Comparative Analysis of Green Bond Issuance Impact on Stock Prices: European Utility Sector vs. Overall Market

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Abstract

This study investigates the impact of green bond issuance on stock prices within the European utility sector, compared to the broader market. Utilizing an event study methodology, the research analyzes data from 2008 to 2024, employing the Fama-French Three-Factor and Five-Factor models to examine performance dynamics. The analysis includes both short [-5,5] and long [-10,10] event windows to capture immediate and extended market reactions. Results indicate a generally positive market reaction to green bond announcements, particularly in the broader market. However, the utility sector shows a more complex response, highlighting the importance of sector-specific factors. Regression analyses reveal that green bond issuance significantly influences Cumulative Abnormal Returns (CARs), with firm size being a notable positive driver. The study underscores the necessity for tailored strategies in different sectors when issuing green bonds and suggests that future research should explore additional factors and regional variations to enhance the understanding of green bond impacts on financial performance and sustainability efforts.

Keywords: Green Bonds, Stock Prices, Event Study, Cumulative Abnormal Returns, Utility Sector

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Resumo

Este estudo investiga o impacto da emissão de obrigações verdes nos preços das acções no sector europeu dos serviços públicos, em comparação com o mercado mais vasto. Utilizando uma metodologia de estudo de eventos, a pesquisa analisa dados de 2008 a 2024, empregando os modelos Fama-French Three-Fator e Five-Fator para examinar a dinâmica do desempenho. A análise inclui janelas de eventos curtos [-5,5] e longos [-10,10] para captar reacções imediatas e prolongadas do mercado. Os resultados indicam uma reação geralmente positiva do mercado aos anúncios de obrigações verdes, particularmente no mercado mais vasto. No entanto, o sector dos serviços públicos apresenta uma reação mais complexa, salientando a importância de factores específicos do sector. As análises de regressão revelam que a emissão de obrigações verdes influencia significativamente os retornos anormais acumulados (CAR), sendo a dimensão da empresa um fator positivo notável. O estudo sublinha a necessidade de estratégias adaptadas aos diferentes sectores aquando da emissão de obrigações verdes e sugere que a investigação futura deve explorar factores adicionais e variações regionais para melhorar a compreensão do impacto das obrigações verdes no desempenho financeiro e nos esforços de sustentabilidade.

Palavras-chave: Obrigações verdes, Preços das acções, Estudo de eventos, Rendimentos anormais acumulados, Setor dos serviços públicos

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Tópico: Análise comparativa do impacto da emissão de obrigações verdes nos preços das acções: Setor europeu dos serviços de utilidade pública vs. mercado global

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Table of Abbreviations

α_i	Abnormal return of security i
BVD	Book Value of Debt
BVT	Book value of Total Assets
CE	Common Equity
CMA_t	Conservative Minus Aggressive at time t
CP	Closing Price
CSO	Common Shares Outstanding
ϵ_{it}	Error term
HML_t	High Minus Low at time t
$OIBD$	Operating income before depreciation
OE	Ordinary Equity
R_{ft}	Risk-free rate at time t
R_{it}	Return of security i at time t
R_{Mt}	Market return at time t
RMW_t	Robust Minus Weak at time t
ROA	Return on Assets
SMB_t	Small Minus Big at time t
TA	Total Assets
β_{iM}, β_{iSMB}, β_{iHML},β_{iRMW}, β_{iCMA}	Factor loadings for security i

1 Introduction

With the Paris Climate Agreement in 2015, most countries set themselves the goal of becoming climate-neutral by 2050. To achieve this goal, the economy must undergo a far- reaching transformation, which will require a great deal of investment. In the European Green Deal Investment Plan, also known as the Sustainable Europe Investment from 2020, the European Commission therefore envisaged the creation of a European standard for environmentally sustainable finance. A significant economic transition necessitates substantial financial commitment, particularly to ensure that the process is advantageous to all segments of society and provides help to the residents and regions that are most vulnerable to the expenses associated with decarbonization. According to the European Commission's estimation, in order to achieve the current objective of lowering greenhouse gas (GHG) emissions by 40% by 2030, relative to 1990 levels, an annual investment of €260 billion will be required. Considering that the Green Deal's objective is to increase the intermediate target of decreasing greenhouse gas (GHG) emissions by a minimum of 50% by 2030, the consequent budgetary needs will be considerably higher. To address this issue, the Green Deal includes a proposed investment strategy aimed at attracting both public and private funds to support the goals of transitioning to a climate-friendly economy.

Within the context of this topic, green bonds are considered to be one of the most important elements and financial vehicles. The European Green Deal Investment Plan 2020 was published by BNP Paribas in 2018. Bond instruments that fall under the category of green bonds are those that are especially designed to direct the funds, either in part or in full, toward the financing of environmentally friendly projects that meet certain criteria. The ability of these initiatives to provide measurable environmental benefits is one of the defining characteristics of these projects. It has been stated by the International Capital Markets Association (2021) that the issuer would be the one to carry out the evaluation and measurement of such benefits. Therefore, when it comes to the financial element, green bonds demonstrate functionality that is comparable to that of conventional bond instruments. The only difference is that the funds created from the bond are allocated towards activities that are environmentally sustainable.

Previous research highlights a direct relationship between the issuance of green bonds and stock market performance. For instance, Flammer (2020) observed a positive investor response to the announcement of green bond issuances, especially for initial offerings and third-party certified green bonds. Other studies, such as those by Yaming Ma et al. (2018), noted a dynamic impact of green bond issuance on stock prices. However, a corporations' choice to issue green bonds rather than traditional bonds may seem perplexing.[1] This

[1]The tools ChatGPT, DeepL, and QuillBot were utilized during the preparation of this master's thesis. These tools assisted in generating text suggestions, performing translations, and making language adjustments. The content of this academic work was fully originated by the author.

is because corporations' investment policies are limited because the proceeds from green bonds are designated for green initiatives. To be registered as green bond issuers, businesses also have to go through third-party verification, which guarantees that the money raised will go toward initiatives that benefit the environment while requiring administrative and compliance expenses. Owing to the limitations of green bonds, it would seem better to first issue conventional bonds and, if more financially feasible, use the revenues to fund green projects (eg.Flammer 2020). Previous literature obtained positive cumulative average abnormal returns (CAARs) suggesting that green bond issuance led to increased stock prices (Flammer 2021; Tang & Zhang 2020; Glavas 2020). Scholars contend that signaling theory, which links the issuance of green bonds to a company's environmental commitment, provides an explanation for this. Furthermore, there is a contention that the issuance of green bonds can bestow further advantages upon the issuing entity. Despite the expanding body of academic research in this domain, utility corporations have frequently been omitted from examination, despite their regular issuance of green bonds. This study aims to address the existing research gap by analyzing the impact of green bond issuance in the utilities seIctor, specifically within the European Market. In addition, a comparison with the market as a whole is intended to highlight any differences that may be of significance to investors. By focusing on this specific topic and building upon prior research, the objective is to provide unique perspectives on sustainable finance practices in the utilities sector within the European Market.

2 Research Question

This study aims to address the existing research gap by examining the impact of green bond issuance on corporate stock prices in the European Utility Sector. According to earlier studies (Flammer 2021; Tang & Zhang 2020; Glavas 2020), issuing green bonds correlates with higher stock prices and positive cumulative average abnormal returns (CAARs). This phenomena suggests numerous potential advantages for companies: First and foremost, it improves the way investors see the situation. Companies demonstrate their commitment to environmental sustainability by issuing green bonds, which may appeal to investors that emphasize these principles. The positive view could lead to a rise in demand for the company's stock, ultimately resulting in an increase in its share price. Secondly, it provides opportunities to raise capital. Positive market responses to green bond issuance reflect investor confidence in the company's sustainability efforts. This confidence can enhance opportunities for raising capital in the future. Moreover, it offers a distinct advantage over competitors. Companies that demonstrate commitment to environmental sustainability through green bond issuance have the potential to gain advantages over their competitors. These advantages may include enhanced customer loyalty, favorable regulatory treatment, and improved stakeholder relationships. Lastly, it fosters long-term value creation. By aligning with sustainability objectives and addressing environmental concerns, companies position themselves for sustained value creation. This can involve decreased operational costs through efficiency enhancements and increased resilience to environmental risks.

