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MASTER THESIS

CORPORATE GREEN BONDS ANNOUNCEMENTS EFFECTS ON STOCK PRICES	ĮMONIŲ ŽALIŲJŲ OBLIGACIJŲ EMISIJŲ PASKELBIMŲ ĮTAKA AKCIJŲ KAINOMS

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Introduction

Climate change has emerged as a crucial global issue, significantly shaping the future of our planet. Over the last decade, green bonds have been seen as one of the most promising financial instruments to tackle climate change. Unlike conventional bonds, green bonds are exclusively used to fund environmentally friendly and sustainable projects. Nonetheless, conventional bond proceeds can also be utilized to finance identical objectives. One significant difference from conventional bonds is that corporations face more issuing costs and burdens while issuing green bonds. Therefore, researchers and investors are trying to understand why companies should issue green bonds from theoretical and practical perspectives. It is clear that green bonds can be an attractive funding instrument for companies if they produce visible benefits for financial performance or reputation. The green bond market has experienced substantial growth since the first green bond issuance in 2007 by European Investment Bank. In the 2021 annual green bond issue surpassed half a trillion-dollar mark and, according to Climate Bond Initiative (CBI), is on track to reach the $5 Trillion milestone by 2025. As the market continues to expand, there is a growing need to explore this relatively new instrument's impact on firms' performance by combining theoretical methods and empirical data.

The literature on green bonds remains limited, with most studies focusing on their contribution to corporate social responsibility (CSR), environmental impact, green bond framework, and impact investing. However, the market for green bonds is still in its nascent stage, facing challenges such as the lack of standardized green labeling frameworks, insufficient transparency, greenwashing scandals, misuse of proceeds, and regulatory gaps. Multiple studies investigate how green bond issuances affect companies' stock prices. Recent established studies by Tang and Zhang (2020), Flammer (2021), Wang et al. (2020), Baulkaran (2019), Glavas (2020), and Lebelle et al. (2020) use event study methodology developed by Kruger (2015) to estimate abnormal stock market reaction to green bond issuance. Most studies find evidence for positive stock market reactions following green bond issuance announcements. However, this finding can be challenged and might not hold in the current market environment anymore. The latest data sets in these studies go only until 2019, and investors' perceptions might have changed, considering green bond market issuance grew significantly over the recent years. In addition, most studies use global green bond datasets and do not focus on specific geographical regions, leading to the low external validity of results. Moreover, event study results can be severely impacted by selected significance tests. Some scholars evaluate their results using a simplistic T-test, while others argue that for event studies, this test is not considered robust against cross-sectional and event-induced volatility. Considering that the green bond market from 2019 until

2023 more than doubled in cumulative issuance size, green labeling frameworks improved, and many new companies publicly committed to altering business models to be more sustainable, these studies need to be revisited with a new data. A thorough analysis of the topic's exploration is presented in this thesis's literature review.

The main problems addressed in this thesis involve understanding whether green bond issuances continue to positively affect firms' equity value, particularly in the context of rapid growth in the green bond market after 2020. Likely, issuers and market participants cannot predict how green bond issuance could affect the stock price of the specific issuer. Currently, issuers and market participants lack a comprehensive understanding of how green bond issuance may impact a specific issuer's stock price. Existing evidence of positive stock returns is limited to a global aggregate level and fails to account for the country, industry, credit rating effects, and different periods. Therefore, issuers cannot blindly trust evidence for positive stock returns. The thesis addresses these problems by focusing on European corporate issuers, their operating industry, and credit rating. Additionally, the thesis addresses the problem of weak significance T-test used in similar event studies by incorporating a standardized cross-sectional test developed by Boehmer et al. (1991).

The aim - to investigate the impact of green bond issuance announcements on the stock prices of listed, non-financial European corporations.

The objectives:

1. Perform a systematic literature review to describe the current green bond market landscape, exploring green labeling framework, potential issuer benefits such as greenium, improved reputation and risk management. Also, compare results from established event studies focusing on green bond issuance announcement effects on shareholders’ value.
2. Define methodology by formulating testable hypotheses, collecting representative green bond and issuer stock price datasets, and developing an effective event study framework with special focus on use of significance tests.
3. Conduct an empirical study to analyze the impact of both initial and subsequent green bond issuances on firms' stock prices. Reevaluate results across different time periods, credit ratings, and industries. Interpret findings and compare them with existing research.

The literature review in the thesis is conducted using systematic reviews and meta-analyses methods. The systematic review enables us to summarize what is the available evidence for green label perception and green bond benefits, while meta-analyses are used to combine and compare results from similar event studies to the one performed in the thesis. The event study is the chosen method for estimating the stock market reaction to green bond announcements. This method is selected as it is the most suitable for assessing the immediate impact of green bond issuances on stock prices. Using a different method, such as linear regression, would have made it more challenging to compare the results. Stock prices are one of the best financial metrics that reflect the value of a company. The dataset of green bonds is collected from the Bloomberg terminal covering scope from 2013 up to 2023, while most stock price data is taken using Yahoo finance API. The event study framework is developed using Python programming language and Excel.

The structure of the master thesis is organized as follows. Section 1 presents a comprehensive literature review, examining green bond labeling frameworks, the benefits of green bonds, and a critical comparison of previous studies on abnormal stock returns following green bond issuances. Section 2 outlines the hypotheses development and defines the methodologies employed to address the main research questions. In Section 3, the empirical study results are presented, encompassing recent developments in the green bond market, and concluding with a discussion of the limitations, potential future research areas, and the practical applicability of the findings.

