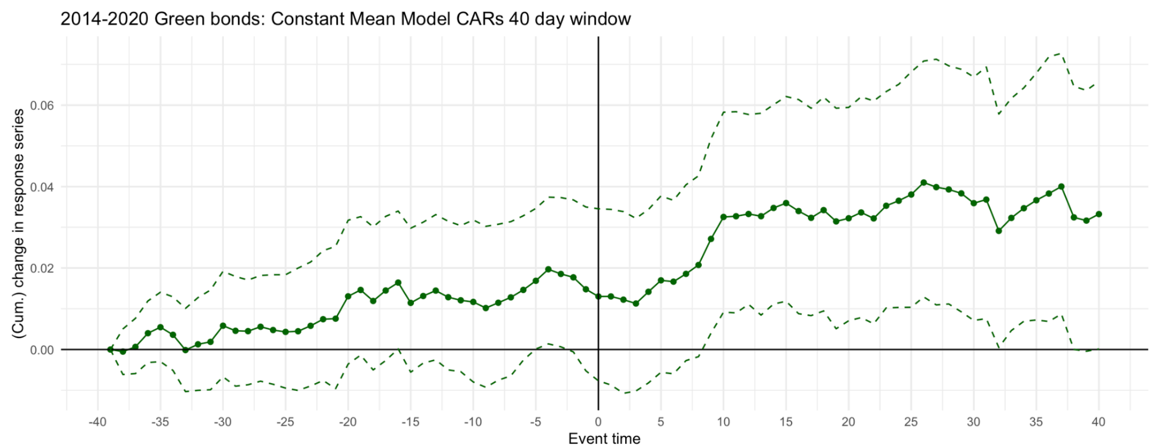

Figure 15. Green bonds issued from 2014-2020 Constant Mean Model for a 40 day window

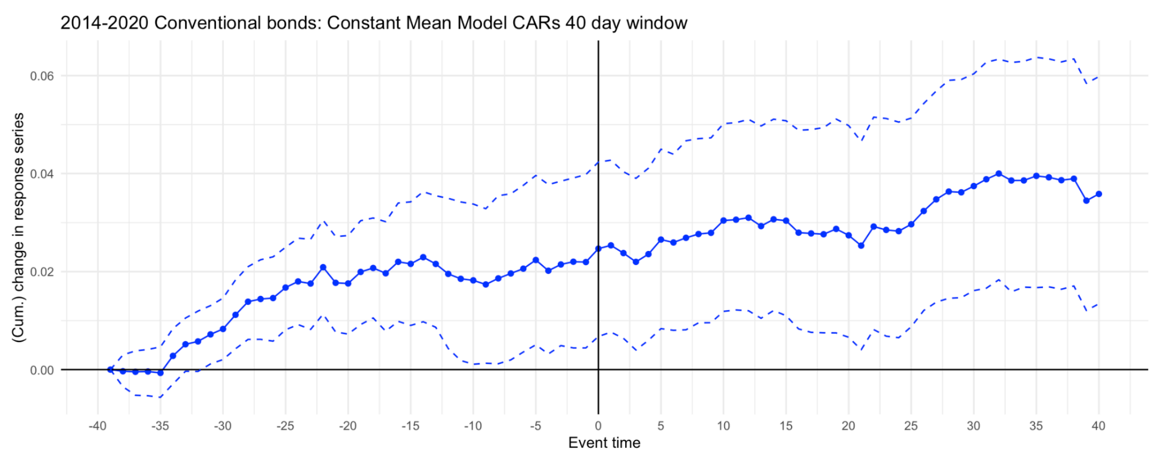

Figure 16. Conventional bonds issued from 2014-2020 Constant Mean Model for a 40 day window

Table 12. Summary table for Constant Mean Model CARs for a 40 day window event for green and conventional bonds issued 2014-2020 including confidence intervals, standard errors and a t-test

CAR 2014-2020 Constant Mean Model 40 day window - Summary table

Green Bonds						**Conventional Bonds**					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-4	0.0197	0.0014	0.0374	0.0092	2.1437* *	-31	0.0072	0.0012	0.0131	0.0030	2.3662* *
0	0.0130	-0.0077	0.0346	0.0108	1.209	-29	0.0112	0.0042	0.0183	0.0036	3.1175* *
9	0.0272	0.0040	0.0518	0.0122	2.2289* *	-24	0.0180	0.0092	0.0268	0.0045	3.9998* *
10	0.0325	0.0092	0.0583	0.0125	2.5982* *	0	0.0247	0.0068	0.0424	0.0091	2.7191* *
12	0.0333	0.0111	0.0577	0.0119	2.7984* *	10	0.0304	0.0119	0.0502	0.0098	3.1131* *
15	0.0360	0.0119	0.0621	0.0128	2.8041* *	20	0.0274	0.0066	0.0498	0.0110	2.4869* *
26	0.0410	0.0129	0.0708	0.0148	2.7752* *	30	0.0375	0.0161	0.0604	0.0113	3.3188* *
30	0.0359	0.0071	0.0669	0.0152	2.3563* *	40	0.0358	0.0134	0.0598	0.0118	3.031* *
40	0.0332	0.0002	0.0658	0.0168	1.9848* *						

Market Model

Running an event study using the market model on both green and conventional bonds issued in the time period between 2014-2020 over multiple event windows mostly resulted in no significant CARs. For this reason visual representation of these results are provided in *Appendix* for further inspection, while here I describe significant trends and some of the event dates that catch interest, followed by comparison between market model and constant mean model.

In the case of green bonds, market model CARs across various event windows show fluctuating patterns with periods of slight increases and decreases around the event date, but with no statistically significant changes. In the 15 day window CARs show some minor fluctuation around zero. The pre issuance period is characterized with negative CARs, while in the post issuance period positive CARs are observed from day 9, however not statistically significant. Similar not statistically significant observation occurs in the 20, 30 and 40 day window where CARs continue to oscillate around zero with more pronounced fluctuation trends, however the 40 day post issuance event window exhibits negative returns from day 30.

Market model for conventional bonds differs from the green bonds in a slightly different pattern, but still with no significant changes in CARs across most event windows, except the 40 day window. 15 and 20 day windows only hold negative CARs in both pre and post issuance window, while the 30 day window shows positive CARs in the pre issuance period until day -11. The 40 day window for conventional bonds from 2014-2020 is the only window estimated by market model that holds some days with positive significant CARs particularly in the pre issuance period until day -18, with a peak at day -22 with a significant mean at 0.0129, as evident in the *Figure 17* and from the summary table provided below.

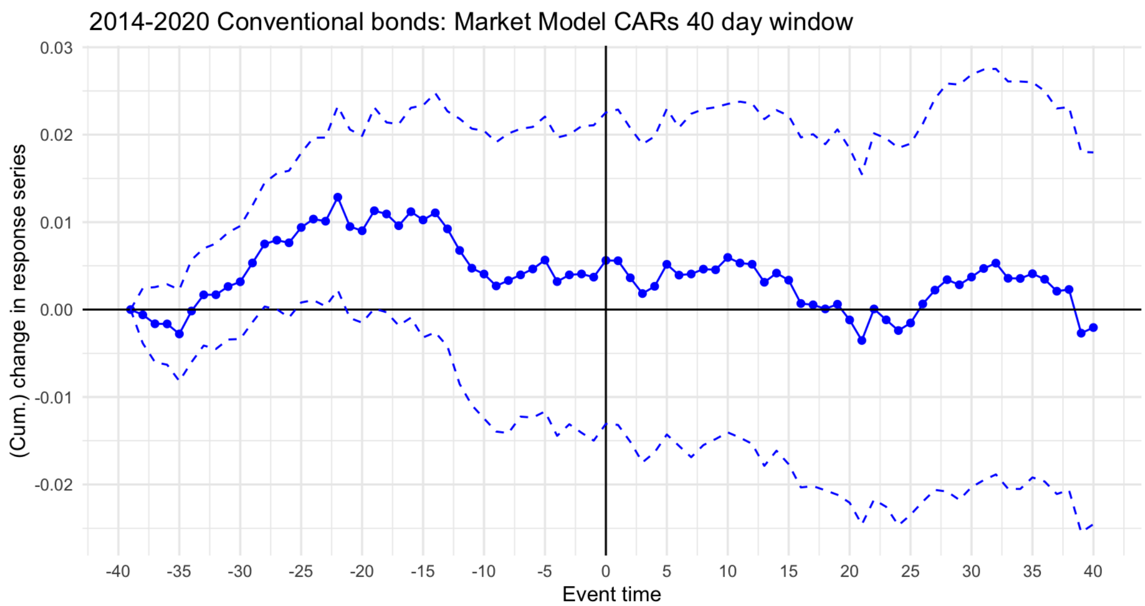

Figure 17. Conventional bonds issued from 2014-2020 Market Model for a 40 day window

Table 13. Summary table for Market Model CARs for a 40 day window event for conventional bonds issued 2014-2020 including confidence intervals, standard errors and a t-test

Conventional Bonds CAR 2014-2020 Market Model 40 day window - Summary table

EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-28	0.0075	0.0003	0.0145	0.0036	2.0766**
-27	0.0079	0.00004	0.0156	0.0040	2.0028**
-25	0.0094	0.0008	0.0179	0.0044	2.1531**
-24	0.0103	0.0011	0.0196	0.0047	2.1844**
-23	0.0101	0.0004	0.0197	0.0049	2.0536**
-22	0.0129	0.0022	0.0232	0.0054	2.3956**
-18	0.0109	-0.0003	0.0214	0.0055	1.9737**
0	0.0056	-0.0131	0.0225	0.0091	0.6189
21	-0.0035	-0.0246	0.0155	0.0102	-0.3455

Constant Mean Model and Market Model comparison

In the 15 and 20 day event window both constant mean and market model for green and conventional bonds show fluctuations in CARs without any statistically significant results. While both constant mean model and market model for green bonds show similar patterns in pre and post issuance window, conventional bonds have different patterns. In the constant mean model conventional bonds' CARs follow a negative trend pre issuance, while in the post issuance there is a positive trend. The market model's post issuance window however continues to show a negative trend.

Differences between models become more noticeable in the 30 day event window, where the constant mean model holds several significant CARs for both types of bonds, particularly post issuance for green bonds. For conventional bonds, significant CARs are observed both before and after the issuance day. On the other hand, the market model shows fluctuations around zero for both types of bonds, but it does not show any significant CARs.

The 40 day window reveals even further differences between models. While the constant mean model shows a substantial number of significant days post issuance for green bonds and pre and post issuance for conventional bonds, the market model only shows significant CARs for conventional bonds for pre issuance period until day -18. The market model for green bonds fluctuates around zero with no significant results.

5.3 Time Period 2021-2024 Subsample

Constant Mean Model

15 day window

From *Figure 18* it is evident that green bond CARs and conventional bond CARs estimated in the 15 day window with the constant mean model have very different patterns. When it comes to green bonds, a consistent negative trend in CARs both pre and post issuance can be observed. Statistically significant CARs are evident in most pre issuance days. The first significant CAR is seen on day -10 with a mean of -0.0131. Days following are also statistically significant and follow the negative trend. On the day of the issuance, day 0, mean CAR is at -0.0193. From here on CARs fluctuate slightly, but the days where CAR goes up, like days 4, 9 and 11, are not significant at 5% level. Negative trend peaks on the last day of the event window with a significant mean CAR of -0.0339.
On the other hand, conventional bonds exhibit a more stable pattern where CARs fluctuate around zero, with no statistically significant values across the whole event window. The highest mean CAR pre issuance is observed on day -10 at 0.0033, and post issuance on day 12 at 0.0092. On other days CARs are either negative or remain relatively close to zero, however not statistically significant.

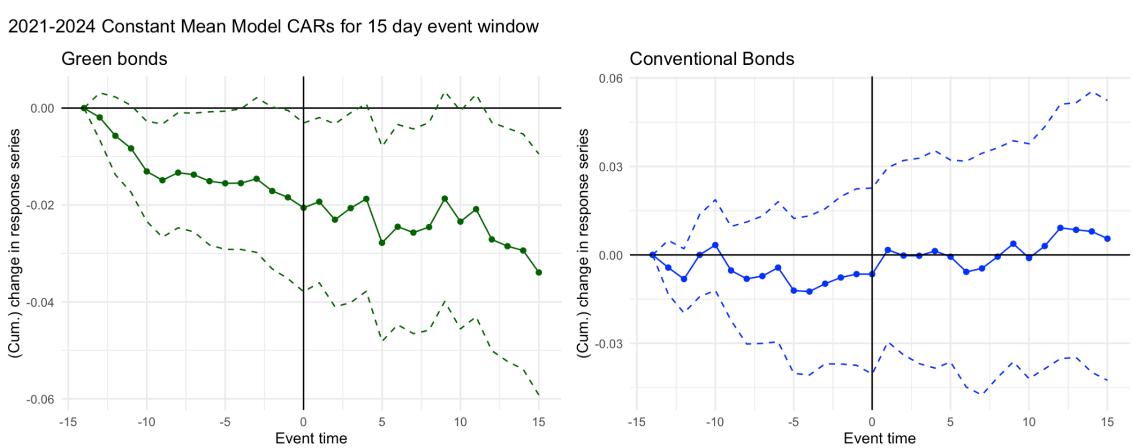

Figure 18. Green and conventional bonds issued from 2021-2024 Constant Mean Model for a 15 day window

Table 14. Summary table for Constant Mean Model CARs for a 15 day window event for green bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

2021-2024 Green Bonds CAR Constant Mean Model 40 day window - Summary table

EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-10	*-0.0131*	*-0.0234*	*-0.0027*	*0.0053*	*-2.4814***
-5	*-0.0155*	*-0.0292*	*-0.0006*	*0.0073*	*-2.133***
0	*-0.0206*	*-0.0379*	*-0.0031*	*0.0089*	*-2.3166***
5	*-0.0278*	*-0.0482*	*-0.0079*	*0.0103*	*-2.7105***
10	*-0.0234*	*-0.0456*	*-0.0006*	*0.0115*	*-2.041***
15	*-0.0339*	*-0.0592*	*-0.0095*	*0.0127*	*-2.6744***

20 day window

In the 20 day window constant mean model reveals statistically significant CARs only for green bonds in post issuance period. From *Figure 19* it can be seen that green bonds still generally follow a negative trend with the exception in the pre issuance period between days -18 and -10 where CARs are positive but not statistically significant. In the post issuance window there is a negative trend where days from 16 to 20 are found to be statistically significant, as evident from *Table 15*. On day 16 mean CAR is -0.0264 and on day 20 it is -0.0339.
CARs for conventional bonds in the pre issuance period are mostly positive but with a tendency to fluctuate around zero, while in the post issuance period there is a more positive trend with fluctuations, however not found statistically significant.