The primary objective of this study is to understand the differential impact of green bond announcements on stock prices in various industries, with a specific focus on the utilities sector compared to the overall industry. The motivation behind this comparative analysis comes from several key considerations. The utility sector is inherently more exposed to environmental regulations and sustainability pressures compared to many other industries. Utilities are major contributors to carbon emissions, and as such, they face significant regulatory scrutiny and incentives to adopt greener practices. Green bonds provide a mechanism for these companies to finance environmentally friendly projects, thus potentially leading to a more pronounced reaction in their stock prices upon the announcement of such bonds. By comparing the utility sector to the industry as a whole, we can isolate the effects of sector-specific regulatory pressures on stock price reactions. Moreover, investors may perceive green bond announcements differently depending on the sector. In the utility sector, green bonds might be seen as a critical step towards compliance with stringent environmental regulations and a commitment to long-term sustainability, which could positively influence investor sentiment and stock prices. Conversely, in other industries where environmental concerns might not be as central, the market reaction to green bond announcements might be less pronounced. This study aims to capture these nuances in investor perception and market expectations by conducting a comparative analysis. Additionally, the financial performance of utility companies is often closely tied to their ability to manage environmental risks and regulatory compliance costs. Green bonds can play a pivotal role in mitigating these risks by providing dedicated funding for sustainable projects, thereby potentially enhancing financial stability and performance. By comparing the utility sector with the broader industry, this study seeks to understand whether green bond announcements have a differential impact on perceived financial performance and risk management across sectors. The utility sector has historically been a significant player in the green bond market, often leading in terms of issuance volumes and innovation in sustainable finance. This sector's strong presence in the green bond market makes it a critical area of study for understanding broader trends and impacts. By juxtaposing the utility sector's response with that of the entire industry, this research aims to identify unique investment trends and patterns that may be specific to high-emission, highly regulated sectors. In summary, comparing the utility sector with the industry as a whole in terms of stock reactions to green bond announcements allows for a more nuanced understanding of how sector-specific factors such as regulatory pressure, investor perception, financial performance, and investment trends influence market reactions. This comparative analysis provides valuable insights into the effectiveness of green bonds as a tool for promoting sustainability and enhancing financial stability across different sectors.

3 Literature

3.1 Green Bond Market

Green Bonds are a fixed income product that enable capital-raising and investment for new and existing projects with environmental benefits (ICMA). Structurally, Green Bonds are generally similar to their conventional counterparts, but with small yet subtle differences. Green bonds are comparable to nongreen bonds in terms of seniority, default risk and rating. However, green bonds have a ”green” purpose, whereas conventional bonds are generally used for general financing. Green Bonds were initially introduced in 2007 when the European Investment Bank issued their first socially responsible fixed income product – the “Climate Awareness Bond” - totaling EUR 600 million. Nevertheless, it took another six years years until the first green bond was issued by a private company. One year later, the publication of the ”Green Bond Principles” by the International Capital Market Association (ICMA) was a significant driver for the further development of issuing activity. These principles set out a voluntary standard for qualifying a bond as a ”green bond” and are still the preferred green bond standard today. Since then, due to an increase in social and political focus on the topic of sustainability the market has experienced a significant growth with only a small setback during the Covid-19 Pandemic.

Issue Date	Issues	Issued (USD in bn)
2012	2	0.31
2013	18	3.39
2014	76	11.41
2015	209	20.94
2016	167	59.15
2017	350	79.75
2018	440	95.44
2019	794	179.41
2020	1048	180.08
2021	1917	374.66
2022	1637	377.85
2023	1515	362.70

Table 1: Development of green bonds

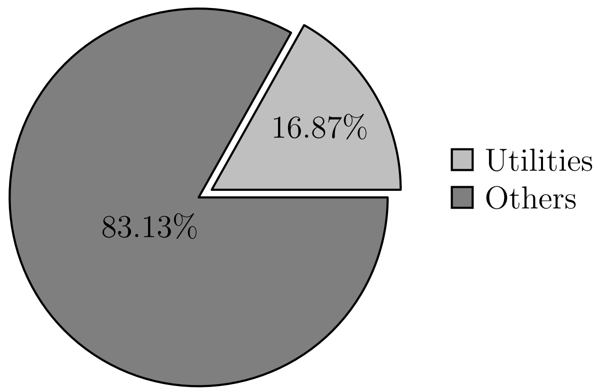

Figure 1: Issued Amounts by Category (in billions USD)

By 2022, the total volume of climate bonds reached an estimated $ 487.1 billion with the US, China, and the European Union as main players. A study conducted by Ehlers and Packer (2017) found that the issuance of green bonds requires more transparency

and compliance with regulations, resulting in higher administrative costs. Additionally, issuers face limitations in selecting the projects to fund. In order to explain the decision on issuing a green bond, Flammer (2020) lists three possible reasons: Acquiring more affordable financing, utilizing green bonds as a form of greenwashing, or portraying the level of commitment of the issuer towards environmental causes. Moreover, there is literature that analyzes the pricing of green bonds focusing on whether green bonds are priced at a premium compared to conventional bonds.
Table 1 provides information on the development of green bonds since their first issuance. The table shows a significant increase in the number of green bond issues and the total amount issued over the years. The high increase in both the number of issues and the total amount issued from 2015 onwards is particularly noteworthy, and is consistent with the increasing focus on sustainable funding following the Paris Climate Agreement. In addition to the distribution of green bond issuance over time, Table 2 provides insights into the distribution of green bonds across different industries. The table below summarises the number of green bond issues, the amount outstanding and the amount issued in billions of US dollars for different industries. Table 2 shows that the banking sector (Banks & Corporate Banks) leads the way in terms of the number of green bond issues and the total amount issued, reflecting its central role in financing green projects. Electric utilities also have a significant number of green bond issuances, highlighting the sector's efforts to transition to renewable energy sources. The data suggests that green bond issuance is widespread across various industries, indicating a broad acceptance of sustainable financing practices. Figure 1 compares the Utilities Sector with the overall market.

TRBC Sector	Issues	Issued (USD in billions)
Banks	1796	490.70
Electric Utilities	717	204.42
Corporate Banks	417	141.63
Multiline Utilities	142	79.14
Real Estate Rental, Development & Operations ...	651	73.42
Corporate Financial Services	331	71.61
Construction & Engineering	314	36.27
Hydroelectric & Tidal Utilities	174	32.48
Retail & Mortgage Banks	51	29.52
Investment Holding Companies	103	26.07
Auto & Truck Manufacturers	31	24.99
Renewable IPPs	188	24.09
Other TRBC Sector	3775	638.97

Table 2: Issued Amount by TRBC Sector

3.2 Green Bond issuance and stock prices

The results of previous studies suggest that there is a clear relationship between the issuance of green bonds and the performance of the stock market; however, the direction of this connection is not entirely clear. The announcement of green bond issuance was met with a favorable reception from investors, according to Flammer (2020), notably for initial offers and third-party certified green bonds. In their study, Ma et al. (2018) found that the issue of green bonds had a dynamic impact on stock prices. On the other hand, Roslen et al. (2017) stated that they saw a considerably favorable stock price response on the first day after the issuing of green bonds, but that they detected either significant or insignificant negative effects during subsequent event periods. Based on their findings, it appears that initial investor enthusiasm may be able to enhance stock prices; but, it is possible that this effect may not be sustained. Similarly, Liang (2018) conducted an analysis of China's green bond data and discovered that, with the exception of the day of the announcement and the three days that followed, the market's reaction to green bond events in other time windows was either significantly negative or insignificant. The response of the market to the environmental preference information that was given by green bond issuance announcements, according to Liang's argument, was neither persistent nor quick. An examination of the similarities and differences between green bonds and regular bonds throughout the same time period provided support for this viewpoint. An investigation on the reaction of the stock market to the issuing of green bonds by Bhagat and Yoon (2023) discovered that there was no substantial market reaction to such announcements, which is consistent with the Greenwashing Hypothesis. This hypothesis suggests that the market may not always take green bond announcements seriously, potentially viewing them as attempts to improve public perception without substantial environmental impact.