1. Literature Review of Green Bond Announcement Effects

The literature around green bonds is growing fast as after the infamous Paris Agreement (2015), many market participants started significantly increasing their investments in environmentally sustainable projects. Climate bonds (further used interchangeably with "green bonds") are one of the most promising financial securities that can help to reach goals defined in the Paris Agreement. Despite trustworthy goals, the green bond market faces numerous issues like greenwashing, asymmetric information, and regulation issues. Generally, literature about green bonds is still developing and is in its infancy compared to conventional bond studies. As the green bond market grows, further research is needed to understand green bond effects on financial markets and especially update existing beliefs. This systematic literature analysis focuses on three main topics related to green bonds. The first part of this literature review is based on scholars' evidence and highlights green bond benefits and answer questions of why corporations choose to issue green bonds rather than conventional "brown" bonds and why investors choose to invest in them. Second, a comprehensive analysis of green bond labeling frameworks is conducted to showcase why the climate bonds market needs more credibility around green labels and asymmetric information problems. This overview is essential because clear definitions and transparent green bond frameworks are one of the bottlenecks of the green bond market. Lastly, green bond issuance announcement effects are investigated by comparing several established studies and providing a theoretical basis for the empirical study of this thesis.

1.1 Benefits of Green Bonds

As already discussed in the previous section, bond markets in the past decade experienced a growing number of green bond issuances that came not only from the governments but also from the financial intermediaries and non-financial companies. Therefore, it is interesting to understand the main benefits of green bonds compared to conventional bonds for corporate issuers. After exploring related literature, I classify benefits into financial, reputational, and risk management. Mentioned categories are discussed in the following sub-sections of this paragraph.

1.1.1 Financial Benefit - Lower Funding Costs

Although scholars often claim that literature on green bonds is relatively scarce, it is not necessarily the case when looking for research on whether green bonds have green premium, commonly referred to as "greenium." This concept defines phenomena when the yield on a green bond is lower than the one of a conventional bond with similar characteristics. Lower yield makes green bonds more expensive for investors and more attractive for issuers, hence the name green premium. If greenium exists, issuers can enjoy lower funding costs due to lower yields of green bonds. However, literature on this topic is truly diverse as some studies claim to find green bond premium, while others strongly deny the existence of it. A group of studies provide evidence that greenium is negative and green bonds trade at a discount. Differences in research results are clear from the MacAskill et. al. (2020) conducted study, where literature on green bond pricing published between (2007-2019) was compared. Their findings showed that only 56% of studies found greenium in primary markets, and that share of studies observing greenium increased when investigating secondary market. Scholars concluded that a mixed but slightly positive consensus is reached that green premium exists, especially for bonds certified and verified by third parties. As a result, several conflicting articles will be presented in the following paragraphs and Table 1.

Flammer (2021) examines lower cost of capital argument by comparing green bonds with closely matched brown bonds that are issued by the same issuer and have similar characteristics, using methodology by Larcker and Watt's (2020). Her findings show no evidence suggesting that green bonds provide cheaper funding possibilities compared to conventional bonds. The average differences in yields were close to zero and insignificant. Results were in line with Larcker and Watt's (2020) findings of non-existent green premium. However, there are many papers that find green premium. For example, Baker et al. (2018) explore a large dataset of 2083 green US municipal bonds (2010-2026) and 19 corporate green bonds (2014-2016). Researchers find green premium for municipal bonds at around six basis points. They also show that green premium can be three times higher when a green bond is verified by a third party, registered in CBI, and labeled as green by Bloomberg. This suggests that market values certified green bonds more than self-labeled ones.

One might ask why researchers draw different conclusions about green premium even if analyzed dataset seems to overlap enough to obtain same conclusions. A likely explanation is that the green premium finding depends on the methodology used. Positive greenium findings by Baker et al. (2018) study are challenged by Larcker and Watt (2020). They show that pooled fixed-effects model in Baker et al. (2018) analysis fails to account for issuer-specific time variation and cannot ensure that

fixed effects are not adequate controls, which all together lead to spurious results. Larcker and Watt (2020) pointed out that green bond issuers are usually larger entities and can outperform smaller-size issuers who do not issue climate bonds. Using their dataset, they replicate the results of Baker et. al. (2018) and find green premium. Then they conducted the same analysis on placebo bonds, non-green bonds issued by green issuers, and still found greenium. With these findings, they argue that Baker et al. (2018) results are flawed. In contrast Larcker and Watt's (2020), using their methodology on the same dataset, did not find the existence of greenium. Despite that, researchers mention that their findings of non-existence of greenium are only valid in the municipal bond market and that greenium might exist in the corporate bond market. This leads to the conclusion that the one comparing greenium studies must carefully distinguish determinants and methodologies used in studies. Another study that found positive evidence for greenium was done by Kapraun et al. (2021). Scholars investigated 1500 green bonds and 20000 conventional bonds datasets to determine which type of bonds trade at a green premium in both primary and secondary markets. Findings showed that greenium is most often observed for bonds issued by governments and supranational institutions denominated in euro currency. They also found that green bonds which are certified and reviewed by third-party are more likely to exhibit green premium. However, scholars did not find evidence for greenium on an aggregate level.

Table 1

Green Bond Premium Existence

Studies	Main Findings
Karpf and Mandel (2017)	Claims green bonds are penalized and trade at lower prices with higher yields.
Baker et al. (2018)	Positive green premium found for municipal bonds (~6 basis points); 3x higher green premium for third-party certified bonds.
MacAskill et al. (2020)	56% of greenium studies found greenium; more cases of greenium for bonds having GBP label.
Larcker and Watt (2020)	No significant evidence of greenium.
Kapraun et al. (2021)	Greenium is most often observed for bonds issued by governments, supranational institutions and among third-party certified green bonds.
Flammer (2021)	No significant evidence of greenium.

Table constructed by the author.