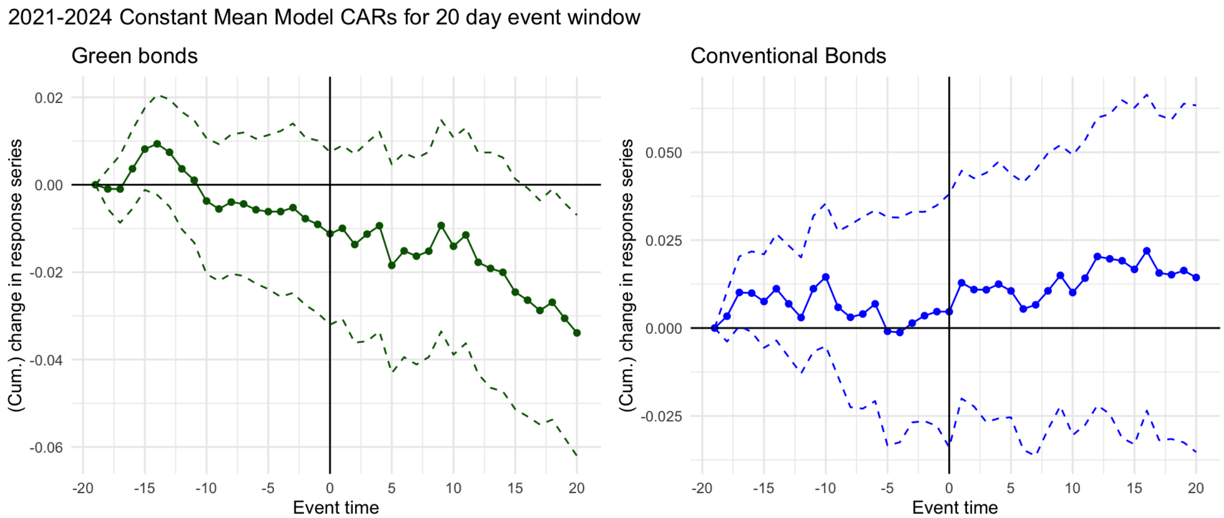

Figure 19. Green and conventional bonds issued from 2021-2024 Constant Mean Model for a 20 day window

Table 15. Summary table for Constant Mean Model CARs for a 20 day window event for green bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

2021-2024 Green Bonds CAR Constant Mean Model 20 day window - Summary table

EventTime	Mean	CI Lower	CI Upper	SE	t-stat
0	*-0.0112*	*-0.0320*	*0.0075*	*0.0101*	*-1.1122*
16	*-0.0264*	*-0.0530*	*-0.0008*	*0.0133*	*-1.9812***
17	*-0.0288*	*-0.0549*	*-0.0036*	*0.0131*	*-2.1987***
18	*-0.0269*	*-0.0538*	*-0.0010*	*0.0135*	*-1.9977***
19	*-0.0306*	*-0.0579*	*-0.0042*	*0.0137*	*-2.2316***
20	*-0.0339*	*-0.0621*	*-0.0069*	*0.0141*	*-2.4099***

30 day window

In the 30 day window CARs for the conventional bonds are still not found statistically significant and are generally fluctuating around zero with an exception of the post issuance window where from day 23 a negative trend begins. CARs for green bonds are mostly not statistically significant, however in the pre issuance period there are a couple of days where CARs are found positive and statistically significant. These days are -15 and -14 with mean CARs at 0.021 and 0.0222 respectively. In the post issuance window the last few days are also found to be significant, namely day 23 and days from 25 to 30. These days hold negative CAR values where the lowest CAR is found on the day 28 with a mean -0.0407.

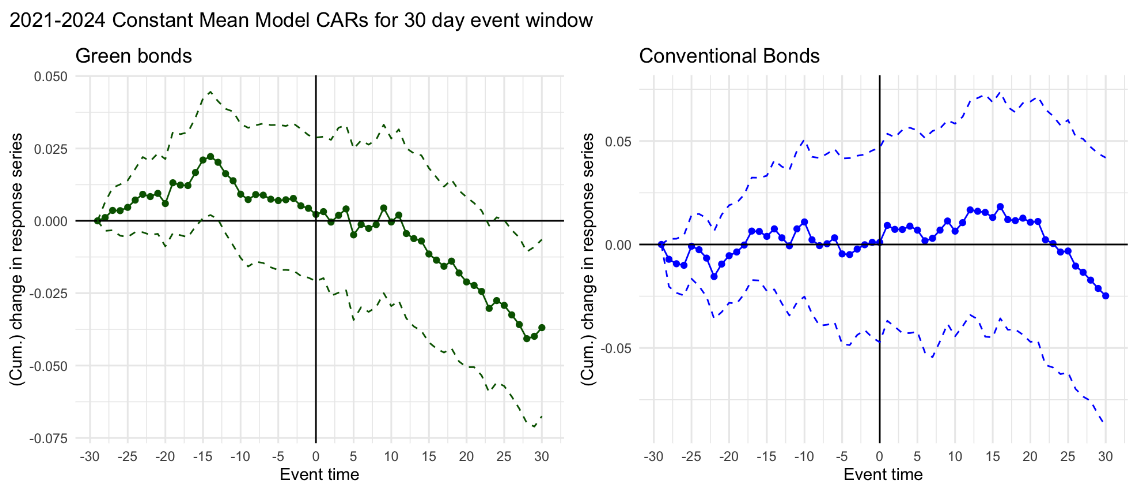

Figure 20. Green and conventional bonds issued from 2021-2024 Constant Mean Model for a 30 day window

Table 16. Summary table for Constant Mean Model CARs for a 30 day window event for green bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

2021-2024 Green Bonds CAR Constant Mean Model 30 day window - Summary table

EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-15	*0.0210*	*0.0009*	*0.0422*	*0.0105*	*1.9939***
-14	*0.0222*	*0.0020*	*0.0445*	*0.0109*	*2.0456***
0	*0.0022*	*-0.0208*	*0.0288*	*0.0127*	*0.1751*
23	*-0.0303*	*-0.0593*	*-0.0017*	*0.0147*	*-2.0576***
25	*-0.0292*	*-0.0571*	*0.0003*	*0.0146*	*-1.9973***
26	*-0.0325*	*-0.0607*	*-0.0032*	*0.0147*	*-2.2148***
27	*-0.0358*	*-0.0649*	*-0.0058*	*0.0151*	*-2.3772***
28	*-0.0407*	*-0.0698*	*-0.0107*	*0.0151*	*-2.6982***
29	*-0.0399*	*-0.0711*	*-0.0090*	*0.0158*	*-2.5185***
30	*-0.0369*	*-0.0675*	*-0.0065*	*0.0156*	*-2.3694***

40 day window

CARs for green bonds in a 40 day window behave similarly to CARs in the 30 event window, following a positive trend in pre issuance and negative trend in post issuance window, where days -15 and -14 are also statistically significant, with mean CARs at -0.0229 and -0.0238.

Likewise, in the post issuance period the last couple of days are significant, spanning from day 28 to 40, with a couple of days in between not being significant as evident from *Figure 21*. Lowest mean CAR is seen on day -39 at -0.0433.

For conventional bonds there seems to be a general negative trend prevailing over the event window. This is the only window in the constant mean model tested for conventional bonds that reveals significant CARs. They are found in the pre issuance period starting from day -35 with mean CAR at -0.0127. Last significant CAR is on day -22 with a mean value of -0.0373, also being the lowest CAR in the whole event window.

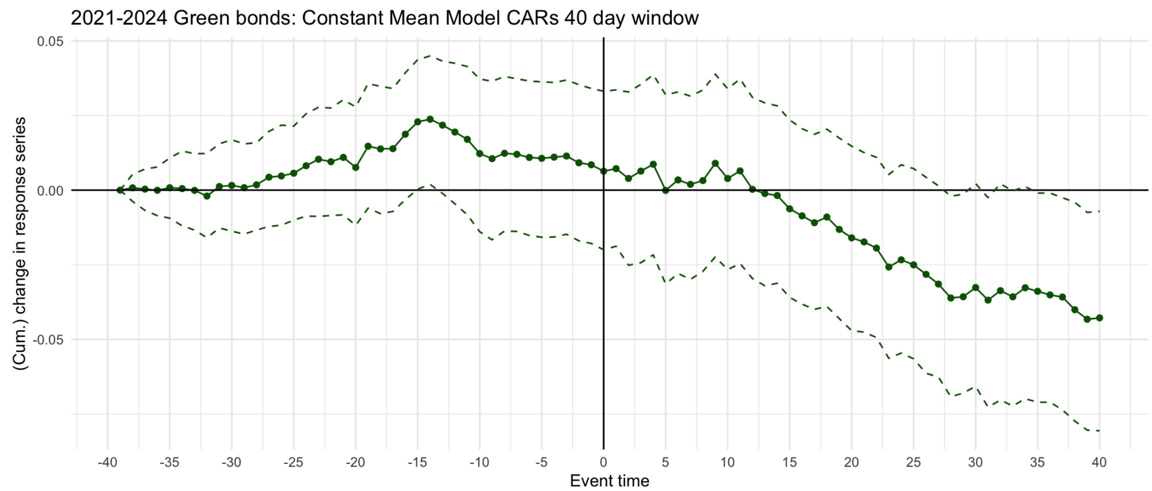

Figure 21. Green bonds issued from 2021-2024 Constant Mean Model for a 40 day window

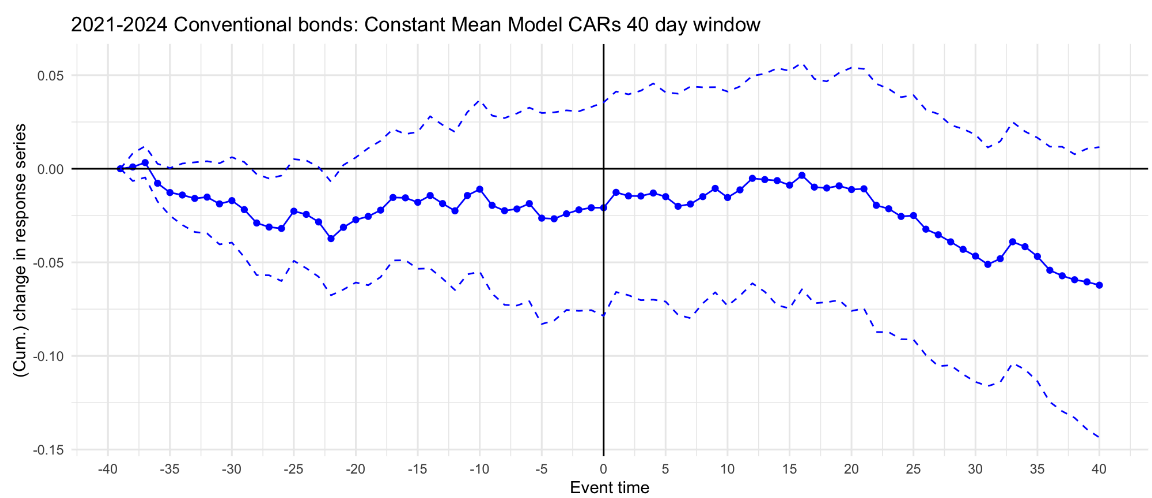

Figure 22. Conventional bonds issued from 2021-2024 Constant Mean Model for a 40 day window

Table 17. Summary table for Constant Mean Model CARs for a 40 day window event for green and conventional bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

CARs 2021-2024 Constant Mean Model 40 day window - Summary table

Green Bonds						**Conventional Bonds**					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-15	*0.0229*	*0.0003*	*0.0437*	*0.0111*	*2.069***	*-35*	*-0.0127*	*-0.0250*	*0.0004*	*0.0065*	*-1.9614***
-14	*0.0238*	*0.0019*	*0.0450*	*0.0110*	*2.1651***	*-28*	*-0.0290*	*-0.0568*	*-0.0029*	*0.0138*	*-2.1065***
0	*0.0063*	*-0.0200*	*0.0331*	*0.0135*	*0.4686*	*-27*	*-0.0311*	*-0.0569*	*-0.0052*	*0.0132*	*-2.3618***
28	*-0.0361*	*-0.0692*	*-0.0020*	*0.0172*	*-2.1065***	*-26*	*-0.0319*	*-0.0600*	*-0.0036*	*0.0144*	*-2.2187***
29	*-0.0357*	*-0.0680*	*-0.0014*	*0.0170*	*-2.1034***	*-22*	*-0.0373*	*-0.0676*	*-0.0069*	*0.0155*	*-2.4127***
31	*-0.0368*	*-0.0727*	*-0.0025*	*0.0179*	*-2.0573***	*0*	*-0.0208*	*-0.0786*	*0.0355*	*0.0291*	*-0.7152*
36	*-0.0351*	*-0.0710*	*-0.0010*	*0.0179*	*-1.9641***						
37	*-0.0358*	*-0.0736*	*-0.0025*	*0.0181*	*-1.9742***						
38	*-0.0401*	*-0.0774*	*-0.0041*	*0.0187*	*-2.1425***						
39	*-0.0433*	*-0.0804*	*-0.0075*	*0.0186*	*-2.3243***						
40	*-0.0428*	*-0.0806*	*-0.0071*	*0.0188*	*-2.2821***						

Market Model

Next I present the results from the market model for the 2021-2024 time period subsample for both types of bonds. The primary focus will be placed on the 15 day event window because it captures representative trends and statistically significant results for green bonds. Results for other event windows, even though statistically significant, are in more detail mostly included in graphical representations and summary tables in the *Appendix*, as they exhibit similar behavior, but with a decreased significance for green bonds as the window expands.

Looking at the CARs for green bonds from *Figure 23*, there is a significant negative trend. Starting from day -11 where mean CAR is at -0.0117, statistically significant CARs are observed and are persistent all through the event window. Significant declines can be noticed in the pre and post issuance periods, with the lowest mean CAR occurring on the last day of the event window at -0.0574 and a t-statistics of -4.4185.

In contrast, CARs for conventional bonds over the same event window are also negative but show no statistically significant values. They fluctuate relatively close to zero throughout the event window, with no notable deviations.