3.3 Priced at Premium?

Multiple studies have examined the pricing dynamics of bonds, noting a yield disparity between green bonds and their conventional counterparts. The investigation of this phenomenon, commonly referred to as "greenium," has given some interesting insights. The extent of cost advantage (greenium) on the issuer side varies depending on the study examined. For instance, according to the research conducted by Caramichael and Rapp (2022) commissioned by the US Federal Reserve, there is an approximate cost advantage of 8 basis points at the issuance time. A study by Ehlers and Packer from 2017 compared 21 green bonds in the primary market with the conventional counterparts of the respective issuers from the period from 2014 to 2017. Despite the identified greenium of 18 basis points, there was a considerable spread in the yield differences, with the yields of the green bonds even being higher than those of their conventional counterparts in 5 out of 21 cases. The overall spread of yield differences ranged from around 80 basis points lower yields to around 20 basis points higher yields for green bonds. Although the sample analysed in the study by Ehlers and Packer was small and the market was still in its early stages, it cannot be ruled out that that for certain bonds there is no yield advantage for the green bond issuer, or in the case of bonds in the secondary market, a lower bond price compared to the conventional Bonds. In contrast, Larcker and Watts from 2019 analysed a bond universe of around 2,900 green bonds from the US municipal bond market and found that there was in fact no greenium for the green bonds of these issuers. According to the authors, there was no detectable greenium in 85% of cases, while the remaining 15% scattered slightly around zero in both directions. Flammer (2021), Tang & Zhang (2020) and Wu (2022) have also indicated that there is no green bond premium, suggesting that the yield difference does not exist. Surprisingly, the studie of Wu (2022) found that green certification actually leads to green bonds being priced higher than conventional bonds. In other words, certification of green bonds plays a crucial role. Green bonds that are self-labeled, without certification, are not linked to CO2 reduction or eliciting a reaction in the stock market. In a comprehensive study by Löffler et al. (2021) compared 2,000 green bonds with 180,000 conventional bonds from 650 different issuers as part of a two-stage matching process. The results show that the greenium is heavily dependent on the respective issuer. Löffler et al. (2021) found that green bonds from publicly listed companies in China actually generated a higher return instead of a lower return for investors. On the issuer side, several compelling reasons contribute to the prominence of green financial products. Firstly, there exists a robust demand for these products, which not only results in higher oversubscriptions but also reduces financing costs in comparison to conventional bonds. This demand is further bolstered by the inclusion of green financial products in indices such as the Green Bond Index, Solactive GB Index, and JP Morgan JESG Green Bond Index, creating additional market interest despite limited supply. Moreover, green financial products tend to demonstrate a more stable secondary market performance due to their scarcity factor. Fund and portfolio managers, driven by internal targets, often retain green issues for longer periods as they align with their objectives. Additionally, issuing green bonds facilitates the diversification of the investor base. This is particularly advantageous in regions where bonds are perceived as expensive, as it attracts additional investors.

3.4 Signaling Theory

Beyond the financial aspect, the literature also deals with Signaling Theory in the context of green bonds. Green bonds can serve as a credible signal to the market, indicating the company's genuine commitment to environmental sustainability. Sangiorgi and Schopohl (2021) show that reputational benefits, the market signaling power of green bonds, and a desire to curb climate change are the main motives for green bond issuance. More precisely, when companies issue green bonds, they are communicating to the broader community their commitment to sustainable business practices. This is in line with findings by Fatica et al. (2021), who also find evidence of a reputation effect on the green bond market, at least for non-financial corporates. They also find evidence of a reputation effect on the green bond market, at least for non-financial corporates. Daubanes et al. (2024) further suggest that managers use green bonds to signal the profitability of the climate-friendly projects they finance, which can attract investors by demonstrating a commitment to profitable and sustainable investments. Green bonds, therefore, not only contribute to environmental goals but also help reduce information asymmetry between companies and investors, ensuring that the firm's green credentials are both genuine and financially sound.

3.5 Financing costs

A study by Eckbo, Masulis, and Norli (2007) states that stock markets have a statistically significant negative reaction to new issues of equity but no such response to new issues of debt. These findings support the pecking order theory proposed by Myers and Majluf (1984), whereas companies prioritize financing from their internal resources. Companies only release new equity as a last resource. Because of asymmetric information, the stock market has responded in different ways. Indeed, managers are typically assumed to possess superior insight into their company's financial prospects compared to investors. Consequently, they might opt to issue new shares of stock during periods of overvaluation, capitalizing on the financial markets' tendency to overestimate the company's worth. Within this paradigm, the issuance of new equity signals to the markets that the company is overvalued, potentially prompting a negative reaction as investors reassess its true value. Setting aside the advantage of accessing cheaper financing through green bonds, there must be additional motivations prompting companies to utilize this financing mechanism. We are left with the conclusion that companies issue green bonds for another reason. If the latter is different from regular bond issuance because it leads to positive abnormal returns in the stock market, then businesses will have a financial reason for the higher costs of compliance and reporting. Additionally, this change in the stock price could only be explained by the fact that financial markets like companies that make environmentally friendly promises that they can keep.

4 Data

My methodical approach involves integrating several data sources as I perform a thorough investigation of European companies that issue green bonds. For data collection, I mostly utilize Refinitiv Eikon, Datastream and Compustat. Firstly, Refinitiv Eikon serves as a crucial database for obtaining comprehensive financial analysis, including detailed information on green bonds issued by companies. It provides data on green bond issuance details, company financials, ESG (Environmental, Social, and Governance) scores and market data. Through Eikon, I extract specific data points such as the time, volume and frequency of green bond issuances, the terms and conditions of these bonds, and their impact on the companies' financial health and ESG ratings. Secondly, Datastream is utilized to gather time series data on firm specific data such as share prices. Lastly, Compustat provides detailed company-specific financial data essential for an in-depth analysis. This includes company financial statements, operational metrics, and other quantitative data. Using Compustat, I extract detailed financial data of companies issuing green bonds, such as balance sheets, with the help of which I was then able to carry out various calculations. This data allows for an in-depth analysis of how green bond issuance affects a company's financial performance.