A notable example of flawed methodology can be seen by looking at Karpf and Mandel's (2017) search for greenium. Scholars claim to find that green bonds are penalized and that they trade at lower prices with higher yields, which is the opposite of the greenium phenomenon. However, Baker et al. (2018) and Larcker and Watt (2020) argued that one could not compare taxable and non-taxable bonds in the US municipal market because of tax rules the results of such comparison are

misleading. As pointed out by Karpf and Mandel (2017), their green bond dataset overlapped by two-thirds with datasets used by Baker et al. (2018). However, using different methodologies, all three studies arrived at entirely different conclusions about greenium existence.

To conclude, there is no unanimous answer to the question of whether there is a green bond premium. In the discussion about green bond standards, we already found that green labels have different credibility and implied "level of greenness." Also, green bonds have many additional determinants that can affect greenium, like exemptions from taxes, use of proceeds, issuer effects, and diverse types of bond markets. Moreover, different methodologies find different results of green premium thus, it is difficult to reach a consensus even when the same dataset is being investigated. Mentioned reasons suggest that scholars should be cautious in conducting studies about the green premium on an aggregate level. The method used by Flammer (2021) to closely match green bonds to brown bonds with similar characteristics seems to be more valid. However, a direct comparison between green and brown bonds is difficult to obtain as one would need to find two bonds with the same issuer, maturity, coupon, and issue date. This type of data is rare; therefore, direct comparisons are difficult. Another option is to compare the average yields of all green bonds with conventional bonds, but results can be spurious due to differing maturities, sectors, or similar. It is safe to say that with an increasing number of green bond issuances, literature about greenium existence will need to develop further. Greenium could be seen as one of the main benefits for an issuer to obtain lower funding costs, making it worth obtaining a certified green bond label.

1.1.2 Reputational Benefit - Investor Composition and Investment Horizon

Nowadays, environmental and sustainability concerns alter many investors' strategies and their portfolio compositions. It became common that institutional investors like pension funds have a mandate to invest a fair share of funds into green financial securities that are aligned with global sustainability agendas like The Paris Agreement (2015). Thus, corporate social responsibility became an essential metric for corporations that want to attract a broad sample of investors. Numerous research suggests that high CSR level can positively impact firms' valuation, usually observed by a positive effect on Tobin's Q measure Hu et al. (2018), Jo and Harjoto (2011) or by an increase in stock price Flammer (2013). Corporations often publicly claim their commitments towards sustainability, and social inclusion goals. However, credibility of such claims can be met with a grain of salt by market participants, and firm valuation does not change. Scholars argue that issuing green bonds can

send a strong message to the market about the firms' commitment to executing sustainability agenda and can positively impact the stock price and attract new investors with different mandates. This is often called as a signaling argument Spence (1973) to the market, which aims to ease the asymmetric information problem. It is generally believed that a corporation has more information than investors and by an action like bond issuance they would signal to the market about the company's commitment to a sustainable future.

In literature, it is often expected that first-time green bond issuance would benefit corporations by attracting a new investor base with green mandates or oriented to long-term gains. However, it will likely take some time until shareholders can benefit from corporations' commitment to a sustainable future. Flammer (2021) finds that green bond issuers experience an increase in long-term investors and an increase in investors with a green mandate. Results suggest that long-term investors' share increased by 1.8% while green investors' share increased by 2.9% after GB issuance. Tang and Zhang (2020) also raise two hypotheses about green bond issuance effects on investor base. First, researchers find that the investor base can change after issuance due to increased media attention. Moreover, issuance can signal changes in expectations about firms' future fundamentals coming to believe that green projects will result in higher long-term valuations. Tang and Zhang (2020) find that institutional ownership of issuers increases by 7.9%. However, their findings suggest that the increase in institutional investors share mainly comes from domestic, not foreign, institutions. Reputational benefit that issuers attract investors with longer horizons is also found in Starks et al. (2017) study, which explored how firms' ESG profiles affect investor horizons. Findings showed that firms with high ESG scores attract investors with longer time horizons. This suggests that long-term investors expect to profit from companies' ESG policies and are less likely to reduce their stakes during short-term downturns. Despite positive evidence that green bond issuers benefit from a new investor base, it is worth mentioning that effects can only be present after first-time green bond issuance. It is likely that the long-term fundamental value of the issuer committed to green projects is already priced in by the market during consecutive green bond issuances or at least would not have such a strong effect as after the first issuance. Evidence for this hypothesis is also found in Flammer (2021), where it was shown that only first-time green bond issuance resulted in significant abnormal returns for firms' stock prices.

To sum up, in the literature, numerous papers find positive effects for firms that increase their CSR scores by issuing green bonds or publicly declaring a commitment to a sustainable future. As suggested by the evidence, firms can expect to improve their market valuation and financial

performance. Considering that many institutional investors like pension funds are required to have green mandates, it is not surprising that scholars find evidence about changes in firms' investor base.

1.1.3 Risk Management Benefits

One possible explanation for why some green bonds have greenium is that they have less exposure to sustainability risks, and trade at a premium. It can be expected that some investors have significant loss aversion Tversky and Kahneman (1991) thus, they are willing to exchange excess returns to minimize losses that can occur via climate-related market disruptions. Climate change effects, like rising sea levels, increasing global temperature, and new policy regulations, create new risks for many publicly listed companies. Evidence suggests that climate change risks that once were seen as tail risks need to be addressed in the current market. For example, firms that invest in new coal power plants might experience financial losses if local government implements a policy for a new pollution tax or takes other measures to discourage non-clean energy. In such cases, bond prices issued to fund such investments as well as firms' valuation in stock market, could decrease. On the other hand, climate bonds have a mandate that their proceeds need to be invested in sustainable projects; thus, environmental risk should be significantly lower for many projects.