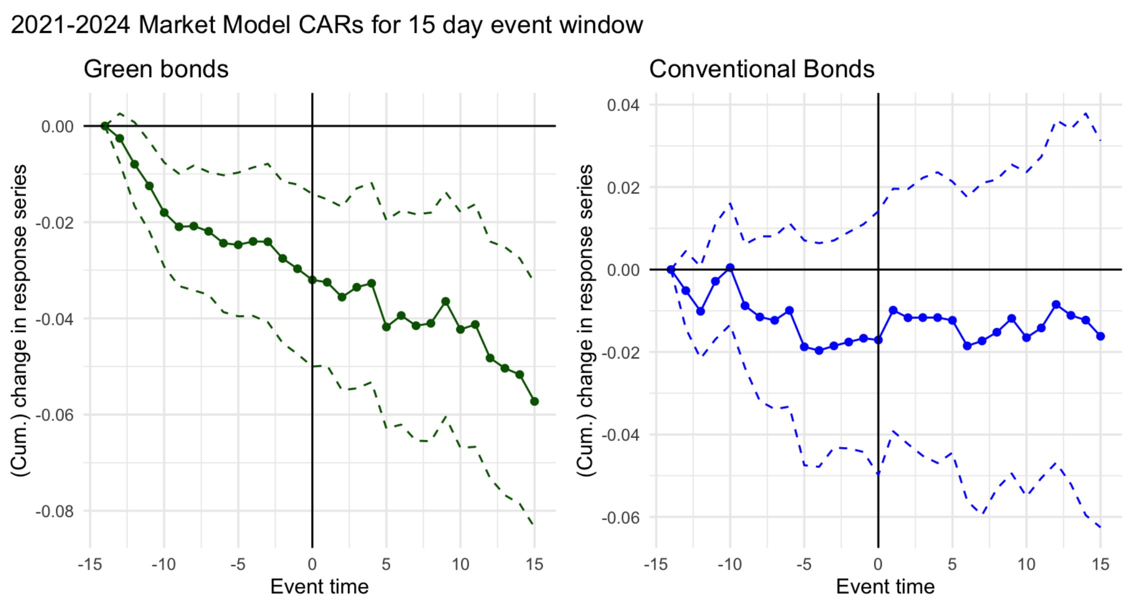

Figure 23: Green and conventional bonds issued from 2021-2024 Market Model for a 15 day window

Table 18. Summary table for Market Model CARs for a 40 day window event for green bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

2021-2024 Green Bonds CAR Market Model 15 day window - Summary table

EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-11	*-0.0117*	*-0.0214*	*-0.0031*	*0.0047*	*-2.5111***
-7	*-0.0203*	*-0.0332*	*-0.0079*	*0.0065*	*-3.1523***
-3	*-0.0241*	*-0.0406*	*-0.0082*	*0.0083*	*-2.92***
0	*-0.0328*	*-0.0503*	*-0.0156*	*0.0089*	*-3.7053 ***
3	*-0.0357*	*-0.0558*	*-0.0161*	*0.0101*	*-3.5201***
7	*-0.0435*	*-0.0660*	*-0.0226*	*0.0111*	*-3.9337***
11	*-0.0432*	*-0.0669*	*-0.0198*	*0.0120*	*-3.5988***
15	*-0.0574*	*-0.0836*	*-0.0327*	*0.0130*	*-4.4185***

While I put the primary focus on the 15 day window, the 20, 30 and 40 day windows provide additional insights into CAR behavior and are still worth mentioning. They generally show similar patterns to the 15 day window but with varying degrees of significance and trends. CARs for green bonds continue being significant and negative in the 20 day window, following a negative trend from day -12, which is not significant, to the end of the event window. The first significant CAR can be observed on day -6 with a mean -0.017, and the lowest mean on the day 20 at -0.0642. In the 30 day window, the negative trend for green bonds continues, however the first significant CAR observed is in the post issuance period on day 2 with a mean of -0.0272. In the 40 day event window, green bond CARs remain to follow a negative trend which becomes statistically significant from day -1 with a mean value of -0.0282.

When it comes to conventional bonds, significant CARs emerge in the longer event windows, but also a negative trend over the whole event window. In the 20 day window, there are no statistically significant CARs, however in the 30 day window, negative significant CARs appear near the end of the event window, with the lowest mean on day -30 at -0.0723. This trend is more detectable in the 40 day window. Negative significant CARs for conventional bonds are observed in the pre issuance period from days -35 to -22 and in post issuance period from day 30 to 40, with the lowest mean at day 40 at -0.1264.

Constant Mean Model and Market Model comparison

Both models provide complementary insights into the CAR behavior for green and conventional bonds during the 2021-2024 time period. For green bonds, a significant negative trend is observed in both models, particularly in the 15 day event window. While the constant mean model identifies several days with significant negative CARs in pre and post issuance period, the market model identifies a broader span of statistically significant days, almost over the entire event window.

While the constant mean model only identifies significant CARs for conventional bonds in the 40 day event window, where even then they are limited to the pre issuance period, the market model reveals significant negative CARs that emerge already in the 30 day window, but are more prominent in the 40 day window in both pre and post issuance periods.

5.4 Sectors

Technology & Industry Sector

Running an event study on different windows and models for the technology & industry sector revealed that there are almost no statistically significant CARs for either green or conventional bonds. The only instance I found significant CARs was in the market model on a 15-day event window and only for the green bonds. From *Figure 24* it can be seen that only two negative

CARs are significant and they are observed in the pre issuance period on days -12 and -9 with means of -0.0196 and -0.0251 respectively. This contrasts to the constant mean model, which shows no significant results. If we look at the overall trends, green and conventional bonds seem to fluctuate around 0 with no significant values in sight. Expanding the event windows shows consistent trends with minor fluctuations but no significant changes.

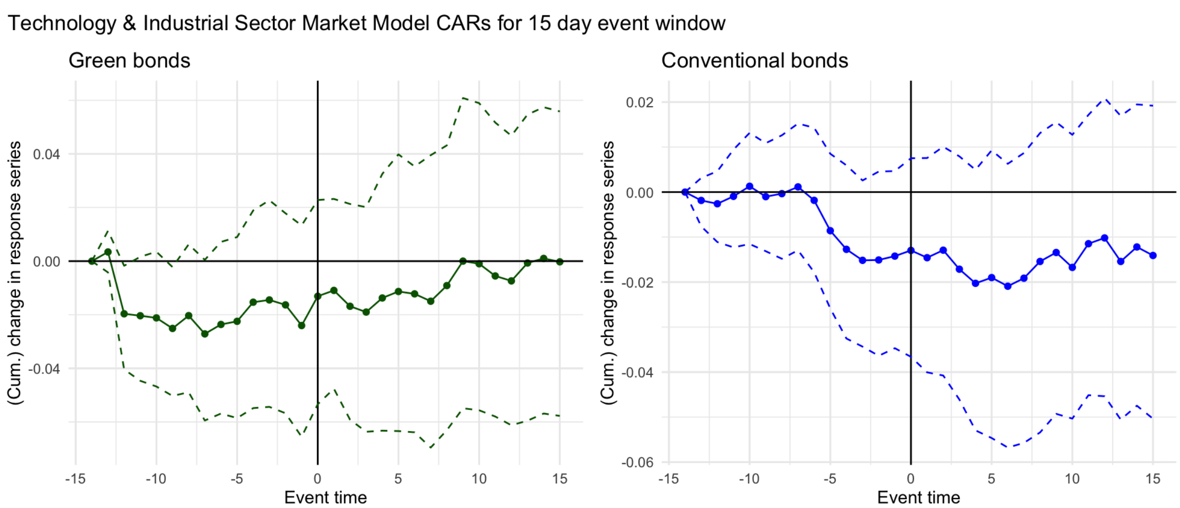

Figure 24. Technology & Industrial sector event study MM 15 day window

Table 19. Technology & Industry sector event study MM 15 day window

Technology & Industrial Sector CAR Market Model 15 day window - Summary table

Green Bonds						**Conventional Bonds**					
Event	Mean	CI Lower	CI Upper	SE	t_stat	Event	Mean	CI Lower	CI Upper	SE	t_stat
-12	-0.0196	-0.0404	-0.0017	0.0099	-1.9914**	-7	0.0012	-0.0129	0.0152	0.0072	0.1609
-9	-0.0251	-0.0503	-0.0022	0.0123	-2.0466**	0	-0.0130	-0.0366	0.0075	0.0113	-1.1513
-13	0.0034	-0.0042	0.0113	0.0040	0.8646	4	-0.0203	-0.0530	0.0049	0.0148	-1.3727
0	-0.0131	-0.0534	0.0228	0.0194	-0.6737	15	-0.0141	-0.0504	0.0192	0.0177	-0.7938
3	-0.0190	-0.0637	0.0202	0.0214	-0.8888						
15	-0.0003	-0.0577	0.0559	0.0290	-0.0088						

Resource & Infrastructure sector

There seems to be a negative trend in the resource & infrastructure in all of the windows for both types of the bonds. While there are significant negative CARs observed for conventional bonds, the frequency and magnitude are less pronounced compared to green bonds. Green bonds show significant negative CARs, primarily captured by the market model. Market model seems to capture significant negative CARs more effectively than the constant mean model, which is in contrast to technology & industry sectors where both of the models presented uniform trends and findings.

While conventional bonds have significant CARs only in the beginning of the pre issuance period, with the exception of day 3 in the 15-day event window captured with the market model, green bonds' CARs are significant in both pre and post issuance periods. These findings are consistent over most of the event windows. Here I will give a detailed interpretation of a 40 day event window estimated with a market model, while in *Appendix* graphical representation on event days that present significant CARs can be found. From *Figure 25* it can be observed that the market model reveals several negative significant CARs for green bonds, starting from day -10 in the pre issuance period with a mean -0.0466 and continues almost uninterrupted to day 39 where the mean CAR is -0.0781. For conventional bonds on the other hand, the only significant reaction is observed on day -27 with a positive CAR with a mean of 0.0304. Green bonds show significant negative CARs on multiple event dates which indicates a strong and sustained reaction to green bond issuances.

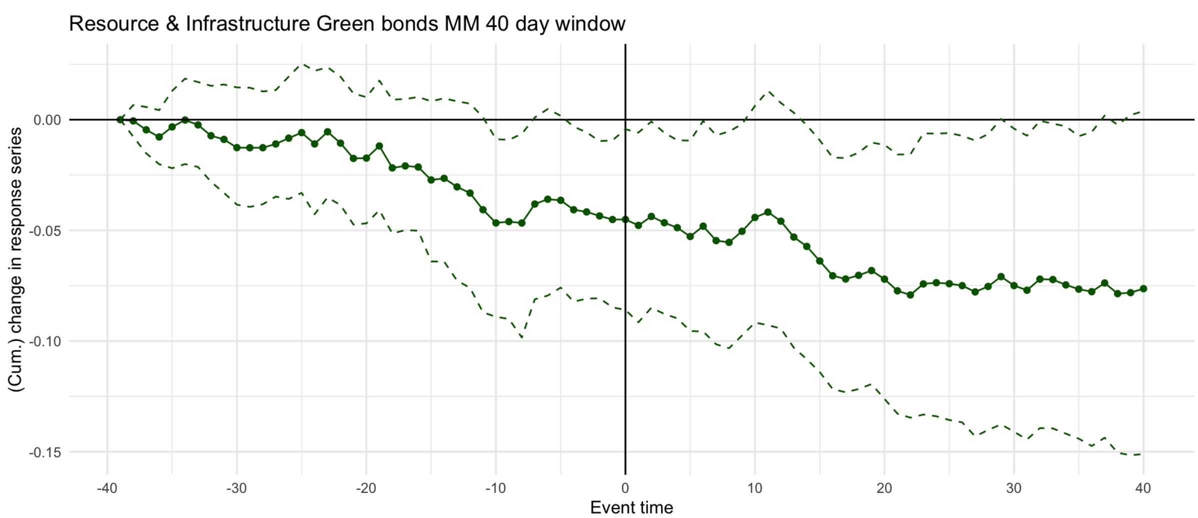

Figure 25. Resource & Infrastructure sector CARs for green bonds estimated with MM in a 40 day event window

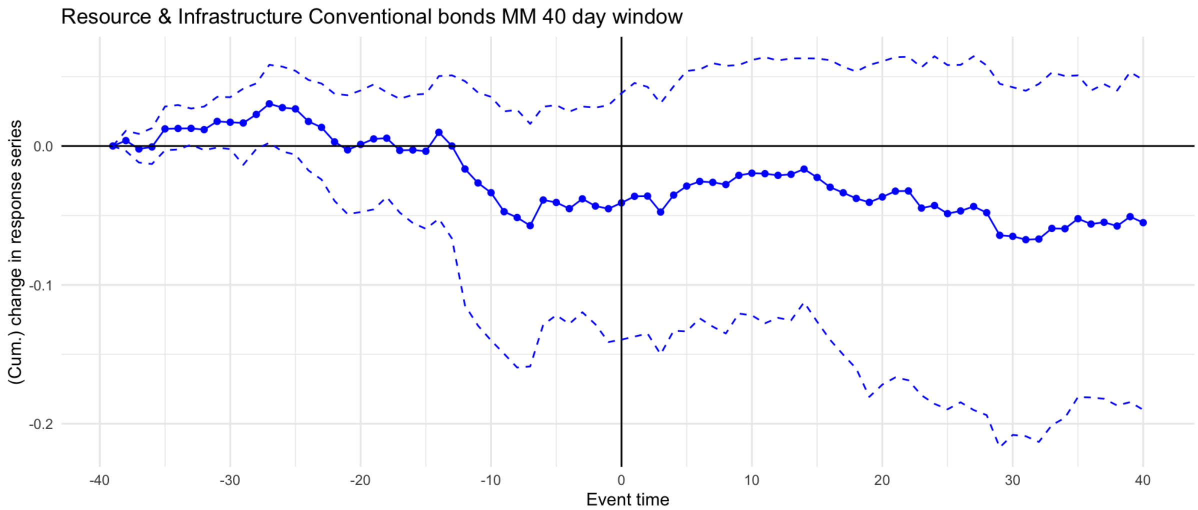

Figure 26. Resource & Infrastructure sector CARs for conventional bonds estimated with MM in a 40 day event window

Table 20. Resource & Infrastructure sector event study MM 40 day window

Resource & Infrastructure Sector CAR Market Model 40 day window - Summary table

Green Bonds						**Conventional Bonds**					
Event	Mean	CI Lower	CI Upper	SE	t_stat	Event	Mean	CI Lower	CI Upper	SE	t_stat
-10	-0.0466	-0.0891	-0.0088	0.0205	-2.2772**	-27	0.0304	0.0023	0.0585	0.0143	2.124**
-4	-0.0407	-0.0822	-0.0031	0.0202	-2.0156**	0	-0.0409	-0.1394	0.0380	0.0453	-0.9044
0	-0.0451	-0.0860	-0.0043	0.0208	-2.1638**						
9	-0.0504	-0.0975	-0.0020	0.0244	-2.0689**						
14	-0.0572	-0.1082	-0.0025	0.0270	-2.1224**						
20	-0.0720	-0.1261	-0.0114	0.0293	-2.4597**						
30	-0.0749	-0.1410	-0.0040	0.0349	-2.1449**						
39	-0.0781	-0.1516	0.0021	0.0392	-1.9931**						

Real Estate sector

Green and conventional bonds show similar patterns and trends across all of the event windows in the real estate sector. Significant positive CARs can be observed throughout the event windows estimated with a constant mean model for both types of bonds. This reflects a strong positive trend in CARs and indicates that the market reacts to both types of bonds similarly before, during and after the bond issuances. In contrast to technology & industry but also resource & infrastructure sectors, the constant mean model is much more effective to capture significant CARs in the real estate sector. The event window that yields the fewest statistical CARs is the 15-day event window, where there is only one significant negative CAR observed on day -12 for conventional bonds. I present results for a 30-day event study using constant mean model in *Figure 27* and *Table 21,* while graphical representation for the 20 and 40 day window can be found in *Appendix.* There are several significant positive reactions, where one of them is a positive significant CAR on the event date 0, where mean CAR for green bonds is 0.0239 and 0.0291 for conventional bonds. Positive and significant CARs for green bonds start from day -17 pre issuance period and continue without interruption until day 26 where mean CAR amounts to 0.0263. For conventional bonds significant CARs start even earlier on than with green bonds, namely from day -25 with mean CAR of 0.0069. From day -25 conventional bonds have been experiencing a straightforward positive and significant trend, where even the last day in the estimation period holds a significant positive CAR at 0.0371.