4.1 Dependent Variables

For my analysis I downloaded 2 datasets for Green Bonds: One for the total market and one for the utilities sector. For the Bond data, I use Refinitiv Eikon. I input "Corporate Bonds" as my search term to locate corporate bonds within the database. To narrow down the results to green bonds, I utilize the available filtering options. Specifically, I look for filters or classifications that identify bonds as green. Once I've applied the appropriate filters, I further refine my search by specifying that I'm interested in green corporate bonds issued within the European Union and denominated in Euros. This allows me to focus on bonds that meet both geographical and currency criteria. Additionally, I include a search parameter for bonds issued from 2008 onwards, as this is when the first green bond was issued. This initial sweep yields a broad dataset, capturing 598 instances of green bond issues across the European market. To gather the corresponding share prices for the companies issuing the bonds, I use the Center for Research in Security Prices (CRSP) database. This resource provides comprehensive historical stock price data for a wide range of companies. By cross-referencing the bond issuers with the CRSP database, I compile a dataset consisting of 70 companies for the entire market. However, since these

	Variable	Obs	Mean	Median	Std. dev.	Min	Max
Total Market	Coupon	1,739	2.134	1.5	2.0569	0	13.916
	Maturity	1,720	12.767	7.005	63.631	1.002	1000.663
Sector	Coupon	250	2.533	2	1.929	0	10.75
	Maturity	236	36.885	9.756	156.411	2.783	1000.663

Table 3: Bond Characteristics

companies typically issue multiple bonds, the number of events expands to 227 events. This dataset will serve as the foundation for analyzing abnormal returns in the event study. In a subsequent search, I narrow down the dataset further by filtering for the utilities sector. This allows for a more focused comparison within this specific industry. Finally, I execute the search and review the results to identify green corporate bonds that align with my criteria. This results in a refined subset of 72 companies operating within the EU region. After obtaining the corresponding share prices for these companies, I compile a dataset consisting of 20 companies. Similar to the broader market analysis, these companies have issued multiple bonds, resulting in a total of 123 events within the dataset. This comprehensive dataset will facilitate a focused analysis of green bond issuances within the utilities industry and their impact on company stock prices.

Total Market	**Issuers**	**Bonds issued**	**Maturity (years)**	**Coupon**
Communications	3	4	8.72	3.563
Banking and Finance	26	110	6.83	2.345
Insurance	2	8	11.54	3.451
Retail	2	3	9.03	3.708
Automotive	4	23	5.61	3.895
Chemicals and Materials	3	6	172.63	3.392
Real Estate	12	41	8.85	2.388
Energy	4	15	6.77	2.425
Logistics	1	3	10.01	2.735
Development	3	3	4.50	5.375
Total	60	216	8924	3.328
Utility Sector	20	129	4633	2.222

Table 4: Summary Statistics

I conducted a comprehensive analysis spanning from 2008 to 2024, utilizing both the Fama-French Three-Factor Model (FF3) and the Fama-French Five-Factor Model (FF5) for a detailed examination of the performance dynamics. I got the historical data from the Kenneth French website, where I downloaded the complete data set and then adjusted it for the appropriate time period in excel.

4.2 Control Variables

To comprehensively understand how different firm characteristics influence Cumulative Abnormal Returns (CARs), a series of regression models are explored, each adding one more explanatory variables. These models are designed to reveal the relationships between CARs at time t and various firm attributes during the corresponding period. By incorporating these variables, insights are gained into how each factor—ranging from basic firm characteristics and financial structure to profitability, market valuation, and ESG performance that affect firm returns. In the following the four regressions are presented.

(1) $\text{CAR}_i = \alpha + \beta_1\text{Dummy}_i + \beta_2\text{Size}_i + \epsilon_i$

(2) $\text{CAR}_i = \alpha + \beta_1\text{Dummy}_i + \beta_2\text{Size}_i + \beta_3\text{Leverage}_i + \epsilon_i$

(3) $\text{CAR}_i = \alpha + \beta_1\text{Dummy}_i + \beta_2\text{Size}_i + \beta_3\text{Leverage}_i + \beta_4\text{ROA}_i + \beta_5\text{Tobins Q}_i + \epsilon_i$

(4) $\text{CAR}_i = \alpha + \beta_1\text{Dummy}_i + \beta_2\text{Size}_i + \beta_3\text{Lev}_i + \beta_4\text{ROA}_i + \beta_5\text{Tobins Q}_i + \beta_6\text{ESG}_i + \epsilon_i$

The dependent variable of interest, the regressor in the regression model, is therefore the variable CAR. The dummy variable is a binary variable and represents whether a green bond was issued (Dummy = 1) or not (Dummy = 0).
Size is intended to control for the scale of the company. Due to their diversification, larger companies may have more resources to cover green bond issuing costs and less volatile stock prices. In contrast, smaller companies might experience more pronounced stock price reactions due to their relatively limited financial flexibility. Including size as a control variable distinguishes green bond issuance from firm size-related market behavior.The key figure used is total assets, which Bloomberg (2017) defines as the sum of all current and non-current assets and which is reported in millions of euros in the annual financial section of the annual report.
Leverage describes the financing ratio of a company, often also referred to as the debt-equity ratio or capital structure.By controlling for leverage, the analysis ensures that the observed effects on stock prices are not merely a reflection of the firm's debt level.
The control variable ROA refers to the profitability indicator return on assets and indicates how profitably and efficiently a company operates and utilises its resources as a percentage of total assets.
Tobin's Q is interpreted under the assumption that the market value and replacement value of a firm should converge, indicating whether the company is overvalued or undervalued (Bloomberg, 2017). Bloomberg (2017) characterizes Tobin's Q as a valuable metric for assessing the worth of a company. By including Tobin's Q, the study controls for the possibility that firms with a higher market valuation may experience different stock price reactions to green bond issuance compared to firms with lower valuations.
Another control variable is ESG. Environmental, Social, and Governance (ESG) performance is included to account for the firm's overall sustainability practices. Companies with higher ESG scores may already be viewed favorably by investors, and the issuance of green bonds might reinforce this perception. Conversely, companies with lower ESG scores might use green bond issuance as a signal to improve their reputation. Controlling for ESG performance helps ensure that the observed stock price reactions are due to the green bond issuance itself, rather than the firm's broader sustainability profile.
The accounting data for the computations of the control variables were obtained from Compustat Global. First, the global company keys (gvkey) for companies that had green

bonds or shares in the dataset from previous research were identified. To calculate these control variables, the necessary balance sheet items were extracted from Compustat: Total Assets, Common Shares Outstanding, Common/Ordinary Equity, Operating Income Before Depreciation, and Debt, which includes long-term debt and debt in current liabilities. For computing Tobin's Q, the share price was required and sourced from the Closing Price in the CRSP database. With this data, the control variables were calculated. The detailed computations and characteristics of the variables can be found in the appendix. Additionally, ESG data were utilized as additional control variables. To obtain this data, the ESG scores for each company were determined using Refinitiv. Since Refinitiv provided these scores as letter grades (e.g., AA, B-, C+), they were converted to numerical values using a conversion table supplied by Refinitiv. After converting the ESG scores to numerical values, these variables were combined with the previously extracted financial metrics (all computations can be found in the appendix). This resulted in an ESG data set of 637 for the market and 132 for the sector. Together, they were used to calculate the regression models, allowing for a comprehensive analysis of how both financial and ESG factors influence Cumulative Abnormal Returns.

5 Methodology

In my thesis, I conduct multiple event studies to analyze whether issuing green bonds affects the stock prices of the issuing companies, comparing the overall market with the utility sector. An event study is a research method used in finance and economics to assess the impact of a specific event on the Company valuation or on the stock market price. The technique is widely utilized to measure how particular occurrences, such as earnings announcements, mergers, or macroeconomic news, influence stock prices. This methodology, which traces its origins to the work of Fama et al. (1969), has become a fundamental tool for understanding the effects of events on financial markets. The primary purpose of an event study is to determine whether there is a significant abnormal return associated with an event. Abnormal returns are the differences between actual returns and expected returns. By analyzing abnormal returns around the event date, researchers can infer the event's impact on firm value.

To identify the event date, prior scholars have used the announcement date of green bonds rather than the actual issue date, as the announcement date represents the day information is communicated to the market. Consistent with Fama's (1970) thesis that market prices reflect all relevant information, the market response should occur on the announcement date. Therefore, this research designates the day of the green bond announcement as the event date (day 0).