1. Diversification properties

A great showcase of green bonds hedging properties against carbon risk is presented by Jin et al. (2020). Researchers explore four market indices ability to hedge carbon market risk. Using dynamic hedging models, they find that the S&P Green Bond index is most suitable to hedge carbon market risk even in highly volatile periods. Other examples of diversification properties of green bonds were presented in a study conducted by Reboredo (2018). He found that the green bond market co-moves with the fixed income market, but when comparing to stock and energy, commodity markets co-movement is very weak. The researcher showed that green bonds have positive diversification effects for stock and energy markets but not for fixed-income markets.

Green bonds can be used to hedge not only against carbon risk but also can be seen as a safe asset. Arif et al. (2022) analyze green bond properties as a safe heaven and good hedge for financial markets. Using cross-quantilogram approach, findings present that green bonds can provide diversification services for medium and long-term equity investors. Researchers also point out that the green bond market is not affected by extreme market fluctuations, as happened during the COVID-

19 pandemic. Arif et al. (2022) suggest that regulators should find a green bond market attractive if they decide to stimulate economies during recessionary times. Findings from these studies support the argument that green bonds have positive diversification and hedging qualities for investors. Due to these qualities, green bonds might experience greater demand than conventional bonds, which might justify the presence of greenium in the market.

2. Hedge against climate change risks

Climate change creates new risks for stock markets. Scholars distinguish two reasons how environmental concerns can result in financial losses for firms. Firstly, climate change creates a physical risk to assets and cashflows. For example, heat waves, global temperature increase, or floods are important emerging risk factors for firms. Hence, investors may require premiums to account for them. The big issue with climate change risk is lack of hedging options. Another risk type is commonly referred to as transition risk. It arises from increased uncertainty about future climate change regulations and move towards a greener economy. This is an important risk factor for firms as newly imposed regulations can be costly and harm firms' financial performance. Cepni et al. (2022) address the concern that climate-driven risks are difficult to hedge by conducting an empirical study and finding that green bonds can be used as a tool to manage environmental risk. They investigate green bond correlation with climate uncertainty and find positive correlations. Alternative to green bonds to mitigate climate risks could be precious metals. However, Cepni et al. (2022) show that precious metals are not a reliable way to hedge against rising climate uncertainty and that green bonds have superior positive time-varying correlations with rising climate uncertainty.

3. Environmental risk faced by green bonds

However, another school of thought argues that green bonds are exposed to environmental risks more than conventional bonds. Ehlers and Packer (2017) presented two arguments for why green bonds can be negatively affected by climate risks. They present two arguments; the first claims green bonds inherit risk from the issuers as some are energy companies operating in highly polluting businesses. For example, if a coal mine issues a green bond to finance a new green project, the bond value faces a lot of risks coming from the issuer. Also, often green bonds in such companies represent only a small fraction of firms' activities and account for a small amount among all bond issuances. The second argument provided by Ehlers and Packer (2017) is that green projects financed by green bonds can have high environmental risks. Researchers provide an example of wind turbines that generate clean energy but face significant flood risk. Such project might reduce potential regulatory

risk but faces simple environmental risk. Researchers provide valid points that not every green bond can function as cushion for climate driven risks. To sum up, as seen in other studies there are many scenarios where green bonds have positive properties to manage risk and can be used as diversification tool by portfolio managers.

1.2 Comparison of Green Bond "Standards"

The green bond market suffers from a lack of a standardized approach to label green bonds. Investors, market agencies often find it challenging to analyze and compare different green investments because green labels sometimes lack credibility. There are multiple options for issuers to obtain green labels. Some attach green labels themselves and issue so-called "self-labeled" green bond. Others chose to follow some established green bond guidelines to get an externally valid label. However, self-selection bias and asymmetric information hurt the credibility of green labels, which makes it difficult for market participants to compare green bonds. Nevertheless, two widely used green certification frameworks cover ~90% of all issued green bonds. The most popular "standard" is the Green Bond Principles (GBP) created by the International Capital Market Association (ICMA), the world bank and a group of major private financial institutions. It was established in 2014 with the goal of providing voluntary guidelines for issuing green bonds. Climate Bonds Initiative (CBI) introduced another widely accepted certification called the Climate bond Standard (CBS) in 2010. Currently it has many similarities with GBP but has more strict requirements. Despite the efforts of these green bond issuing schemes and other labels provided by Moody's or Bloomberg, the lack of well-regulated issuance frameworks in literature is seen as one of the main bottlenecks and risks for the green bond market. To address the lack of standardization and reduce "greenwashing" in the green bond market, the European Commission in 2020 agreed to establish the European Green Bond Standard (EUGBS). However, at the beginning of 2023, there was still no agreement reached to launch EUGBS due to concerns about how binding the guidelines should be and how future taxonomy changes would affect previous green bond issuances. Hereby, in following paragraphs review and comparison of different green bond "standards" is made, outlining some challenges these bond labeling frameworks face. Table 2 presents concise summary of green labeling frameworks.

One of the oldest and widely accepted green bond labeling framework is called Green Bond Principles (GBP). The primary purpose of GBP is to achieve transparency in the green bond market and increase investor confidence that bonds having this label use proceeds to fund environmentally

beneficial projects. This framework is sometimes called “voluntary process guidelines” and over the years became the de facto standard green bond issuing framework. To obtain GBP the issuer might face additional costs and effort. However, it is often shown in literature, like in a study by MacAskill (2020), that markets reward issuers of bonds having GBP labels with higher green premiums. This suggests that GBP can help to solve asymmetric information between issuers and investors and provide more credibility for issuers' green claims. GBP also suggests that issuers get external review like CBS. In a working paper, Pietsch and Salakhova (2022) investigate the determinants of green premium. They divide the green bond dataset into two parts. In the first group all bonds are aligned with GBP and have had external certification, while another group of bonds is partially aligned with the GBP. Finds show that certified green bonds exhibit a green premium of 5.3 basis points compared to conventional bonds and trade lower than 15.6 basis points compared to simple green bonds. This evidence suggests that not certified green bonds can even trade at a discount compared to conventional bonds.