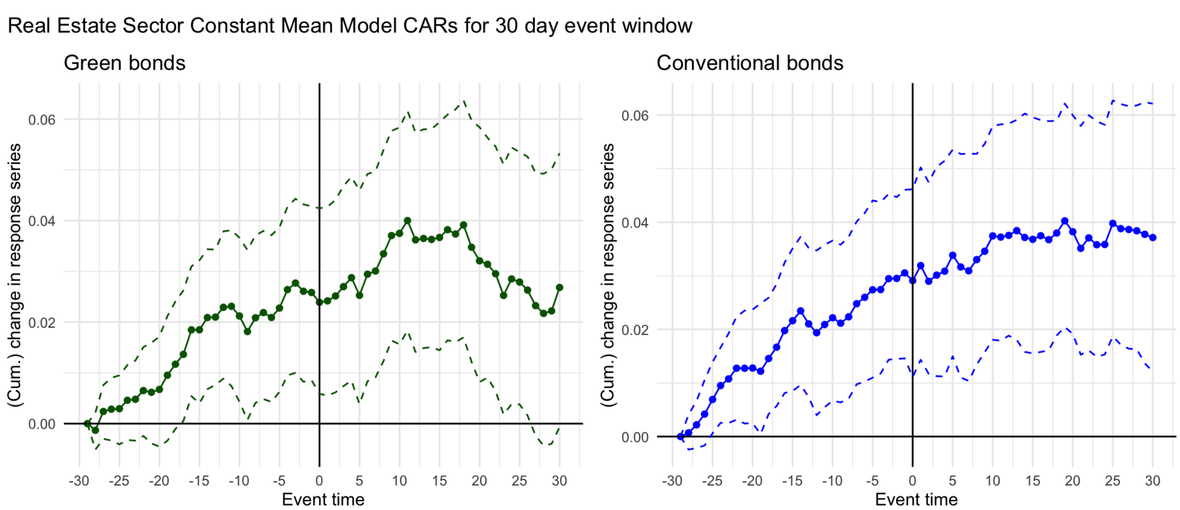

Figure 27. Real estate sector event study CMM 30 day window

Table 21. Real Estate sector event study CMM 30 day window

Real Estate Sector CAR Constant Mean Model 30 day window - Summary table

Green Bonds						Conventional Bonds					
Event	Mean	CI Lower	CI Upper	SE	t_stat	Event	Mean	CI Lower	CI Upper	SE	t_stat
-17	0.0137	0.0005	0.0262	0.0066	2.0809* *	-25	0.0069	0.0006	0.0139	0.0034	2.0403* *
-11	0.0231	0.0074	0.0381	0.0078	2.9499* *	-17	0.0167	0.0057	0.0285	0.0058	2.8714* *
-5	0.0228	0.0062	0.0387	0.0083	2.754* *	-11	0.0209	0.0055	0.0358	0.0077	2.7039* *
0	0.0239	0.0059	0.0424	0.0093	2.5637* *	-5	0.0274	0.0110	0.0440	0.0084	3.2485* *
10	0.0375	0.0156	0.0584	0.0109	3.4407* *	0	0.0291	0.0111	0.0462	0.0089	3.2552* *
20	0.0321	0.0082	0.0584	0.0128	2.5045* *	10	0.0374	0.0181	0.0580	0.0102	3.6792* *
26	0.0263	0.0016	0.0526	0.0130	2.0209* *	20	0.0382	0.0192	0.0600	0.0104	3.6719* *
						30	0.0371	0.0122	0.0621	0.0127	2.9149* *

Having thoroughly presented findings from the main sample and subsamples, I will proceed with analyzing, discussing and interpreting them in relation to my hypotheses. This includes investigating factors behind varying market responses, the effectiveness of different models in capturing significant CARs and how these results align with the existing literature. I will also consider a broader implication of these findings for issuers and investors in green and conventional bonds.

6. DISCUSSION

The results of this thesis event study provide insights into the stock market's reaction to the issuance of green and conventional bonds issued by non-financial Nordic companies. By examining CARs across different event windows and employing the constant mean model and the market model, several key findings emerged. While green bonds generally exhibited positive CARs in the post issuance period, particularly in longer event windows, with several statistically significant event dates at 5% level, conventional bonds showed less pronounced and more fluctuating CARs, where significant effects were mostly observed in the pre issuance period. The constant mean model generally captured more significant CARs compared to the market model, with the exception of resource & infrastructure sector subsample, which suggests it has been effective to reflect investor sentiment around bond issuance events. These findings have several implications for my hypotheses.

The main sample results revealed distinct reactions to green and conventional bond issuances. In shorter event windows negative trends or fluctuations around zero were observed for both types of bonds in the pre issuance period with just a few statistically significant CARs. In the post issuance period positive trends emerged, again with only a few statistically significant CARs. Expanding the event windows past 20 days, revealed quite a few more significant results, especially for green bonds. In the 30-day event window green bonds had significant positive CARs on multiple days pre and post issuance, with a peak observed on day 11. With conventional bonds on the other hand, significant positive CARs were found in both pre and post issuance but not in the same intensity or amount as the green bonds. The 40-day window showed the biggest impact green bond issuance has had on CARs with multiple significantly positive periods pre and post issuance, while the conventional bonds issuances had similar findings to the 30-day window. Given these findings, I can cautiously state that issuing green bonds tends to have a positive effect on stock performance, which is especially evident in longer event windows. Even though evidence might lean toward the positive impact of green bond issuance, there is a lack of consistent and uniformly confirmed significant CARs. Thus I cannot fully reject the null hypothesis of no significant impact on stock performance. This is in line with the findings of (Xi & Jing, 2021) who found that the stock price effect of green bond issuance varies based on factors such as investor sentiment and the nature of the issuing company. This indicates that other factors may also have some role to play in influencing the stock performance such as firm size or previous experience, so further research is needed with control variables isolating the effect of the green bond issuance from other influencing factors.

In relation to my second hypothesis, the results indicate that green bonds tend to have more significant positive CARs compared to conventional bonds, especially over longer event windows. I find that while issuing both types of bonds can have an impact on stock performance, it seems that the market sees issuing green bonds more positively. However, given that significant positive CARs were also observed for conventional bonds and that the results varied across event windows, I cannot definitely reject the null hypothesis of no difference. Additionally, there were instances of significant CARs for both types of bonds on the same days in the market model, seen in the 15-day event window, but also in the constant mean return model in the 30- and 40-day event window, which could be due to investor sentiment. This suggests a subtle impact where firms generally perform better, indicated by positive significant CARs, after issuing green bonds and might be perceived positively, but further research is needed to confirm these observations more robustly. This aligns with

(Kanamura, 2020), who found that green bonds outperform conventional bonds due to investor preference for sustainability, and (Reboredo, 2018) who noted that conventional bonds generally have a less pronounced impact on stock performance. Additionally, (Alonso-Conde & Rojo-Suárez, 2020) observed that green bond financing leads to higher profitability and better credit quality compared to conventional financing.

To ensure the reliability of my findings, I conducted several robustness checks by using another model to validate the results obtained from the constant mean model, and analyzing various subsamples based on different time periods and industrial sectors. This yielded mixed results across different event windows and models.

Comparing the results from the constant mean model and market model in the main sample reveals that the constant mean model is better at identifying significant CARs. Market model did not detect any significant CARs for green and conventional bonds. This suggests that some green bond CARs may be affected by factors that are specific to green bond issuance independently of broader market conditions. This calls for further research to try and isolate these factors.

Time period 2014-2020 subsample shows a similar pattern to the main sample, with the constant mean model showing more significant CARs than the market model. In both main and the subsample, green bonds exhibited more significant positive CARs post issuance, especially in longer event windows. This partially aligns with my hypothesis that green bonds are perceived more favorably by the market. Conventional bonds showed significant CARs pre and post issuance but they were less consistent and intense compared to green bonds. The robustness checks using this subsample largely confirmed the main findings, however differences in the number of significant CARs, where the subsample has fewer significant days were found. This could potentially be explained by the evolving market conditions. In the earlier part of the subsample period, awareness and preference for sustainable investments were still developing, whereas in the later part of the period, green financing had gained more recognition. This could explain the more pronounced significant CARs in the main sample.

In contrast to the first time period, the second time period subsample from 2021-2024 reveals different trends compared to the main sample. The main difference is the significant negative CARs observed for green bonds, and fluctuating patterns for conventional bonds in the 2021-2024 subsample, which is in contrast to the positive CARs seen in the main sample. Another observation is that a shorter window in the subsample already reveals significant CARs for green bonds. This could potentially be due to investor behavior due to economic conditions. Although I tried to adjust the estimation period to mitigate high volatility due to an economic downturn, the lingering effects from the economic crisis and recovery phases could have influenced and heightened sensitivity of investor behavior, where investors might adjust more rapidly to new information trying to navigate through economic uncertainties, which could be detected by shorter windows. This emphasizes the need for accounting broader market conditions and accounting for external factors through control variables. Since I used the market model as one for my robustness checks, general market movements should be adjusted for as the market model adjusts for overall market movement by comparing stock returns to the returns of a market index. But despite this, the market model finds significant negative CARs in all of the event windows, even in the shortest one. Compared to the findings of the constant mean model from the subsample, where there are also negative significant CARs found, this indicates robust reactions in the subsample itself.

Last subsample I used to perform robustness checks are the sectors. Starting with the technology & industry, I find almost no statistically significant CARs for either green or conventional bonds. There is only one instance of significant CARs which is observed in the market model in the 15-day window for green bonds. Expanding the event windows showed consistent trends with minor fluctuations but no significant changes. This suggests that investor reaction to bond issuances in this sector might be more muted or influenced by other factors.

In the resource & infrastructure sector there is a general negative trend for both types of bonds across all event windows, but most evident in the 40-day window. Significant CARs are more pronounced for green bonds, and are primarily caught by the market model. Negative consistent reactions to green bond issuances in this sector suggest heightened sensitivity to these bonds. Additionally, the market model being more robust in capturing significant CARs could be an indication that broad market conditions are important in this sector.

For the real estate sector green and conventional bonds show similar patterns and trends across all event windows. Significant CARs are observed through all event windows, which reflects a strong positive trend. Unlike in the resource & infrastructure sector, the constant mean model is more robust in capturing significant CARs for this sector, indicating that different dynamics are at play, which could be an interesting point for further research in finding what drives these positive reactions.

An Interesting finding is that the variability in CARs across different sectors highlights the importance of sector specific dynamics in influencing investor reactions to bond issuances. Robustness of the main findings are validated in some sectors like real estate, while other sectors reveal additional complexities compared to the main sample. This opens possibilities for future research that could focus on control variables, extended analysis periods and sector specific dynamics to enhance the understanding of how bond issuances impact stock performance and provide more robust insights into investor behavior and market dynamics.

In the following section I present the limitations and challenges faced when writing this thesis .

7. LIMITATIONS

I encountered the first limitation to my thesis in my research of the green bond data. Refinitiv Eikon has a vast information on green bonds, however it lacks the dates on the announcement. The absence of the announcement dates in my dataset necessitates the use of the next available proxy, which is the issuance date. Announcement dates are preferred in event studies due to their ability to capture the day when information is provided to the market (Flammer, 2021). I recognize that relying on issuance dates may result in measuring a delayed response in stock prices because some impact may already be reflected in the markets by then. Hence, I employed a broader estimation window to account for potential earlier reactions.

Second limitation I encountered relates to the estimation window in R's event study package, programming software I used for conducting the study. The default setting of the software is set to start the estimation window from the beginning of the data period and run it up to the event window. As some of my event dates are as recent as 2014, I collected data for stock prices all the way from 2012. This creates an issue for more recent event dates, where the estimation window is taken 10 years prior to the event. When using a long estimation window with the Constant Mean Return Model, there is a risk of obtaining very low or negative returns if there were many negative returns in that period. This might not accurately represent normal return behavior, as investors typically do not believe that past negative returns from far back in time would significantly affect the future return estimates. Similar issues arise with the Market Model.

Betas change over time and they tend to converge towards 1. If we take a long window, wrong beta is applied and thus leading to wrong predictions on normal returns. I realize and understand that these are my limitations, however I did my best given the data that was available to me. Considering all the available evidence at hand, I have no support to reject the hypotheses regarding no significant returns. Nonetheless, this process has been extremely educational for me.

8. CONCLUSION

The main objective of this thesis was to examine the impact green bond issuance has on the stock performance in non-financial companies in the Nordic region, which is known for its high environmental standards. I collected the data from Refinitiv Eikon and Factset, and examined 193 green and 199 conventional bonds issued between 2014 to mid-March 2024 in Denmark, Sweden, Finland and Norway. Using an event study methodology along with constant mean model and market model I estimated CARs around the bond issuance dates for different event windows.

My study results showed instances of positive CARs following green bond issuances, but the impact varied across event windows. Furthermore, positive and negative significant returns were observed on several days for green and conventional bonds both across different event windows and models. This may be an indication that investor behavior has had an impact in causing green and conventional bonds to have simultaneous reactions. However, conventional bonds showed more variability in CARs, where significant effects were mostly observed in the pre issuance period. On the other hand, green bonds generally showed positive CARs in the post issuance period, especially in longer event windows. These mixed findings make it challenging to conclusively reject the possibility that there is no difference between green and conventional bond issuances, as I initially hypothesized, as significant returns were found for both bonds simultaneously. While there is some evidence from technology & industry sector analysis that suggests differences, these differences are not consistent enough to reject the null hypothesis.

Performing robustness checks yielded some additional insights, especially when analyzing different sectors. While the real estate sector displayed a consistent trend of significant and persistent CARs across the event windows, potentially indicating investor confidence in its green projects and immediate environmental benefits, other sectors showed more diverse responses. Results from the time period between 2021 to 2024 revealed a stronger negative market response to green bond issuances, which may possibly be due to worries about greenwashing. When it comes to conventional bonds in the same time period, significant results are found only in extended event windows, where a negative trend can also be noticed, but again with no consistent findings.