Following Flammer (2020), the analysis includes the following time windows: Baseline Time Window: [-5, 5] This window spans from 5 days prior to 5 days following the announcement. The short event window of [-5,5] days around the announcement captures the immediate market reaction to the announcement of a green bond issuance. This window is chosen because it allows for the detection of both pre-announcement effects, where information may have leaked or been anticipated by the market, and post-announcement reactions, where the market adjusts based on the new information. Moreover I include an additional window with a timespan of [-10, -10]. The long event window of [-10,10] days provides a broader perspective by capturing both the immediate reaction and any delayed market responses. Some investors may take longer to react as they digest the implications of the green bond issuance, particularly if it signals a significant strategic shift for the company. Additionally, this window allows for the examination of whether the initial market reaction is sustained or reversed in the days following the announcement. By including a longer event window, the study ensures that both short-term volatility and longer-term adjustments are accounted for, providing a more comprehensive understanding of the market's response. After the event window was defined, I started calculating the expected returns with the Fama-French model. The Fama-French model expands the Capital Asset Pricing Model (CAPM) by including additional factors to better explain stock returns. To delve deeper into the performance evaluation, I employed both FF3 and FF5 models to ascertain the expected returns. This involved a meticulous process: I performed multiple linear regressions to estimate the factor loadings, encompassing market, size, value, profitability, and investment style factors. These factor loadings, encapsulated in coefficients (β_M, β_{SMB}, β_{HML}, β_{RMW}, β_{CMA}), delineated the influence of each factor on my security or portfolio's returns. By multiplying these loadings with the historical returns of the corresponding factors, I derived the expected contributions of each factor to the overall returns. The Fama-French 3-factor model (1) adds size (Small Minus Big) and value (High Minus Low) factors to the market risk factor, while the 5-factor model (2) further includes profitability (Robust Minus Weak) and investment (Conservative Minus Aggressive) factors.

$$(5)\ E(R_{it}) = \alpha_i + \beta_{iM} R_{mt} + \beta_{iSMB} SMB_t + \beta_{iHML} HML_t$$

$$(6)\ E(R_{it}) = \alpha_i + \beta_{iM} R_{mt} + \beta_{iSMB} SMB_t + \beta_{iHML} HML_t + \beta_{iRMW} RMW_t + \beta_{iCMA} CMA_t$$

After determining the expected returns, the next step is to calculate the abnormal returns. Abnormal returns are the differences between the actual returns of a security and its expected returns over a specified period. These abnormal returns are crucial as they provided insights into the security performance relative to expectations.

$$(7)\ AR_{it} = R_{it} - E(R_{it})$$

where:

- AR_{it} is the abnormal return of security i at time t.
- R_{it} is the actual return of security i at time t.
- $E(R_{it})$ is the expected return of security i at time t.

To comprehensively evaluate the overall impact of the event, we aggregate the abnormal returns over the event window. This aggregation provides a clearer picture of the event's effect on the security's price. The cumulative measure of these abnormal returns over the event window is known as the Cumulative Abnormal Return (CAR). The CAR is calculated as follows:

$$(8)\ CAR_{i(t_1,t_2)} = \sum_{t=t_1}^{t_2} AR_{it}$$

where:

- $\text{CAR}_{i(t_1,t_2)}$ is the cumulative abnormal return for security i from time t_1 to t_2.
- AR_{it} is the abnormal return of security i at time t.
- t_1 is the start of the event window.
- t_2 is the end of the event window.

Following the structural organization of the event study, two hypotheses were formulated to be answered with the help of the event study.

First Hypothesis: Is there a significant impact of the issuance of green bonds on the stock prices of the respective companies in Europe and are there differences when considering the entire market versus the utility sector?

Second Hypothesis: Do the variables Leverage, Size, ESG, ROA, and Tobin's Q influence the Cumulative Abnormal Returns?

6 Empirical Results

In the following I will discuss the results from the event study. First I will focus on the Cumulative Average Abnormal returns I got from the event study, followed by the t-tests of means of the CAARs between the Market and the Sector. I will do this both, for the Long Event Window as well as the short. After that I will discuss the results from the regressions computed with the control variables. Figure 2 illustrates the results from the event studies in multiple graphs. The blue line visualizes the results for the long event window, while the orange line visualizes the short window. It can be observed that the CAARs for the market using the 3FF model show a slight decline just before the event, followed by a noticeable increase post-announcement. This upward trend suggests that the market reacts positively to green bond announcements, indicating that investors perceive these announcements as favorable news that may enhance company value. This

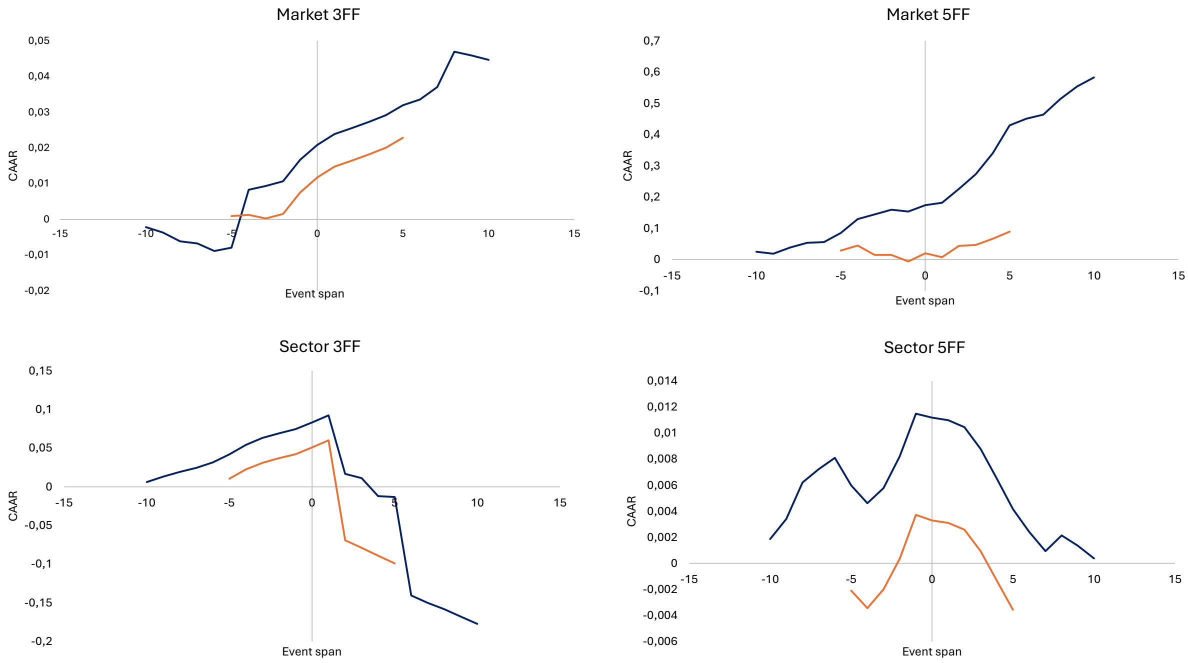

Figure 2: Cumulative Abnormal Returns. The blue line represents the long event window, and the orange line represents the short event window

observation aligns with findings in the existing literature where positive market reactions to green bond announcements are documented (Flammer, 2021). The CAARs under the 5FF model exhibit a similar trend but with a steeper increase post-event. The sharper rise indicates that the additional factors in the 5FF model capture more of the variation in returns, potentially related to investment and profitability factors that are relevant for green bonds. The significant positive CAARs post-announcement reaffirm the market's positive reception of green bond issuances, consistent with studies by Tang and Zhang (2020).