For the green bond to be aligned with GBP, the project must adhere to four key aspects of this issuing scheme.

1. **Use of proceeds.** Proceeds from green bonds should be used to fund green projects contributing to climate change mitigation. This is a common requirement amongst different green bond certification guidelines.
2. **Process for project evaluation and selection.** This component aims to ensure that issuers clearly communicate to investors about project selection. The process should include presenting the selected project's sustainability objectives and eligibility with green project categories defined in GBP.
3. **Management of proceeds.** This requirement asks issuers to create a separate account for managing proceeds obtained from green bonds or groups of bonds. It is **suggested** to have an external auditor to ensure full transparency of the use of proceeds.
4. **Reporting.** Issuers should be able to provide transparent, up-to-date reports about the use of proceeds, green project performance, and fund allocations.

These four GBP components aim to ensure that bond proceeds are used to finance green, sustainable projects. However, unlike CBS, external verification is only recommended and is not required, making the GBP label easier to obtain and reducing its credibility. Also, GBP does not have

its taxonomy and does not define which use of proceeds will be considered as green. This is left to be figured out by advisers and reviewers.

Table 2

Green Bond Labels Comparison

Framework	Green Bond Principles (GBP)	Climate Bonds Standard (CBS)	European Green Bond Standard (EUGBS)
Establishment Year	2014	2010	2020 (proposed) 2023 (agreed)
Issuing Body	International Capital Market Association (ICMA), World Bank, Private Financial Institutions	Climate Bonds Initiative (CBI)	European Commission
Certification Process	Voluntary, no binding requirements after issuance, external verification recommended.	Strict, requires external verification for both pre- and post-issuance reports.	Proposed, external review, certification tied to EU taxonomy.
Verification Requirement	Recommended, not mandatory, no penalties for misallocation.	Required, external verification by an approved third-party verifier.	External review mandatory, registered third-party reviewers supervised by ESMA.
Taxonomy Definition	Not defined, left to advisers and reviewers.	Defined in alignment with GBP guidelines, but stricter.	Aligned with EU taxonomy, specific requirements for fund allocation and reporting.
Penalty Mechanism	None, issuers may face only reputational consequences.	None explicitly mentioned, recurring verification optional.	Not specified (as of beginning of 2023), potential EU taxonomy alignment enforcement.
Challenges	Lack of binding requirements, potential greenwashing, reduced credibility.	Limited recurring verification, potential greenwashing challenges.	Clash points, unclear validity period post-EU taxonomy updates.
Benefits	Market rewards issuers with higher green premiums, increased investor confidence.	Higher green premiums, reduced greenwashing risks.	Standardized guidelines, issuer and investor benefits, reduction of greenwashing.

Table constructed by the author.

Despite these trustworthy requirements, GBP are only voluntary guidelines and do not have any binding requirements after issuance. There is no penalty mechanism for issuers when proceeds are misallocated. Thus, issuers misusing proceeds might only face reputational consequences, not financial ones. This issue is one more characteristic reducing credibility of GBP. As a result, investors cannot determine solely from green label whether an issuer is aligned with principles and does not involve “greenwashing” activities.

Other labeling framework, Climate Bonds Standard (CBS) introduced by CBI is one of the most credible green bond standards currently used in the market, which also happens to have its taxonomy, classification defining which activity is environmentally sustainable. CBS is mostly in line with GBP and contributes to them by introducing taxonomy and external review requirement. In 2022 CBS already had a third version from its establishment in 2010. To obtain a certification with CBS process can be separated into two parts pre-issuance and post-issuance process. Pre-issuance requirements are similar to those from GBP. The issuer is asked to present how proceeds will be used, how projects will be selected and evaluated, and how the issuer will ensure the management of proceeds. The issuer is also asked to prepare a green bond framework and make it public. This framework should consist of various controls to ensure alignment with the standard. Different from GBP, to get CBS certification issuer needs to engage an approved third-party verifier to get pre-issuance and post-issuance reports showing that CBS requirements are met. This raises costs for the issuer but is welcomed by investors and agencies. After the external verifier produces reports, issuer can submit it to CBI to get CBS certification and issue a certified bond. Later, within 24 months of issuance, the issuer should submit the verifiers' post-issuance report to keep certification. To extend certification even further, the issuer must provide a simple annual report to bondholders and CBI while disclosing all updates publicly. Many scholars looking for green premium identify that CBS certification often gives superior green premium measures than other certifications or self-labeled green bonds. For example, Kapraun et. al. (2021) find that certified green bond results in higher green premium, especially for corporate bonds where investors value additional reassurance more than compared to governmental or municipal issuers.

CBS compared to GBP is a more strict framework. As pointed out by Ehlers and Packer (2017), CBS introduces sector-specific eligibility criteria used to determine suitability to issue a green bond. Also, in order to obtain CBS, issuers are required to get external verification from a third party to confirm that the issuer is aligned with CBS requirements, has developed controls and processes, and is ready to issue a green bond. Ehlers and Packer (2017) pointed out that CBS's main drawback is that external verification is required only once to get CBS, while recurring verifications are recommended but are optional. However, in 2018, when CBS version 3 was published, this matter was addressed by demanding post-issuance external reviews and annual public disclosure of updated reports. This addressed a concern that having long-term position investors can be blindsided by how green bond proceeds are used on an ongoing basis. Solely this CBS improvement in my opinion, makes good argument that green bond aligned with GBP is not enough and should have certification.