These findings imply that green bonds tend to have more significant positive CARs compared to conventional bonds. As both green and conventional bonds showed significant negative CARs on some days, this suggests that factors such as investor behavior might be influencing their performance in a similar way. Thus, despite some evidence that CARs around the issuance date for green bonds might be performing better than CARS around the issuance date for conventional bonds, green bonds CARs seem to be affected by the same external factors as conventional bonds CARs. The mixed results from sectors and time periods point to the complex investor behavior and the importance of context in evaluating bond performance.

To better understand the impacts observed in this thesis, further research is suggested. It could for example include adding control variables to account for the role of firm size or industry that might explain differences in market reactions.

Lastly, I contribute to the literature on green bonds by providing evidence on the relationship between green bond issuance and stock performance relative to conventional bonds in non-financial companies in the Nordic region. Findings from the thesis may be used as a valuable insight to investors, as they suggest that investing in green bonds could potentially be a beneficial diversification adding positive returns to their portfolios, but also companies in the real estate sector as green bonds in the real estate sector are found to have most positive significant returns around issuance date compared to other sectors.

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Appendix A: Data

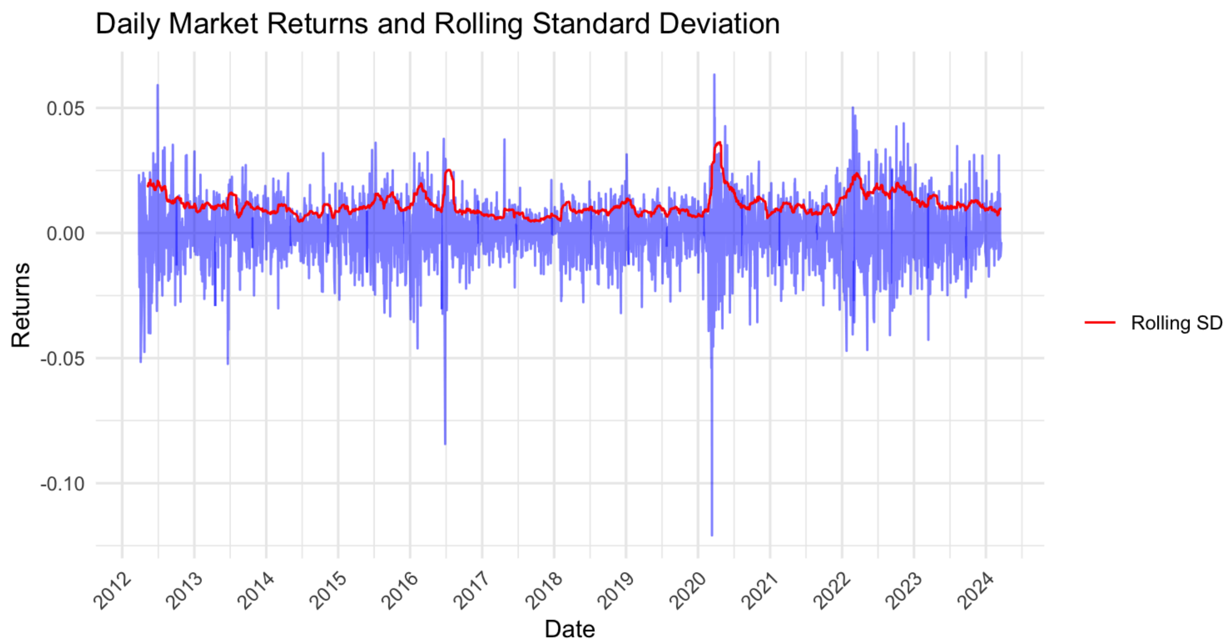

Figure A.1. Daily returns on OMX Nordic 40 and rolling standard deviation, source: Author's own work based on data from FactSet

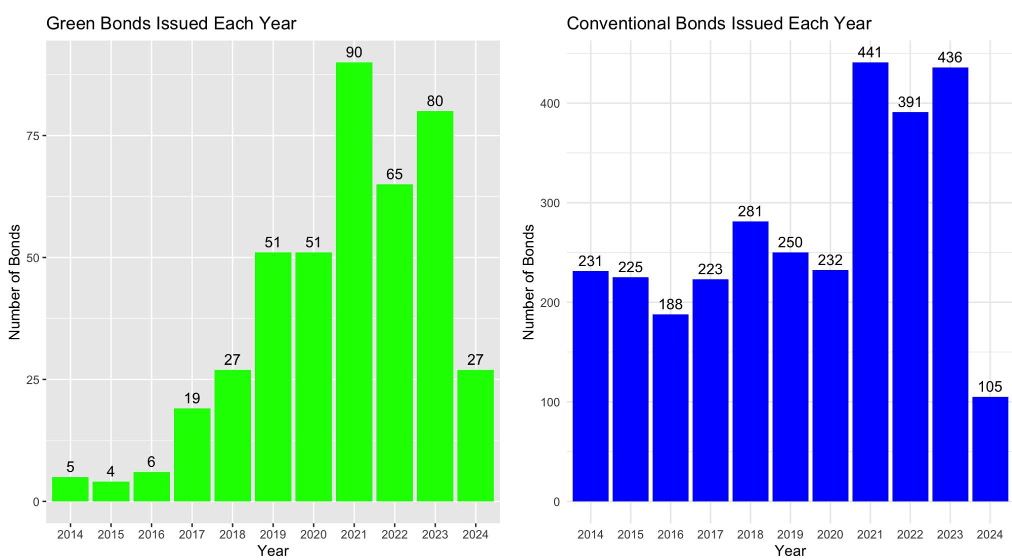

Figure A.2. Original sample. Distribution of Green and Conventional bonds issued per year, source: Author's creation based on data from Refinitiv Eikon

Table A.1. Original sample. Green and Conventional bonds issued per nation, source: Refinitiv Eikon

Bonds per nation

Nation	Green Bonds	Conventional Bonds
Denmark	40	317
Finland	44	269
Norway	84	852
Sweden	257	1,565
Total	425	3,003

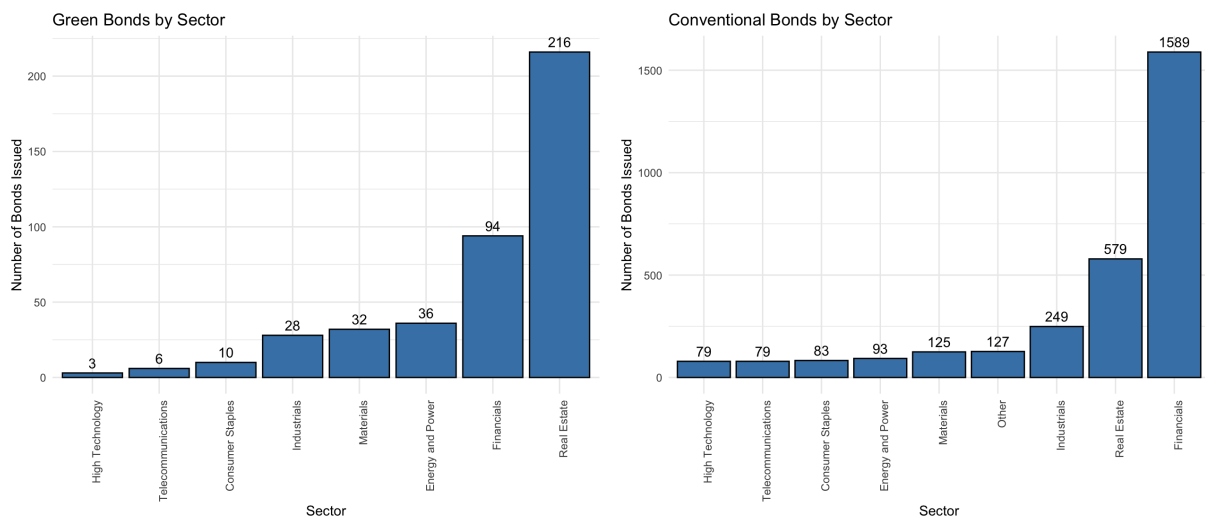

Figure A.3.: Original sample. Distribution of Green and Conventional bonds by sector from 2014-2024, source: Author's own creation based on data from Refinitiv Eikon

Appendix B: Event Study Results for Main Sample

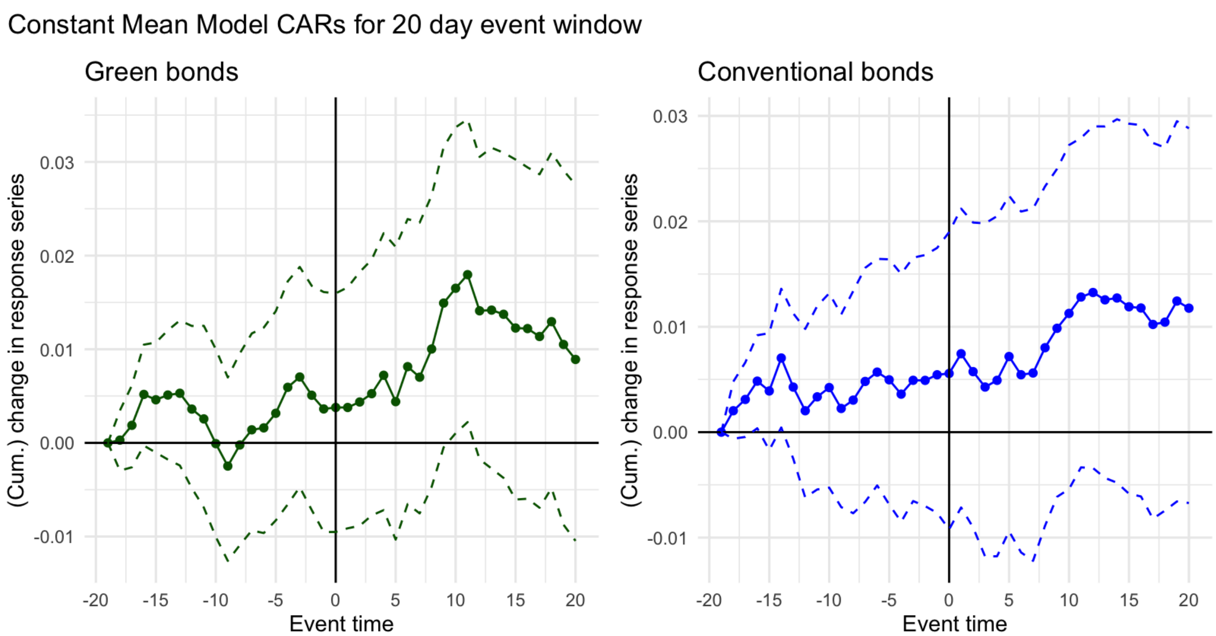

Figure B.1. Constant Mean Model CARs for green and conventional bonds using a 20 day window, source: Author's own creation

Table B.1. Summary table for Constant Mean Model CARs for a 20 day window event for green and conventional bonds including confidence intervals, standard errors and a t-test

CAR Constant Mean Model 20 day window - Summary table

Green Bonds						**Conventional bonds**					
EventTime	Mean	CI Lower	CI Upper	SE	t-stat	EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-14	0.0051	-0.0020	0.0126	0.0037	1.3724	-16	0.0048	0.0003	0.0097	0.0024	2.0191**
-9	-0.0025	-0.0130	0.0075	0.0052	-0.4732	-14	0.0070	0.0008	0.0137	0.0033	2.1318**
-3	0.0070	-0.0054	0.0191	0.0063	1.1244	0	0.0056	-0.0084	0.0193	0.0071	0.7881
0	0.0038	-0.0088	0.0165	0.0065	0.5848						
5	0.0044	-0.0104	0.0190	0.0075	0.5873						
10	0.0165	0.0012	0.0332	0.0081	2.0264**						
11	0.0180	0.0025	0.0352	0.0083	2.1532**						
20	0.0089	-0.0098	0.0294	0.0100	0.8916						

Appendix C: Event Study Results for Time Period 2014-2020

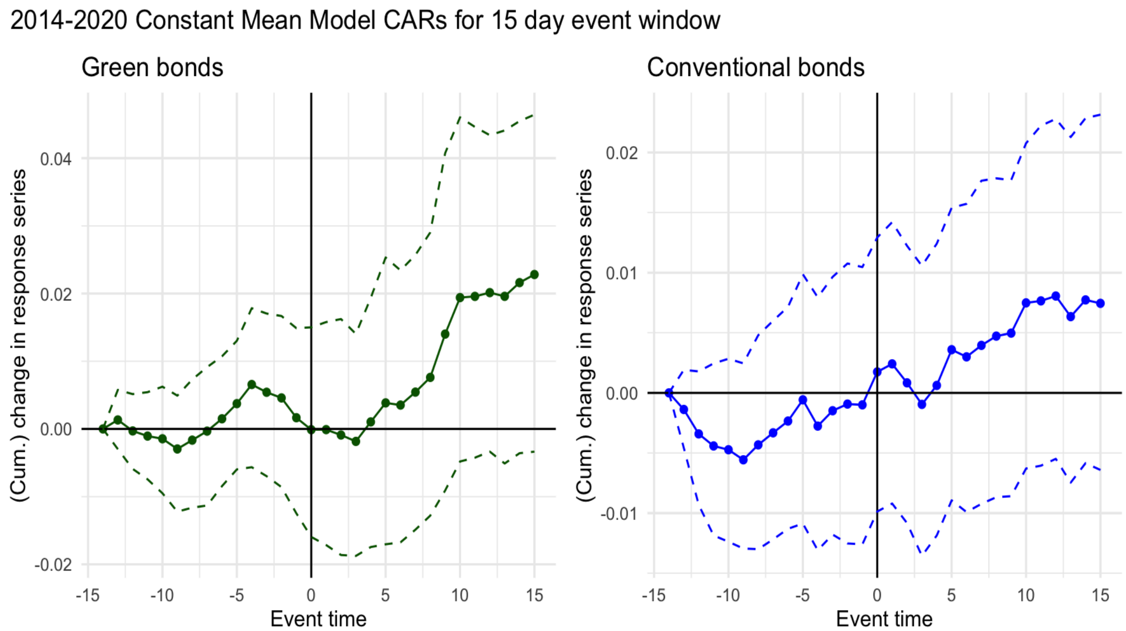

Figure C.1. Green and conventional bonds issued from 2014-2020 Constant Mean Model for a 15 day window

Table C.1. Summary table for Constant Model CARs for a 15 day window event for green and conventional bonds issued from 2014-2020 including confidence intervals, standard errors and a t-test

2014-2020 CAR Constant Meant Model 15 day window - Summary table

Green Bonds						Conventional Bonds					
EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat	EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat
-9	-0.0030	-0.0122	0.0049	0.0044	-0.6766	-9	-0.0056	-0.0129	0.0025	0.0039	-1.4164
-4	0.0066	-0.0057	0.0178	0.0060	1.0954	-5	-0.0006	-0.0109	0.0099	0.0053	-0.1089
0	-0.0001	-0.0160	0.0150	0.0079	-0.0142	0	0.0017	-0.0099	0.0129	0.0058	0.3001
4	0.0010	-0.0174	0.0194	0.0094	0.1107	3	-0.0010	-0.0136	0.0106	0.0062	-0.1554
15	0.0228	-0.0034	0.0464	0.0127	1.7962	15	0.0074	-0.0064	0.0231	0.0075	0.988