In contrast, the utility sector shows a more varied response. The 3FF model reveals a decline in CAARs leading up to the event and a further drop immediately post-announcement. This negative reaction is in contrast to the overall market and suggests that the utility sector may face unique challenges or investor skepticism regarding green bonds. One explanation could be that the utility sector is more exposed to environmental regulations and sustainability pressures than many other industries. Utilities are significant contributors to carbon emissions and are subject to strict regulatory scrutiny, making their transition to greener practices both crucial and costly. Investors could be ambivalent. On one hand, it signals a commitment to sustainability and compliance with regulatory requirements, which could be viewed positively. On the other hand, the financial burden associated with implementing green projects and meeting compliance standards may raise concerns about profitability and financial stability, leading to a more cautious or even negative market reaction. This aligns with Bachelet, Becchetti, and Manfredonia

(2019) who noted sector-specific negative reactions in their analysis of varying impacts of green bonds across different industries.

The CAARs for the utility sector using the 5FF model display a more complex pattern with an initial positive reaction, followed by a sharp decline. This volatility indicates that the utility sector's response to green bond announcements is influenced by factors beyond those captured in the 3FF model. The brief positive spike could be due to initial investor optimism, which quickly reverses possibly due to concerns about the financial implications of implementing green projects. This reaction underscores the importance of considering sector-specific dynamics and the broader economic factors encapsulated in the 5FF model.

6.1 Long Event Window

The mean CAR for the Market is -0.00819, while for the Sector, it is -0.08734. The difference in mean CARs is 0.07914. The 95% confidence interval for the difference in means is [0.05288, 0.10540], which does not include zero. This indicates that the difference in means is statistically significant at the 5% level. The t-statistic is 6.0912 with 40 degrees of freedom, which corresponds to a p-value much smaller than any conventional significance level (e.g., 0.05, 0.01). Therefore, we reject the null hypothesis that the mean CARs of the Market and the Sector are equal. There is a statistically significant difference in the cumulative average returns around the event window between the Market and the Sector. The Market has a higher CAR compared to the Sector. This result suggests that the event had a different impact on the Market compared to the Sector, with the Market experiencing less negative returns on average. The significant difference in CARs between the Market and the Sector following the event indicates that the Market was relatively more resilient. This highlights the need for investors to consider sector-specific risks and the benefits of diversification. For policymakers, it emphasizes the importance of understanding sector-specific impacts and implementing measures to support more vulnerable sectors during significant events. The new results reinforce that there is a

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
Market	21	-0.00819	0.00544	0.02495	-0.01955	0.00315
Sector	21	-0.08734	0.01179	0.05406	-0.11194	-0.06273
Combined	42	-0.04776	0.00890	0.05773	-0.06576	-0.02977
diff		0.07914	0.01299		0.05288	0.10540

diff = mean(Market3FF) - mean(Sector3FF)
t = 6.0912, df=40, H0: diff = 0

Table 5: Two-sample t test with equal variances, 3FF, [-10,10]

significant difference in the impact of the event on the Market versus the Sector. While the first test (3FF model) showed that the Market was less negatively affected, the second test (5FF model) indicates that the Market was significantly positively affected compared to the Sector. These findings suggest that the Market's performance during the event window was more resilient or positively influenced, whereas the Sector did not share the same level of positive impact. This highlights the importance of considering different models and perspectives when analyzing market events. The different results between

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
Market	21	0.24083	0.04094	0.18746	0.1554	0.32625
Sector	21	0.00582	0.00078	0.00357	0.0041	0.00745
Combined	42	0.12332	0.02731	0.17699	0.06817	0.17844
diff		0.23501	0.04095		0.15223	0.31778

diff = mean(Market5FF) - mean(Sector5FF)
t = 5.7383, df=40, H0: diff = 0

Table 6: Two-sample t test with equal variances, 5FF, [-10,10]

the 3FF and 5FF models can be explained by the additional factors (profitability and investment) included in the 5FF model. These factors capture additional dimensions of risk and return that are not accounted for in the 3FF model. The Market might have a more favorable exposure to these factors, resulting in higher positive CARs. In contrast, the Sector's characteristics might not align as well with these factors, leading to a smaller change in its CARs. This highlights the importance of selecting the appropriate model that best captures the underlying risk and return dynamics when analyzing financial events.

6.2 Short Event window

The results from the 3FF model indicate that both the Market and the Sector experienced negative cumulative average returns in the short window around the event. The Market's mean CAR is -0.01038, while the Sector's mean CAR is -0.05367. The difference in means is 0.04329, which is statistically significant. This suggests that while the event had an overall negative impact, the Market as a whole was more resilient than the specific Sector. The less negative CAR for the Market indicates that investors were somewhat more optimistic or less pessimistic about the overall market compared to the specific sector during the short window. On the other hand, the more severe negative CAR for the Sector suggests that this sector was particularly vulnerable to the event, potentially due to sector-specific risks or a higher sensitivity to the event-related factors. The 5FF model results show a significant positive CAR for the Market and a near-zero CAR for the Sector in the short window around the event. The Market's mean CAR is 0.15297, while the Sector's

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
Market	11	-0.01038	0.00272	0.00902	-0.01644	-0.00432
Sector	11	-0.05367	0.00854	0.02832	-0.07270	-0.03464
Combined	22	-0.03203	0.00643	0.03019	-0.04541	-0.01864
Difference		0.04329	0.00896		0.02459	0.06198

diff = mean(Market3FFshort) - mean(Sector3FFshort)
t = 4.8297, df=20, H0: diff = 0

Table 7: Two-sample t test with equal variances, 3FF, [-5,5]

mean CAR is 0.00014. The difference in means is 0.15282, which is statistically significant. The additional factors in the 5FF model (profitability and investment) appear to capture different dimensions of firm characteristics and risks, leading to these distinct outcomes. The significant positive CAR for the Market suggests a favorable immediate reaction to the event. This could be driven by firms with strong profitability and conservative investment strategies, which are captured by the additional factors in the 5FF model. The near-zero CAR for the Sector indicates that the event did not have a material impact on this sector in the short run. This lack of significant reaction suggests that the sector either did not benefit from the event or that the sector's firms did not exhibit the characteristics (robust profitability or conservative investment) that would have led to a positive CAR.

Variable	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
Market	11	0.15297	0.03068	0.10177	0.08459	0.22134
Sector	11	0.00014	0.00083	0.00276	-0.00171	0.002004
Combined	22	0.07655	0.02241	0.10513	0.02994	0.12317
Difference		0.15282	0.03069		0.08879	0.21686

diff = mean(Market5FFshort) - mean(Sector5FFshort)
t = 4.9784, df = 20, H0: diff = 0

Table 8: Two-sample t test with equal variances, 5FF, [-5,5]

The contrasting results between the 3FF and 5FF models underscore the importance of considering additional factors when analyzing market reactions. The 3FF model highlights a negative impact for both the Market and the Sector, with the Market being more resilient. In contrast, the 5FF model reveals a positive impact on the Market and a neutral impact on the Sector, indicating the significance of profitability and investment factors in understanding immediate market responses to events.