One of the main criticisms for CBS and GBP is that they do not have mechanisms through which issuers would be punished if they deviate from the original sustainable use of proceeds commitment and engage in "greenwashing." This raises concerns for green bond investors about whether they can trust green labels. Furthermore, if there were severe penalties embedded with CBS due to the standard being voluntary, issuers might be affected by self-selection bias. Therefore, to avoid this standard should be mandatory, which is unlikely since behind CBS stands CBI, while behind GBP stands ICMA, both of which are not lawmakers.

Scholars often point out that obtaining either GBP or CBS can be costly and cumbersome for the issuer, and there is a risk that this burden would make conventional bonds more attractive than green bonds. For example, it is mentioned that to obtain recommended second opinion for a GBP label can cost around an estimated EUR 40,000, according to ESMA Report on Trends, Risks and Vulnerabilities No. 2, 2021. Even though there is a fine line between the benefits and cost of getting CBS certification, multiple research studies find that bonds with CBS have higher green premiums than self-labeled green bonds.

The aforementioned "standards" are voluntary and not mandatory. This lack of consensus exhibits not only reputational risk for green bonds but also challenges faced by investors as they need to perform independent due diligence while investing in bonds. In the brief history of a green bond market, some greenwashing examples exist when issuers collect the benefits of green issuances without needing to adhere to any regulatory framework. Following the Action Plan on Financing Sustainable Growth published in 2018 and European Green Deal, European Parliament (MEPs), with co-legislators in 2022, were in the final stages of agreeing on a new voluntary European Green Bond Standard. It is aspired to be the golden standard not only for bonds issued in the EU but also on a global level. This new standard aims to reduce greenwashing and increase investor confidence. EUGBS will demand that issuers meet strict sustainability requirements, which would make this standard not only aligned but more demanding than both GBP and CBS.

According to MEPs press release in 2021, there are four essential requirements for EUGBS. First, funds raised using green bonds should be fully allocated in alignment with the EU taxonomy regulation. A second key requirement is that issuers need to be fully transparent when reporting on proceed allocation and would follow detailed reporting requirements. Third, an external reviewer must check all European green bonds, which is similar to the demand for CBS. The fourth demand is that all third-party reviewers must be registered with the European Securities Markets Authority (ESMA) and supervised by them. EUGBS is promising for both issuers and investors. Standardized

guidelines across European bonds will enable the issuer to show that projects are aligned with EU taxonomy. At the same time, investors will be able to observe whether their investments are genuinely sustainable.

Currently (beginning of 2023), this standard still needs to be finalized due to several major clash points that occurred during finalizing decision between the European Parliament and member states, according to Bloomberg news[1]. The European Parliament proposes that issuers wanting to issue green bonds should have a sustainable transition plan touching their whole business rather than a specific sustainable project. Moreover, issuers should disclose whether proceeds would be used to finance nuclear power or gas-related projects. Another debate point is how wide-reaching this regulation should be. It will be seen as a success if it is agreed that transparency and disclosure requirements would also be imposed on conventional bond issuances, not only green bonds. It is also unclear how long green label would be valid after the EU taxonomy is updated with new versions. Despite all the challenges to agreeing on this regulation, it is one of the most promising new frameworks that should bring some clarity to the green bond market.

Currently, ESG investments in the market are met with confusion due to a lack of clear definitions, standardized transparent frameworks, and multiple private agencies. A recent example happened when one of the largest asset managers Amundi reclassified its $45 billion worth of green funds from "really green" to "sort of green". This anecdotal evidence shows how some ESG frameworks can enable firms to bend ESG consensus and label their projects as green or sort of green, but what is actually meant is unclear to public investors. Scholars Berg & Kolbel (2022) conducted empirical research about the divergence of ESG ratings between six prominent ESG rating agencies. They showed that ESG ratings provided by different agencies correlated only from 0.38 to 0.71 and argued that such divergence in ratings makes it challenging to evaluate firms' ESG performance and can decrease incentives for firms to try and increase their ESG ratings. Green bonds, a subset of ESG type investments, also inherit some of the mentioned issues. Despite the rapid growth of the green bond market in the last decade, uncertainty about what projects/investments are aligned with green consensus damages the integrity of a green bond market. It seems that efforts like ICMA developed GBP or CBS created by CBI, are not enough and the green bond market is still exposed to significant reputational risks.

[1] EU Fails to Reach Deal to Fight Greenwashing in Bond Market. Bloomberg News.

Talbot (2017) argues that current most prominent guidelines have serious drawbacks. One issue is that issuer participation in them is voluntary. Other than that, they cannot provide any legal bindings or penalties to the issuers who are not compliant. In addition, the author points out that increasing the green bond market size requires a standardized and transparent regulatory framework to achieve long-term success. However, it seems that mandator standard would be required to completely fix these issues and that might need to wait until markets reach decent maturity level, and this can take quite a lot of time.

Ehlers & Packer (2017) also discuss challenges investors face with green bonds coming from various green bond verifications and labels provided by private agencies. Scholars outline that aims to develop more consistent green bond standards frameworks by EU and China are promising. However, they point out that a valid green label might deteriorate over time along with new updated policies. European green bond standard (EUGBS) aspires to be the global gold standard to certify green bond issuances. EU officials in 2018 agreed that the rapidly developing green bond market needs a standardized framework. Some stakeholders aim that the standard would become mandatory in the future. However, in my opinion this should be done after there is unmistakable evidence other the years that green bonds give issuers clear benefit as compared to conventional bonds. As pointed out by Flammer (2021) green bond certification process and further reporting on the matter can get quite costly for the issuer. Also, if there is no significant benefit to issuing green bonds compared to conventional bonds, mandatory certification might be too much of a binding condition for a global standard. I agree with Ehlers and Packer's (2017) conclusion that investors would benefit from more standardized certifications and that information behind green labels can depreciate over time. This creates a convincing argument for ongoing, periodic third-party verifications for green bonds to ensure alignment with claimed objectives and provide up-to-date information to investors.