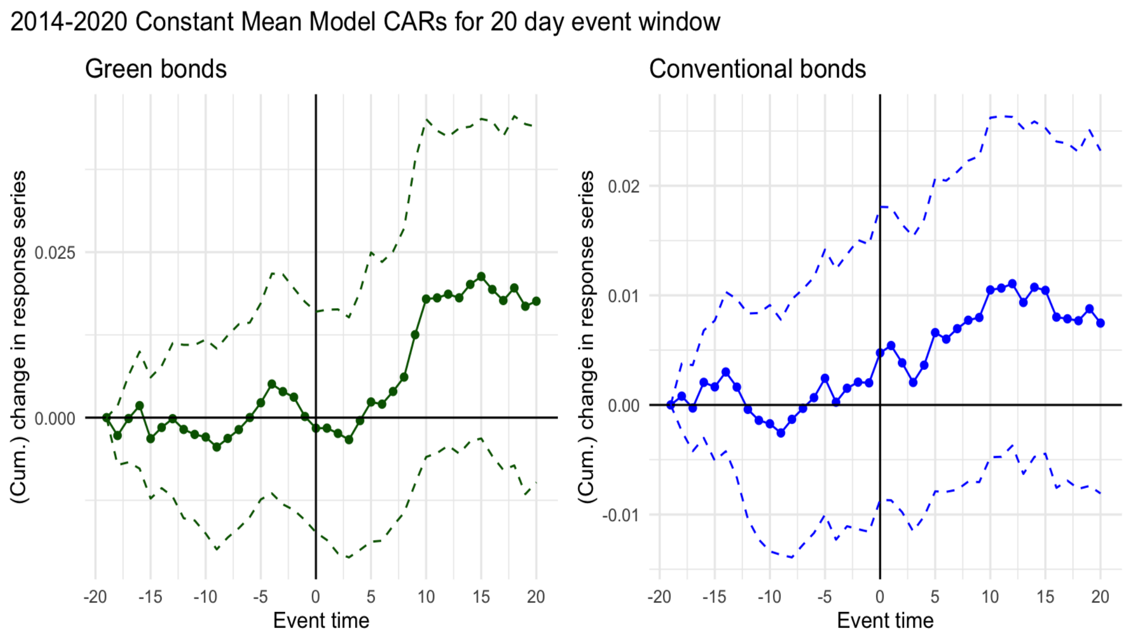

Figure C.2. Green and conventional bonds issued from 2014-2020 Constant Mean Model for a 20 day window

Table C.2. Summary table for Constant Model CARs for a 20 day window event for green and conventional bonds issued from 2014-2020 including confidence intervals, standard errors and a t-test

2014-2020 CAR Constant Meant Model 20 day window - Summary table

Green Bonds						**Conventional Bonds**					
EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat	EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat
-9	-0.0044	-0.0199	0.0104	0.0077	-0.5741	-9	-0.0026	-0.0137	0.0078	0.0055	-0.4671
-4	0.0051	-0.0114	0.0218	0.0085	0.5993	-5	0.0024	-0.0100	0.0142	0.0062	0.3942
0	-0.0016	-0.0173	0.0160	0.0085	-0.1878	0	0.0048	-0.0087	0.0181	0.0068	0.6968
3	-0.0033	-0.0211	0.0151	0.0093	-0.3597	3	0.0021	-0.0115	0.0154	0.0069	0.2988
20	0.0176	-0.0098	0.0440	0.0137	1.2837	20	0.0075	-0.0081	0.0232	0.0080	0.9363

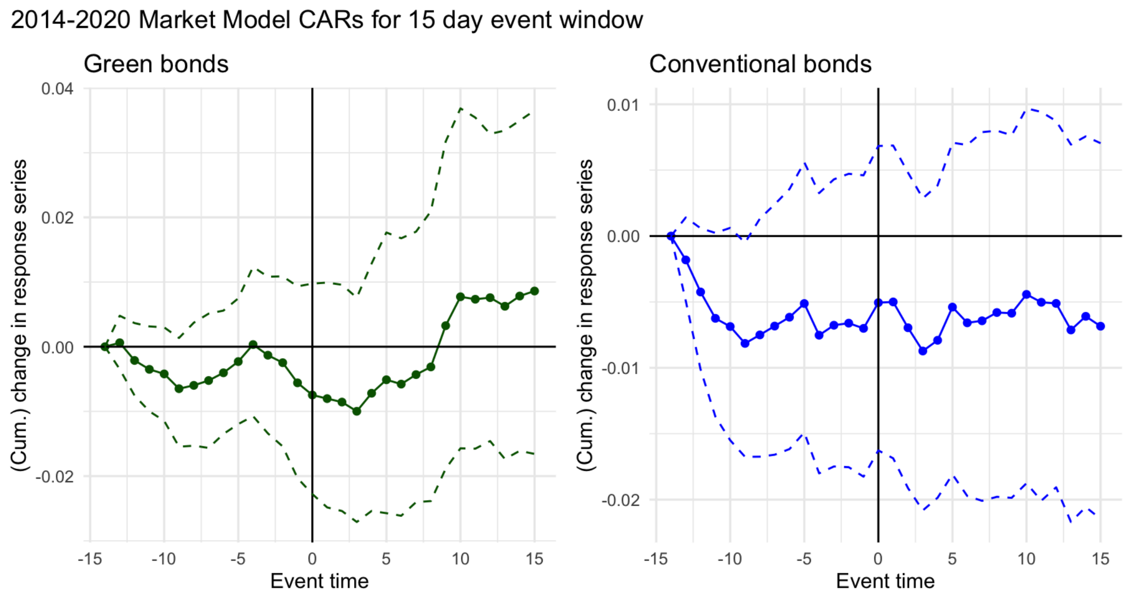

Figure C.3. Green and conventional bonds issued from 2014-2020 Market Model for a 15 day window

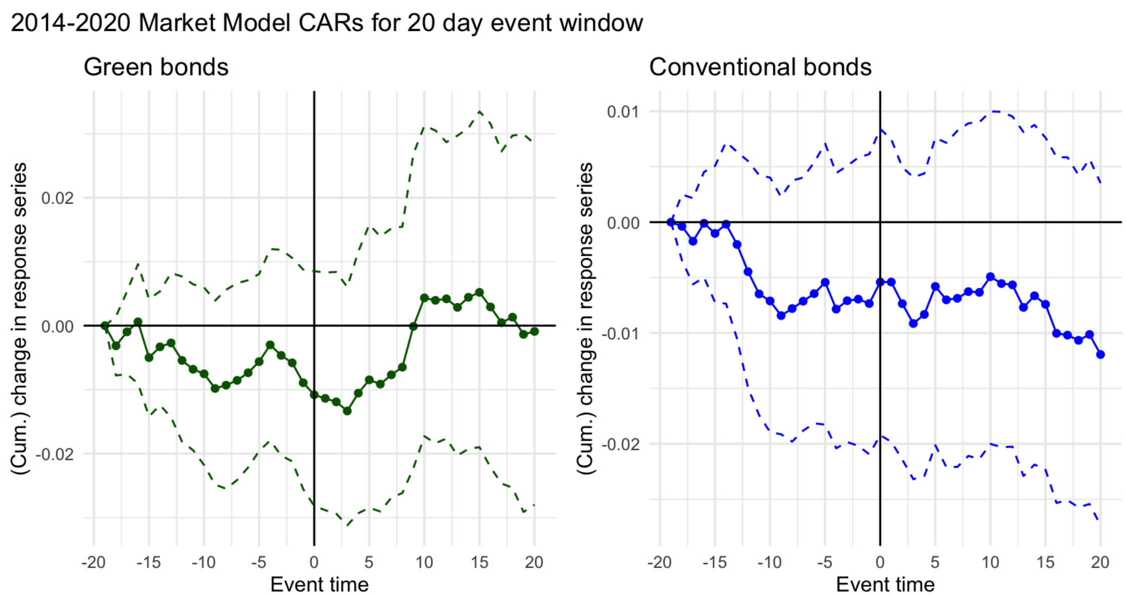

Figure C.4. Green and conventional bonds issued from 2014-2020 Market Model for a 20 day window

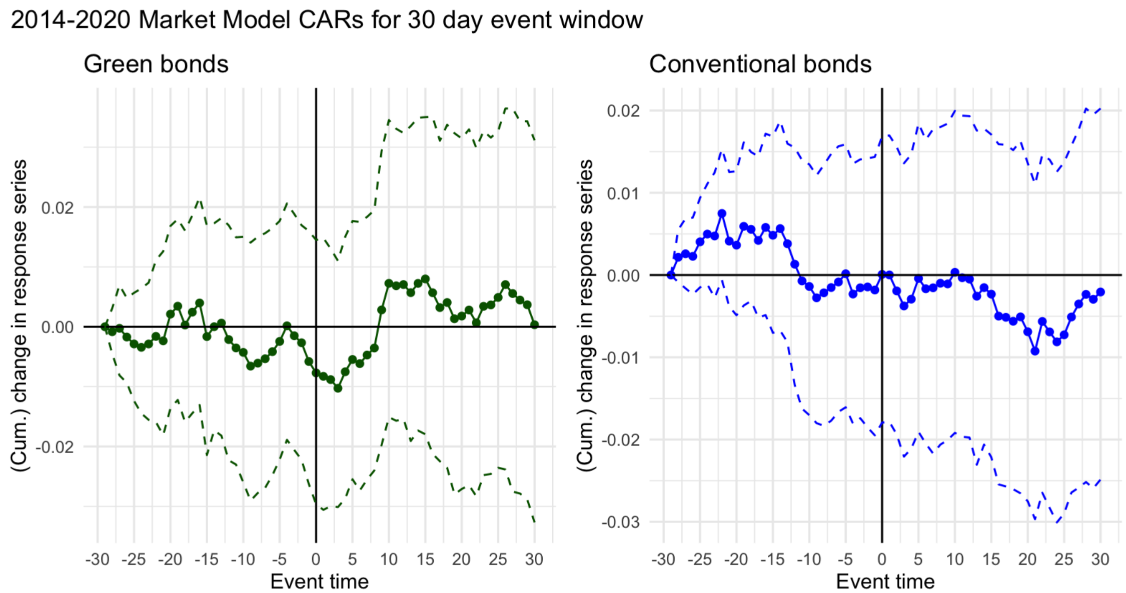

Figure C.5. Green and conventional bonds issued from 2014-2020 Market Model for a 30 day window

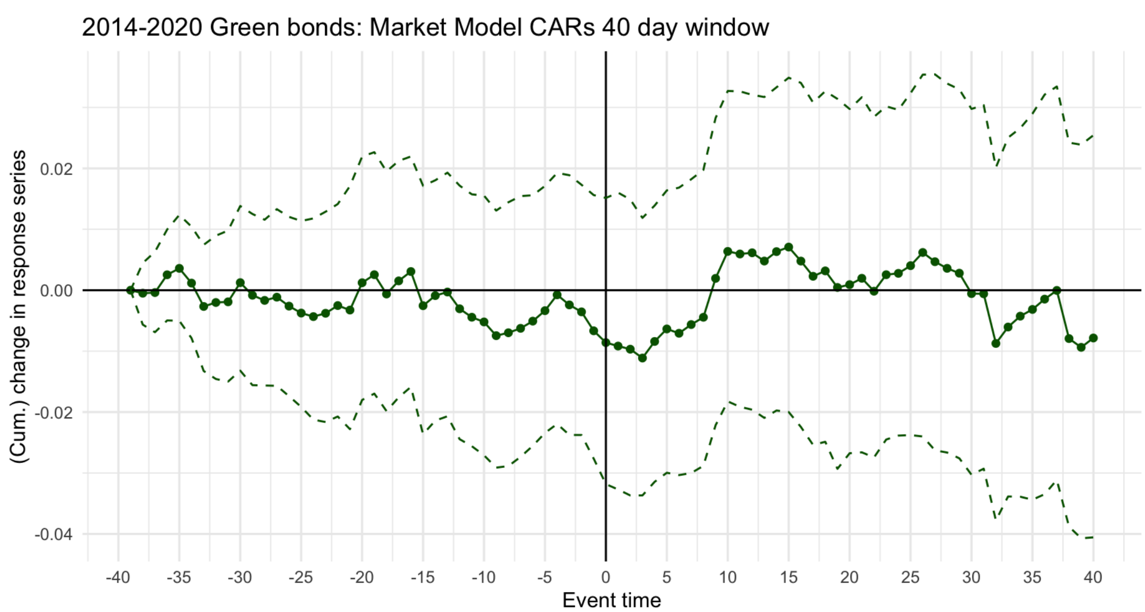

Figure C.6. Green bonds issued from 2014-2020 Market Model for a 40 day window

Appendix D: Event Study Results for Time Period 2021-2024

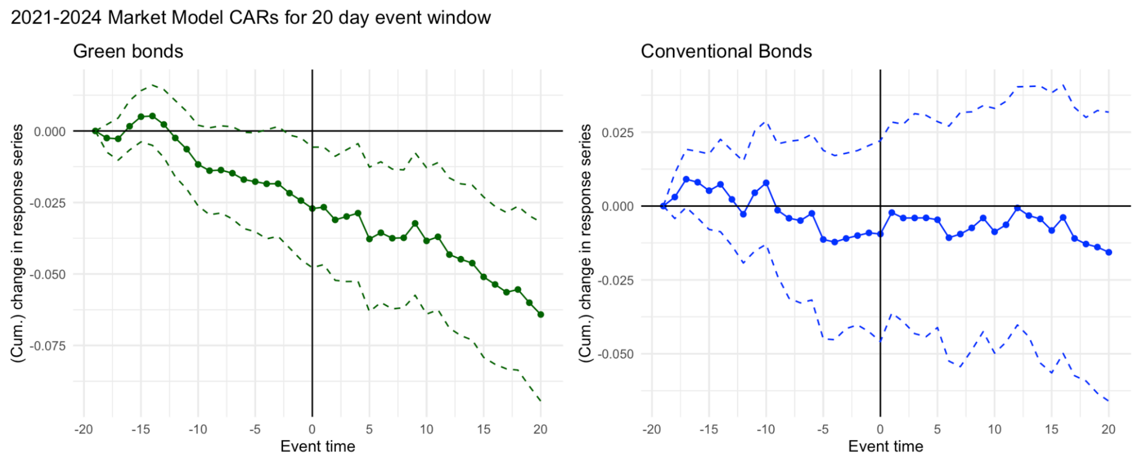

Figure D.1.: Green and conventional bonds issued from 2021-2024 Market Model for a 20 day window