6.3 Control Variables for Market

6.3.1 Three Factor model

Table 9 shows the regression results where the CARs where computed by the Fama French Three Factor Regressions. The results show the impact of various factors on the Cumulative Abnormal Return around the issuance of green bonds, with analyses for the event windows [-10,10] and [-5,5]. The dummy variable represents whether a green bond was issued (Dummy = 1) or not (Dummy = 0). For the event window [-10,10], the results across all regressions indicate that the issuance of a green bond (Dummy) has a positive and significant effect on CAR, suggesting that green bond issuance leads to increased abnormal returns. The control variables, including Size, Leverage, ROA, Tobins Q, and ESG, do not show significant impacts on CAR, implying that the primary driver of the positive abnormal returns is the green bond issuance itself. Table 13 in the appendix contains the descriptive statistics. The dependent variable CAR has a negative mean with -0.521, while the values fluctuate strongly between -4,489 and 18,996. All other explanatory variables have a positive mean value, with comparatively small fluctuations. Large differences can also be recognised in the size factor, with a differences between the minimum value and the maximum value of almost 6. Table 15 in the appendix shows the correlations between

	[-10,10]				[-5,5]			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Dummy	0.499***	0.504***	0.495***	0.493***	0.571***	0.574***	0.566***	0.575***
	(5.04)	(5.07)	(4.96)	(4.30)	(5.75)	(5.78)	(5.67)	(4.91)
Size	0.0286	0.0363	0.036	0.0532	0.0236	0.0330	0.0345	0.061
	(0.87)	(1.06)	(0.96)	(1.03)	(0.73)	(0.98)	(0.95)	(1.24)
Leverage		0.155	0.141			0.199	0.183	0.115
		(0.74)	(0.67)			(0.96)	(0.88)	(0.47)
ROA			-0.385	-0.921			-0.324	-0.756
			(-0.61)	(-1.06)			(-0.52)	(-0.89)
Tobins Q			-1.57e-08	0.00			-1.79e-08	0.00
			(-0.79)	(0.45)			(-0.91)	(0.40)
ESG				-0.062				-0.142
				(-0.27)				(-0.65)
cons	-0.737***	-0.822***	-0.790***	-0.749**	-0.714***	-0.821***	-0.800***	-0.775**
	(-4.70)	(-4.23)	(-3.64)	(-2.82)	(-4.61)	(-4.31)	(-3.76)	(-2.95)
N	1182	1182	1182	637	1175	1175	1175	633

t statistics in parentheses
*T*he dependent variable is the Cumulative Abnormal return (CAR)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Three Factor Model

the individual control variables. There is a moderate positive correlation between CAR and the dummy (0.1833). This means that the issue of green bonds tends to lead to higher cumulative abnormal returns. For the other values values are slightly positive or negative, but all very close to 0. The negative correlation between ROA and Size should be emphasised among the explanatory variables (-0.4664). ESG is also almost exclusively positively correlated. When shifting to the results in the short event window [-5,5], the Dummy variable remains positive and significant across all regressions, further confirming that green bond issuance results in higher abnormal returns. The control variables again show no significant effects on CAR, reinforcing the conclusion that green bond issuance is the main factor influencing the positive abnormal returns observed. Overall, the Fama French Three Factor Model reveals that green bond issuances consistently lead to higher cumulative abnormal returns in both event windows. Unlike in the sector-specific models, these market-level analyses consistently show a strong positive response to green bond issuances, with control variables such as Size, Leverage, ROA, Tobins Q, and ESG having no significant impact on abnormal returns.

6.3.2 Five Factor model

In the [-10,10] window, the issuance of a green bond (Dummy) consistently shows a positive and significant impact on CAR across all regressions, indicating that green bond issuance leads to higher abnormal returns. The variable Size is identified as a significant driver with a positive impact, while the variables Leverage, ROA, and ESG are found to be insignificant. Tobins Q is also insignificant except for the final regression, where a slightly positive reaction at a 5% level is observed. Similarly, in the [-5,5] window, the Dummy variable remains positive and significant in all regressions, reinforcing that green bond issuance results in higher abnormal returns.

	[-10,10]				[-5,5]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy	-4.449***	-4.447***	-4.440***	-3.912***	-4.393***	-4.390***	-4.378***	-3.880***
	(-12.81)	(-12.80)	(-12.76)	(-6.79)	(-12.51)	(-12.49)	(-12.42)	(-6.65)
Size	0.304*	0.320*	0.395**	0.436	0.312*	0.325*	0.397**	0.403
	(2.39)	(2.39)	(2.75)	(1.77)	(2.48)	(2.47)	(2.80)	(1.69)
Leverage		0.301	0.346			0.288	0.329	-0.480
		(0.37)	(0.42)			(0.36)	(0.40)	(-0.40)
ROA			3.478	4.904			3.498	3.610
			(1.40)	(1.08)			(1.36)	(0.80)
Tobins Q			0,00	-0.01*			-0,00	-0.01*
			(-0.53)	(-2.28)			(-0.23)	(-2.10)
ESG				-1.863				-1.669
				(-1.60)				(-1.45)
cons	2.884***	2.719***	2.177**	3.346**	2.856***	2.703***	2.173**	3.591**
	(4.75)	(3.60)	(2.58)	(2.64)	(4.77)	(3.66)	(2.61)	(2.80)
N	1099	1099	1099	573	1096	1096	1096	573

t statistics in parentheses
*T*he dependent variable is the Cumulative Abnormal return (CAR)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Five Factor Model

Overall, across both event windows, the issuance of green bonds consistently results in higher cumulative abnormal returns, as indicated by the significant Dummy variable. Unlike the sector-specific model, these market-level analyses reveal a strong positive market reaction to green bond issuances, with control variables, except for Size, not showing significant effects.

6.4 Control Variables for Utilities Sector

6.4.1 Three-factor model

If the utilities sector in the 3-factor model in Table 11 is examined, similar results for the dummy can be seen, indicating a positive relationship across all regressions. Unlike the total market, Leverage displays a significant positive effect, suggesting that greater abnormal returns are experienced by utilities firms with higher leverage. Additionally, the control variable ROA is highly significant and negative in regression (3), but becomes positive and insignificant when Tobins Q and ESG are included. Tobins Q is also significant but has a negative impact. These results are observed in both short and long event windows, while ESG does not exhibit significant effects. Overall, this sector-specific analysis for Utilities reveals that the issuance of green bonds consistently leads to increased cumulative abnormal returns in both event windows. The positive reaction is particularly pronounced for firms with higher leverage, whereas Tobins Q has a negative impact.

	[-10,10]				[-5,5]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy	0.406***	0.385***	0.348***	0.416**	0.429***	0.408***	0.369***	0.414**
	(4.20)	(4.02)	(3.70)	(2.82)	(4.46)	(4.28)	(3.94)	(2.99)
Size	-0.009	0.102	0.098	0.150	-0.002	0.108	0.104	0.319*
	(-0.14)	(1.39)	(1.34)	(1.05)	(-0.04)	(1.46)	(1.42)	(2.25)
Leverage		1.206**	1.802***			1.192**	1.795***	3.247***
		(2.98)	(4.18)			(2.95)	(4.18)	(4.18)
ROA			-5.497***	1.944			-5.562***	-2.940
			(-3.37)	(0.44)			(-3.42)	(-0.68)
Tobins Q			-0.205**	-0.583*			-0.205**	-0.680**
			(-3.04)	(-2.24)			(-3.04)	(-2.77)
ESG				0.170				-0.148
				(0.26)				(-0.24)
Cons	-0.423	-1.299**	-0.819*	-0.849	-0.452	-1.317***	-0.835*	-1.891*
	(-1.57)	(-3.28)	(-1.99)	(-0.98)	(-1.68)	(-3.33)	(-2.04)	(-2.21)
N	314	314	314	132	314	314	314	132

t statistics in parentheses
*T*he dependent variable is the Cumulative Abnormal return (CAR)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Sector, Three Factor Model

Table 14 in the appendix shows the summary statistics of the control variables in the sector. It is noticeable that the CARs are negative in the mean value and have a negative

standard deviation. Compared to the whole market, the utility sector shows less variability and less extreme values for the CARs.
Table 16 (Appendix) presents that the issue of a green bond (Dummy=1) tends to lead to higher CARs (0.3107). Compared to the overall market (0,1833) the correlation in the sector is significantly higher indicating that the market reaction to green bonds in this sector is stronger than in the overall market.