To conclude, scholars have shown that certified green bonds increase the green premium, reduce greenwashing risks, and improve investors' confidence. Upcoming new standards like EUGBS are promising development for the green bond market. In the empirical study of this thesis, a huge focus will be put on green bond certification.

1.3 Studies of Green Bond Announcement Effects

One of the main objectives of this master thesis is to conduct an empirical study about green bond issuance's effect on stock prices and compare different issuers' business areas using BIC codes.

This is achieved by replicating part of the study conducted by Tang and Zhang (2020) with newer data and expanding their event study design to separate effects based on BIC codes. Therefore, to build a solid theoretical base for this thesis, it is beneficial to review Tang and Zhang's (2020) study and compare it with similar comprehensive studies conducted in recent years. Table 3 showcases headline findings across similar studies, while the following paragraphs compare in detail the results Tang and Zhang (2020), Flammer (2021), and Baulkaran (2019) obtain. All studies find some support that there exists a positive abnormal effect on stock prices after green bond announcements. However, this finding is not absolute and is influenced by characteristics like green bond certification status or whether it was the first-time issuance by the company. Furthermore, results differ across studies due to different methodology settings and data scopes. All three papers calculate abnormal returns using event study analysis based on Kruger (2015) but use different characteristics like selected event window timeframes.

Table 3

Comparison of Event Studies Investigating Green Bond Announcement Effects on Stock Prices

Study	Sample	Estimation & Event Windows	Cumulative Abnormal Return	Unique Issuers	Region/Period
Tang and Zhang (2020)	1510	[-300, -50] & [-10, +10]	Agg. level: **+1.4%** First-time: **+1.39%**	132	**Global (28 countries)** 2007-2017
Flammer (2021)	1189	[-220, -21] & [-5, +10]	**+0.49%**	400	**Global** 2013-2018
Baulkaran (2019)	Hand collected	[-250, -21] & [-10, +10]	**+1.48%**	54	**Majority from Europe** Not disclosed
Glavas (2020)	302	[-250, 0]* & [-0, +0]	**+0.46%**	74	**Global (22 countries)** 2013-2018
Labelle et al. (2020)	2079	[-300, -50] & [-0, +0], [-0, +1]	**-0.5%, -0.2%**	190	**Global** 2009-2018

* Estimation window ends before selected event window starts.
Table constructed by the author.

Tang and Zhang (2020) conduct the first comprehensive empirical study investigating the real effects of green bond announcements on a company's stock performance. The central research question is whether green bond announcements affect issuer's stock prices. The article also examines three channels that might positively affect stock prices. First, issuers can benefit from cheaper funding costs which the stock market could welcome. Investors with ESG mandates might increase demand for green bonds, which would reduce yield, increase the bonds' price and result in the existence of greenium. The second tested channel is called the "Investor attention channel." Positive media attention after green bond issuance can attract new investors' attention and positively affect the stock's demand. The authors also monitor stocks' liquidity performance after the bond announcement to check this hypothesis. The third channel states that green bond issuance signals firms' dedication to a sustainable future and improves firms' fundamental value, which might lead to a positive stock price reaction. These last two hypotheses in literature are often called signaling arguments and can affect stock prices through increased attention or improved firm fundamentals.

Flammer (2021), in the study "Corporate green bond issuances: An international evidence," conducts event study analysis to determine whether stock prices increase after green bond issuance. The author examines three rationales for issuing green bonds and determinants for positive abnormal returns, which are very similar to the hypotheses tested by Tang and Zhang (2020). Flammer (2021) also investigates whether green bond issuers can benefit from a cheaper cost of capital by estimating greenium. The signaling argument is evaluated as a positive abnormal return driver. Moreover, the author investigates whether companies engage in greenwashing. Commitment to sustainability is assessed by investigating whether environmental performance metrics, like reduced CO2 emissions, improve in the future after the bond issuance.

Baulkaran (2019), in the study "Stock market reaction to green bond issuance," investigates whether "self-labeled" green bonds create additional value for shareholders and aims to determine which firms and bonds characteristics influence market reaction. Similarly, to Tang and Zhang (2020) and Flammer (2021), event study analysis is used to determine the market reaction to green bond announcements. The author emphasizes bond issuance characteristics like coupon rates and tests whether positive abnormal returns can be expected for all green bonds. In addition, Baulkaran (2019) looks at how firms' risk measures develop after green bond issuances.

Comparison of Data Scopes, Methodologies and Results

Tang and Zhang (2020) contribute to the consensus in the literature that despite the green bond market's rapid growth, there is no agreement on a clear definition to determine what green bond is. However, the scholars claim to manage to create a large representative dataset of green bonds. They combine data provided by CBI with green bond data from Bloomberg to get additional information, like exact issuance announcement date, and cross-validate green labels. Data taken from CBI lies within 2007-2017 and get 1181 green bonds. After the dataset is merged and supplemented with Bloomberg data, the final dataset contains 1510 worldwide green bonds. Asset-backed and private placement green bonds are excluded from the dataset. Data is also filtered to contain only bonds issued by publicly listed firms, which dramatically reduces the issuers count to 132 companies. The sample decreases even more to 109 firms when looking for firms that issued subsequent green bonds. Similar data collection methods were used by Flammer (2021). The author's study was conducted on a corporate green bond data sample from 2013 to 2018. The final dataset consisted of 565 issued bonds from public issuers, which is very similar to the one used by Tang and Zhang (2020). In contrast, Baulkaran (2019) used a completely different data collection method. The author hand-picked firms that issue green bonds, excluding those with a market capitalization of less than 5 billion USD. Baulkaran (2019) also excluded companies that had some confounding effects around the green bond issuance date. The final sample comprised 54 firms, most of which are in Europe, resulting in the smallest and least credible dataset among the three studies.