Table D.2. Summary table for Market Model CARs for a 20 day window event for green bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

2021-2024 Green Bonds CAR Market Model 20 day window - Summary table

EventTime	Mean	CI Lower	CI Upper	SE	t-stat
-6	-0.0170	-0.0341	-0.0005	0.0086	-1.9795* *
-5	-0.0177	-0.0352	-0.0006	0.0088	-2.0098* *
-2	-0.0217	-0.0409	-0.0014	0.0101	-2.1598* *
-1	-0.0243	-0.0450	-0.0024	0.0109	-2.2395* *
0	-0.0271	-0.0478	-0.0057	0.0107	-2.5231* *
5	-0.0378	-0.0632	-0.0127	0.0129	-2.9308* *
10	-0.0384	-0.0640	-0.0128	0.0131	-2.9423* *
20	-0.0642	-0.0945	-0.0319	0.0160	-4.018* *

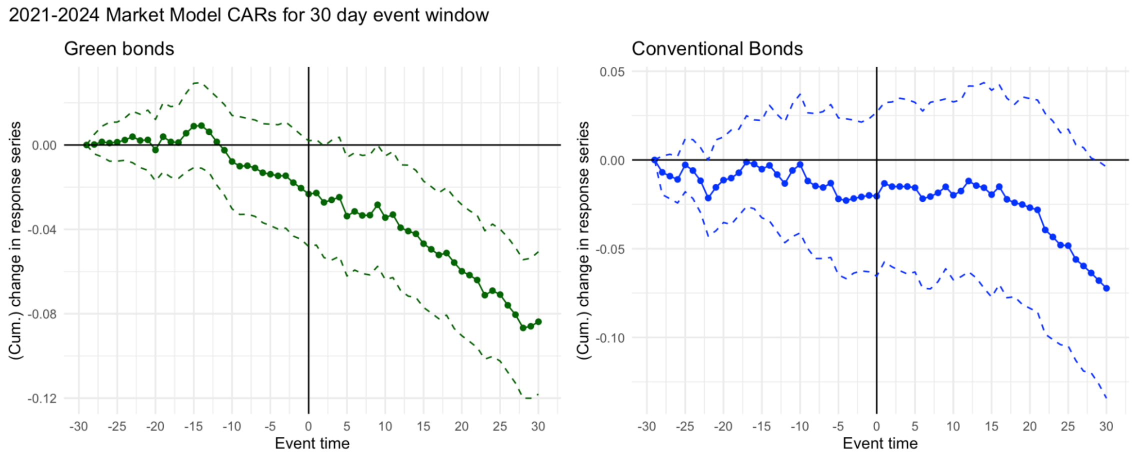

Figure D.2. Green and conventional bonds issued from 2021-2024 Market Model for a 30 day window

Table D.3.: Summary table for Market Model CARs for a 30 day window event for green bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

2021-2024 CAR Market Model 30 day window - Summary table

Green Bonds						**Conventional Bonds**					
EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat	EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat
2	*-0.0272*	*-0.0534*	*-0.0005*	*0.0135*	*-2.0181* **	*-22*	*-0.0215*	*-0.0429*	*-0.0001*	*0.0109*	*-1.9662* **
10	*-0.0344*	*-0.0638*	*-0.0052*	*0.0149*	*-2.3015* **	*28*	*-0.0637*	*-0.1199*	*0.0011*	*0.0309*	*-2.0627* **
20	*-0.0599*	*-0.0904*	*-0.0283*	*0.0158*	*-3.7785* **	*29*	*-0.0680*	*-0.1263*	*-0.0009*	*0.0320*	*-2.1239* **
30	*-0.0838*	*-0.1181*	*-0.0506*	*0.0172*	*-4.8627* **	*30*	*-0.0723*	*-0.1343*	*-0.0040*	*0.0332*	*-2.175* **

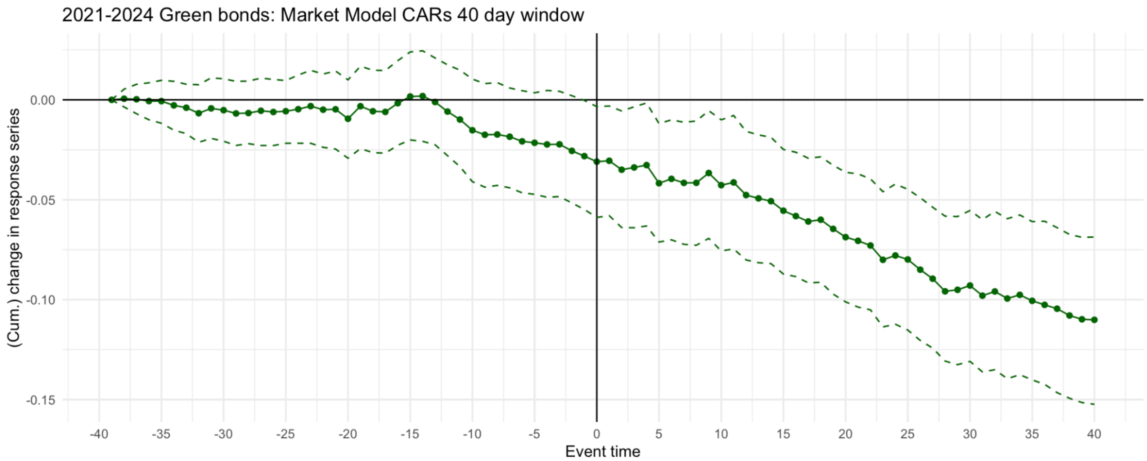

Figure D.3 Green bonds issued from 2021-2024 Market Model for a 40 day window

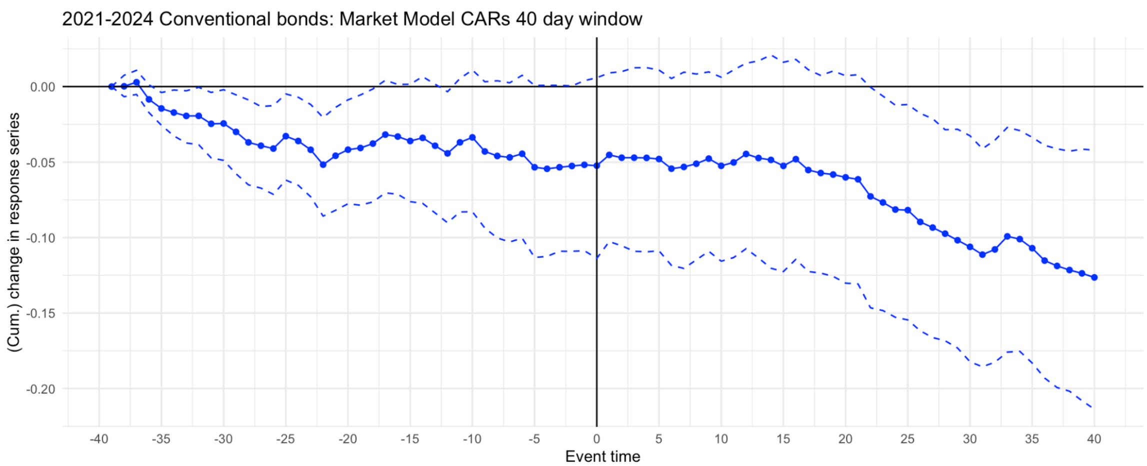

Figure D.4. Conventional bonds issued from 2021-2024 Market Model for a 40 day window

Table D.4. Summary table for Market Model CARs for a 40 day window event for green bonds issued 2021-2024 including confidence intervals, standard errors and a t-test

2021-2024 CAR Market Model 40 day window - Summary table

Green Bonds						**Conventional Bonds**					
EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat	EventTime	Mean CR	CI Lower	CI Upper	SE	t-stat
-1	-0.0282	-0.0548	-0.0003	0.0139	-2.0241* *	*-35*	*-0.0145*	*-0.0256*	*-0.0039*	*0.0055*	*-2.6208* **
0	-0.0309	-0.0588	-0.0034	0.0141	-2.1887* *	*-25*	*-0.0328*	*-0.0619*	*-0.0049*	*0.0146*	*-2.2557* **
5	-0.0417	-0.0712	-0.0119	0.0151	-2.7588* *	*-22*	*-0.0517*	*-0.0858*	*-0.0205*	*0.0167*	*-3.1046* **
10	-0.0427	-0.0756	-0.0100	0.0167	-2.552* *	*0*	*-0.0524*	*-0.1138*	*0.0059*	*0.0305*	*-1.7168*
20	-0.0687	-0.1011	-0.0363	0.0165	-4.1544* *	*23*	*-0.0419*	*-0.0730*	*-0.0119*	*0.0156*	*-2.6836* **
30	-0.0929	-0.1309	-0.0554	0.0193	-4.8256* *	*30*	*-0.1062*	*-0.1823*	*-0.0326*	*0.0382*	*-2.78* **
40	-0.1101	-0.1524	-0.0687	0.0214	-5.1554* *	*40*	*-0.1264*	*-0.2137*	*-0.0421*	*0.0438*	*-2.8878* **

Appendix E: Event Study Results for Resource & Infrastructure Sector

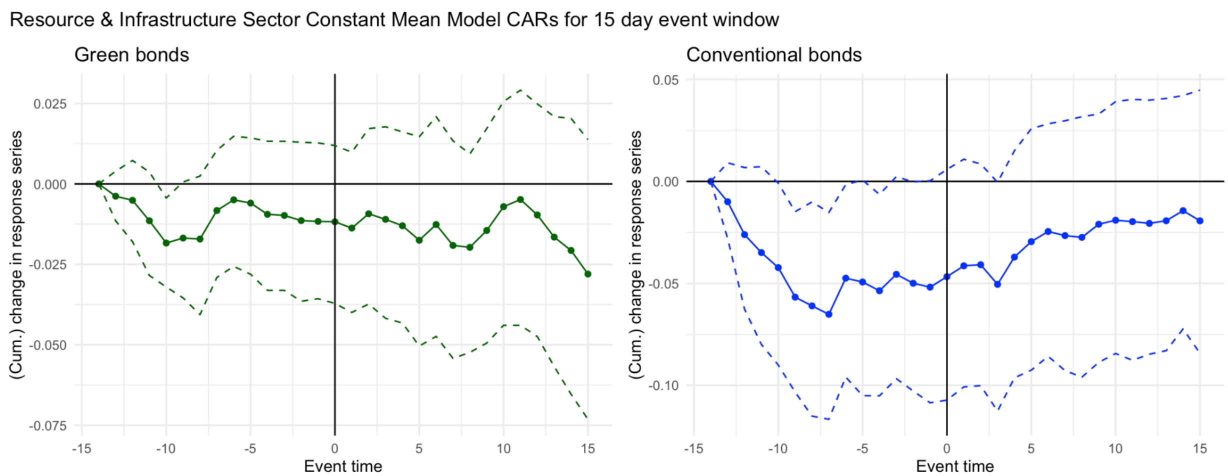

Figure E.1. Resource & Infrastructure sector event study CMM for green and conventional bonds 15 day window

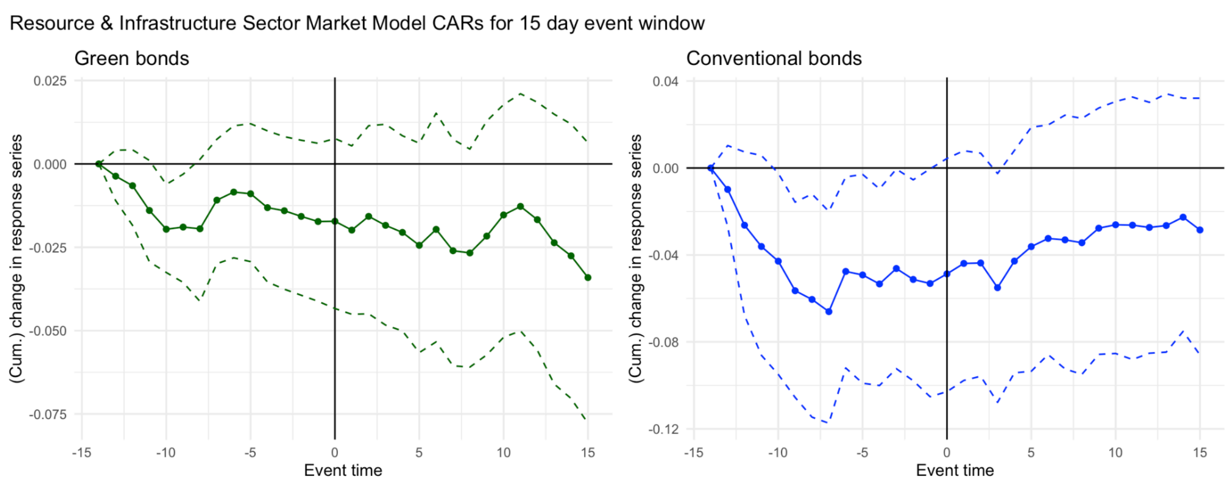

Figure E.2. Resource & Infrastructure sector event study MM for green and conventional bonds 15 day window

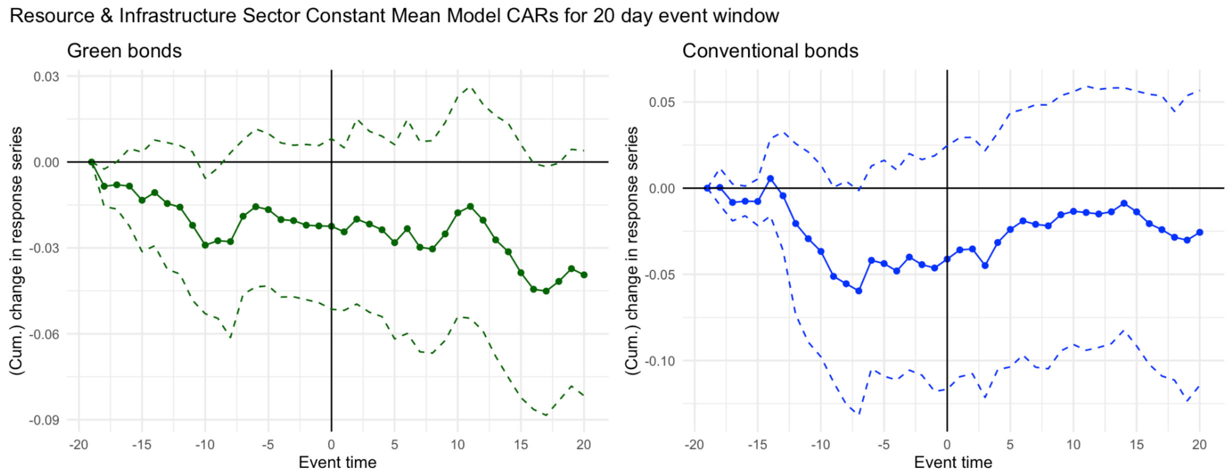

Figure E.3. Resource & Infrastructure sector event study CMM for green and conventional bonds 15 day window