6.4.2 Five Factor Model

When the results of the Five Factor Model are examined, it is noticeable that the results for the dummy are different compared to the Three-Factor Model, where the Dummy variable was significant. Firm size consistently shows a negative and significant impact, suggesting that larger firms experience lower abnormal returns. Additionally, ESG performance is positively significant in some models, indicating that better ESG performance correlates with higher abnormal returns. Leverage, ROA, and Tobins Q do not show significant effects. In the [-5,5] window, the Dummy variable remains insignificant across all regressions, further indicating that green bond issuance does not significantly impact abnormal returns in this shorter timeframe. Firm size continues to exhibit a negative and significant effect, while ESG performance is positively significant in some models. Leverage, ROA, and Tobins Q do not have significant impacts on abnormal returns. In

	[-10,10]				[-5,5]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy	0.0247	0.0239	0.0166	-0.0424	0.0122	0.0116	0.00518	-0.0393
	(0.79)	(0.76)	(0.53)	(-0.90)	(0.40)	(0.38)	(0.17)	(-0.85)
Size	-0.0566**	-0.0528*	-0.0537*	-0.137**	-0.0505*	-0.0479*	-0.0490*	-0.154***
	(-2.81)	(-2.26)	(-2.26)	(-3.16)	(-2.54)	(-2.08)	(-2.09)	(-3.50)
Leverage		0.0413	0.146			0.0297	0.129	-0.263
		(0.32)	(1.04)			(0.23)	(0.93)	(-1.05)
ROA			-0.957	-2.493			-0.906	-1.843
			(-1.82)	(-1.86)			(-1.74)	(-1.34)
Tobins Q			-0.0371	-0.145			-0.0365	-0.142
			(-1.70)	(-1.85)			(-1.70)	(-1.85)
ESG				0.515*				0.590**
				(2.61)				(3.02)
Cons	0.255**	0.226	0.311*	0.631*	0.231**	0.209	0.294*	0.679*
	(3.02)	(1.79)	(2.34)	(2.43)	(2.76)	(1.68)	(2.23)	(2.56)
N	308	308	308	124	308	308	308	124

t statistics in parentheses
The dependent variable is the Cumulative Abnormal return (CAR)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Sector Five Factor Model

summary, the Fama French Five Factor Model for the Utilities sector indicates that the issue of green bonds does not have a substantial impact on abnormal returns during any event window. Green bond issuances are typically linked to lower abnormal returns in larger enterprises, whereas higher abnormal returns are correlated with superior ESG performance. The inclusion of profitability (ROA) and investment (Tobins Q) as additional factors does not materially affect these conclusions.

7 Conclusion

Previous literature has analyzed the impact of corporate green bond issuances on share prices, generally finding a positive market reaction. This thesis aimed to build on the existing literature by specifically comparing the European market as a whole with the European utilities sector, using both the Fama-French Three-Factor (FF3) and Five-Factor (FF5) models. The analysis revealed a generally positive reaction in the broader market to green bond announcements, consistent with existing research that highlights favorable investor perceptions of green financing. This comparison between the overall market and the utility sector has produced some interesting results. The analysis of CAARs in the whole market around green bond announcements reveals a generally positive market reaction, aligning with the existing literature that underscores the favorable investor perception of green financing. When comparing the FF3 to the FF5 approach, a sharper rise in CAARs for the market in the 5FF model compared to the 3FF model was observed. A possible explanation for this is that the additional factors of profitability and investment, included in the 5FF model, are significant in explaining the market's reaction.

Different to the whole market, the utility sector exhibits a more complex and sometimes negative response. This might suggest that sector-specific factors play a crucial role in shaping investor reactions. These findings emphasize the need for tailored strategies when issuing green bonds in different sectors and highlight the importance of comprehensive models to capture the diverse influences on stock returns.

In a further step, a multivariate regression was carried out to identify possible factors that influence the Cumulative Abnormal Returns. The results suggest that the issue of green bonds is mostly significant. While the results in the 3-factor model for the market and sector produce a slightly positive reaction, the results in the 5-factor model are negative.

This work is primarily limited by the fact that the number of companies issuing green bonds is still low. In particular, the sector-specific analysis was based on a small data sample, which may affect the overall informativeness of the work. Future studies could delve deeper into sector-specific factors and their interactions with broader market factors. This can help tailor investment strategies more effectively for different industries, optimizing returns by considering sector-specific dynamics. Moreover, researchers can investigate the effects of incorporating additional factors beyond the Five-Factor Model.

For instance, integrating momentum factors or other behavioral finance elements could enhance the explanatory power of the models. This could lead to a more comprehensive understanding of stock returns. Since this study focuses on the European market, extending the analysis to different geographic regions and market conditions could help understand the green bond market. The performance of the green bond market across developed and emerging markets could be compared, revealing important differences and similarities and potentially uncovering regional strengths and weaknesses of the model. This analysis would provide insights into how different economic environments impact the model's effectiveness, guiding investors in making more informed decisions across various markets. By exploring these areas, future research can enhance the applicability and robustness of factor models in financial analysis and investment strategies, contributing to more effective and informed investment decisions.

8 Appendix

Variable	Obs	Mean	Median	Std. dev.	Min	Max
CAR	1,182	-0.521	-0.055	1.241	-4.489	18.996
ROA	1,182	0.052	0.027	0.060	-0.168	0.392
Size	1,182	4.748	4.813	1.114	1.915	7.516
Leverage	1,182	0.307	0.283	0.180	0.007	0.887
Tobins Q	1,182	1.345	1.003	0.460	0.340	2.350
ESG	637	0.664	0.708	0.203	0.042	0.958

Table 13: Summary Statistics for the Market (3FF)

Variable	Obs	Mean	Median	Std. dev.	Min	Max
CAR	314	-0.342	0.772	-0.689	-3.272	0.750
ROA	315	0.077	0.028	0.079	-0.027	0.182
Size	315	4.254	0.690	4.074	2.497	5.372
Leverage	315	0.339	0.120	0.340	0.035	0.720
Tobins Q	315	1.120	0.638	1.032	0.692	9.340
ESG	132	0.704	0.108	0.708	0.458	0.875

Table 14: Summary Statistics for the Utility Sector (3FF)

	Dummy	CAR	ROA	SIZE	Leverage	TobinsQ	ESG
Dummy	1.0000	0.1833	-0.0787	0.0635	0.0065	0.1283	0.2034
CAR		1.0000	-0.0928	0.0825	0.0016	0.0541	0.0144
ROA			1.0000	-0.4664	0.1440	-0.1259	0.2468
SIZE				1.0000	-0.0638	0.0616	0.1761
Leverage					1.0000	-0.1784	0.0742
TobinsQ						1.0000	-0.2705
ESG							1.0000

Table 15: Correlation Matrix for control variables for the market (3FF)

	Dummy	CAR	ROA	SIZE	Leverage	Tobins Q	ESG
Dummy	1.0000	0.3107	-0.2493	0.3322	-0.1244	-0.1385	0.2620
CAR		1.0000	-0.1506	0.1996	0.1686	-0.2320	0.1232
ROA			1.0000	-0.5085	0.4596	0.3720	-0.1795
Size				1.0000	-0.4319	-0.1199	0.3333
Leverage					1.0000	0.2276	-0.0321
Tobins Q						1.0000	-0.0318
ESG							1.0000

Table 16: Correlation matrix for control variables for the Utility Sector (3FF)

Variable Name	**Formula**	**Source**
Tobin's Q	$\frac{TA+(CSO\times P)-CE/OE}{TA}$	Flammer (2021)
Return on Assets	$\frac{OIBD}{BVT}$	Flammer (2021)
Size	log(BVT)	Flammer (2021)
Leverage	$\frac{D}{BVD}$	Flammer (2021)

Table 17: Computation of control variables

9 Literature

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