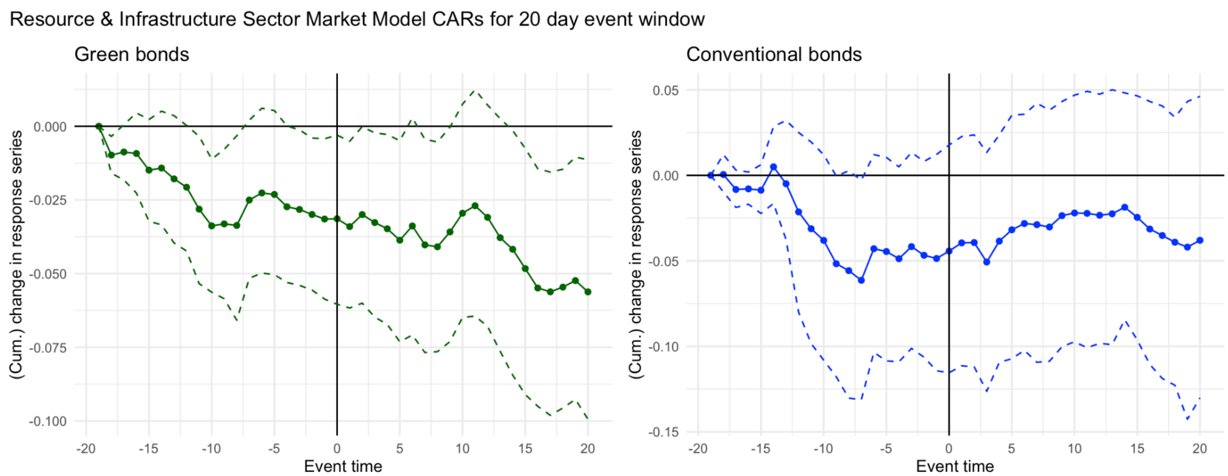

Figure E.2. Resource & Infrastructure sector event study MM for green and conventional bonds 20 day window

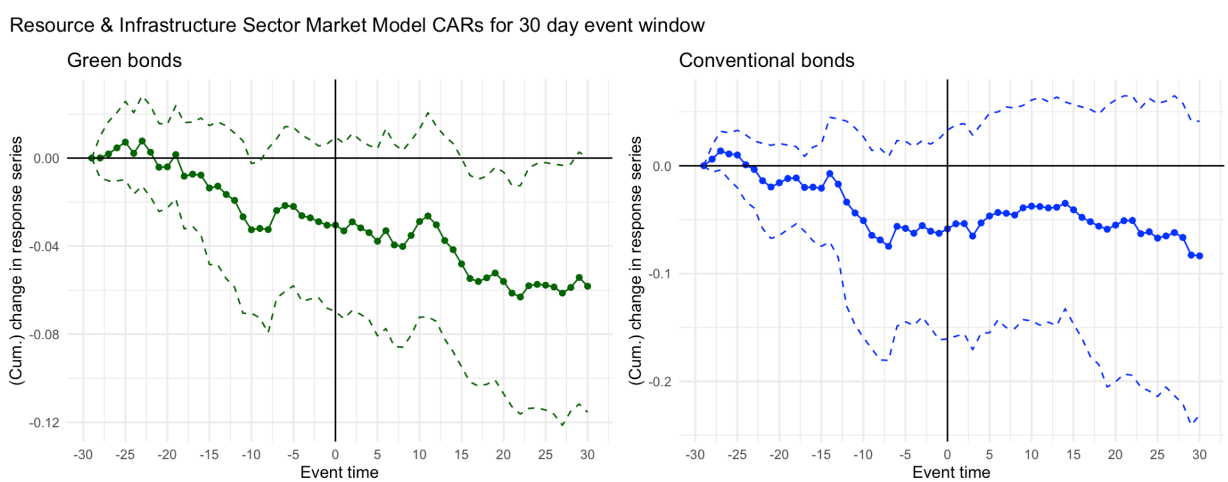

Figure E.3. Resource & Infrastructure sector event study MM for green and conventional bonds 30 day window

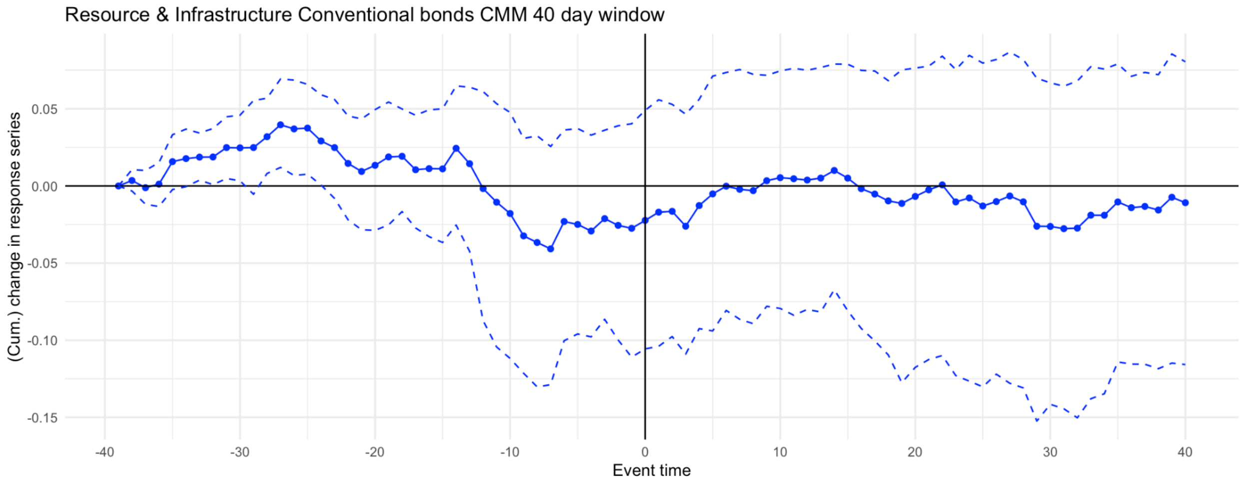

Figure E.4. Resource & Infrastructure sector event study MM for conventional bonds 40 day window

Appendix F: Event Study Results for Real Estate Sector

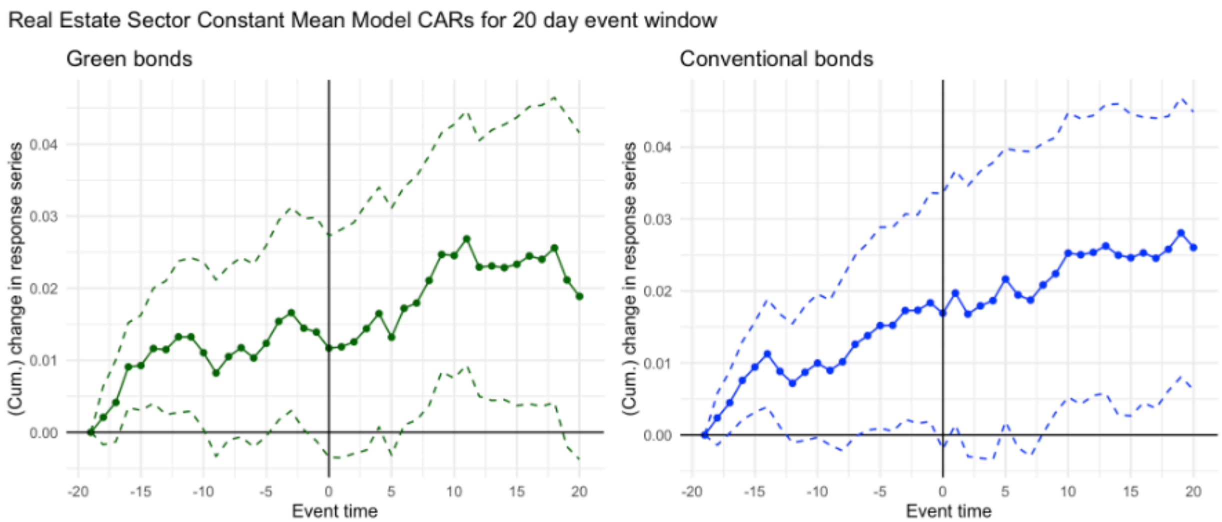

Figure F.1. Real Estate sector event study CMM for green and conventional bonds 20 day window

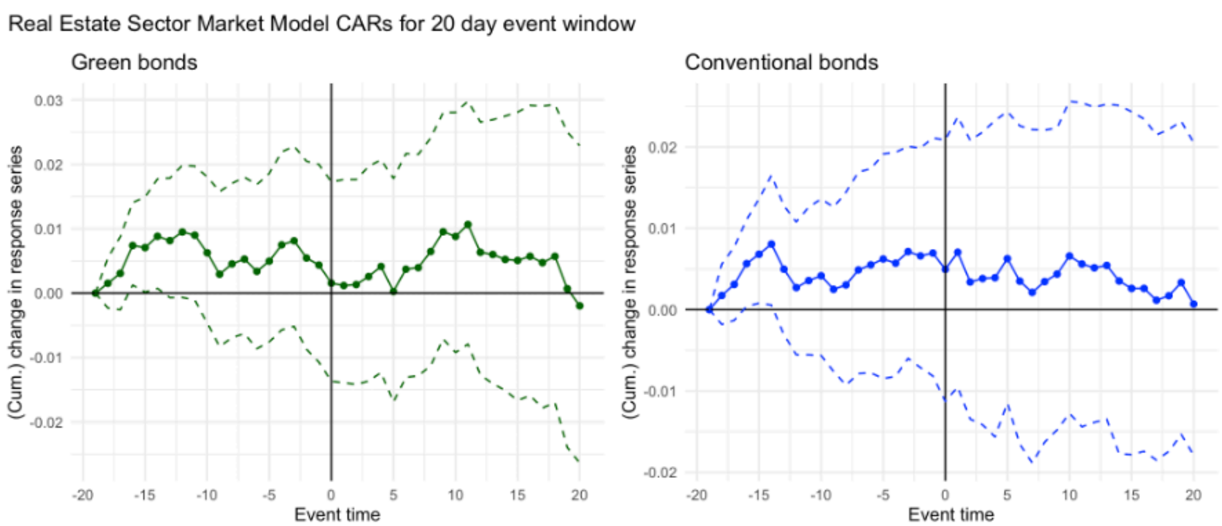

Figure F.2. Real Estate sector event study MM for green and conventional bonds 20 day window

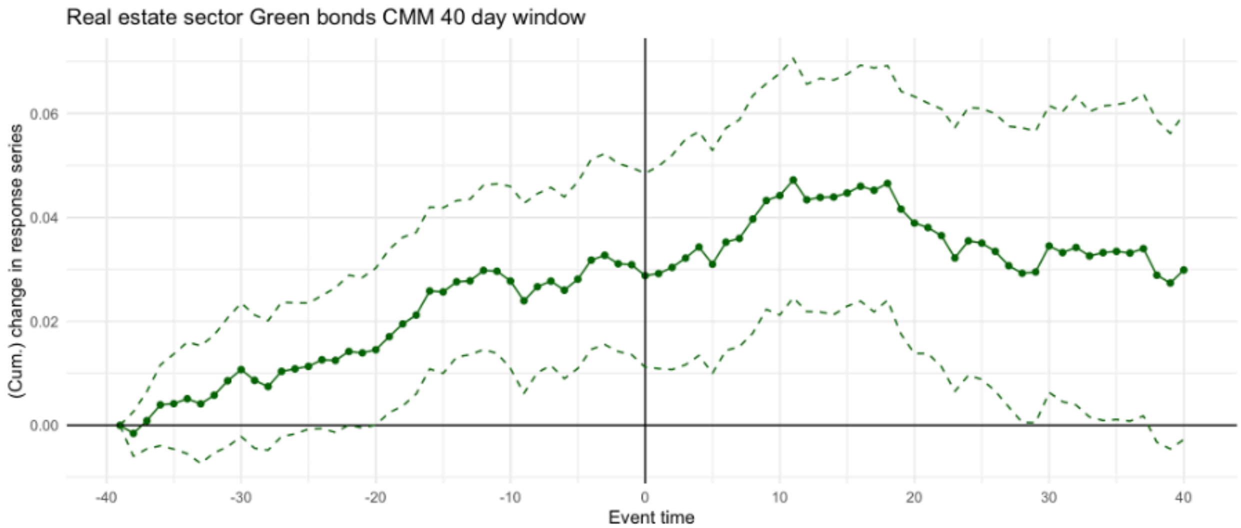

Figure F.3. Real Estate sector event study CMM for green bonds 40 day window

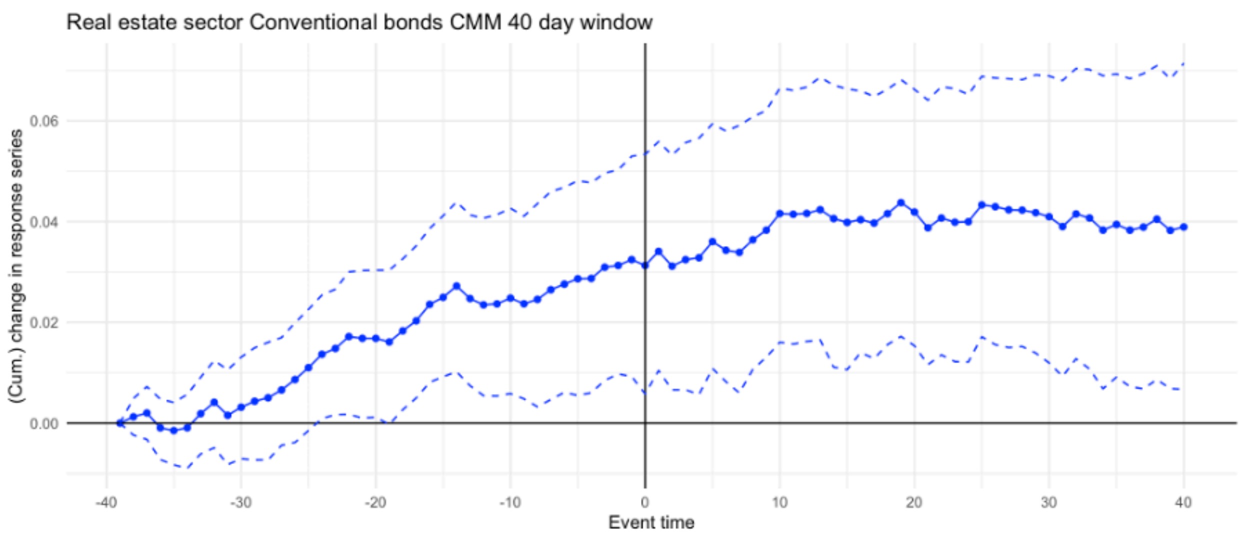

Figure F.4. Real Estate sector event study CMM for conventional bonds 40 day window