Methodologies in all three studies to calculate abnormal returns were based on Krugers (2015) event study technique, which estimates stocks' performance using the capital asset pricing model (CAPM) based on a selected period before the issuance and calculates aggregated differences between actual stock prices and estimated prices withing window of several days around the event date. Since in the Tang and Zhang (2020) dataset, the issuer's stocks are from different markets, the index of a market where the company is listed is used in CAPM. Authors estimated CAPM beta based on a window starting 300 days and ending 50 days before the announcement date [-300;50]. Scholars use index return minus ten-year treasury bond yield to get market premium. Using CAPM, cumulative abnormal returns are calculated (CAR) for two windows ten days before and after the announcement date [10;10] and five days before and ten days after [-5;10]. Tang and Zhang (2020) used a nonparametric Wilcoxon signed-rang test to confirm the findings and run robustness checks using Fama and French 3 and 5-factor models. Exactly the same method to obtain abnormal returns is used by Flammer (2021). However, selected event windows are slightly different. Flammer (2021) uses event methodology and sets the event date 0 to the announcement date. The default event window is

set to be [-5; 10]. In addition, windows [-20; -11], and [11;20] are tested to check for stock price behavior. The author uses OLS regression to estimate the parameters of CAPM based on 200 days before the first event window [-220; -21]. This common technique was also used by Baulkaran (2019). The author calculated CAR based on the estimation window from -250 to -21 days [-250; -21] before green bond issuance and used event windows [-10; 10] and [-10; 20]. Authors use expert judgment in defining event windows, which can lead to biased window selection, used to find the most suitable window to satisfy hypotheses.

Tang and Zhang (2020), for the first-time issuances, find a significant CAR of 1.39% for an event window of [-10, +10] days and 1.04% for a [-5,10] window. While for subsequent issues, CAR is neither significant for the 21-day nor 16-day window. Authors also check for CAR results separating company samples in corporations and financials. Findings show that only corporations have a significant positive CAR. However, sample sizes were reduced even further. Considering a significant boom in the green bond market after 2017, which resulted in more than $1.5 Trillion in newly issued bond amounts, new studies are needed to observe whether these findings are still valid. Authors find evidence to back only one out of the three mentioned channels. First, they do not find strong support that lower funding cost explains positive stock returns. Tang and Zhang (2020) found 6.9% greenium on an aggregate level when accounting only for country effects. However, no significant green premium was found after accounting for fixed effects such as company, country, year, and month. Important to note that only 41 firms in the sample had both green and conventional bond issuances, which raises doubts about the external validity of such results. This is an excellent example of how different methodologies can lead to opposite conclusions. The authors support the second hypothesis by finding an increase in institutional ownership by 7.9%, mainly from domestic institutions. Tang and Zhang (2021) use two methods to evaluate stocks liquidity. At first, they calculate stocks bid-ask spreads divided by mid prices and conduct matching sample analyses with similar conventional matched bonds. Moreover, they follow Amihud's (2002) method to calculate stock liquidity. The investor attention argument is also supported by scholars' findings that firm stock liquidity improves significantly more than 1.2% compared to matched firms, while following the Amihud measure, liquidity increases by 2.2%. Improved liquidity is explained by newly attracted investors and supports the second channel of increased attention. However, the authors claim that it goes against the third channel of improved firms' fundamentals as they argue that to benefit from long-term gains, liquidity should stay the same or decrease. In my opinion stock liquidity measure is not enough to deny improved firms' fundamentals channel since two effects can happen

simultaneously. Tang and Zhang (2020) also do not find support for improved firms' fundamentals effect on stock returns by checking CAR for subsequent issues. They did not find a positive CAR, meaning markets did not price in potentially improved firms' fundamentals reflected by new green bond issuances.

Baulkaran (2019) finds that CAR for event windows [-10; 10] and [-10; 20] are significant and have mean values of 1.48% and 1.46%, respectively. Interestingly, most abnormal returns come after issuance, and the author suggests this is due to increased media attention. The drawback of this study is that the sample size is very small and might not represent the current market situation well. Also, the author is not very transparent about how he selected issuers; thus, selection bias might influence results. Baulkaran (2019) also investigated what might drive abnormal returns. He conducted a regression analysis and determined that issuers offering higher coupon rates receive an adverse market reaction. This finding adds a new perspective to green bond announcement literature by showing that issuance characteristics like high coupon rates can receive adverse market reactions due to the high cost of debt. Moreover, scholar find evidence that factors like firms' size, Tobin's Q, or asset growth positively influence abnormal returns. The author also showed that the firm's risk, beta, and standard deviation of price, decreased following issuance.

Flammer (2021) also found some evidence for cumulative abnormal returns (CAR). The calculated CAR for the default window is 0.489% and is significant at the 5% level, while the other four event windows around the default window in the range from 20 days prior to 60 days past showed insignificant results. CAR for certified green bonds was 0.71% which is much larger and more significant than for non-certified bonds. A similar effect is seen when comparing the first issuance of green bonds with subsequent issuance, which indicates that the stock market reacts positively only once, likely because environmental commitment is being priced in only once by the market. Besides improved environmental scores and reduced CO2 emissions, a study found that green bond issuance attracts investors with a green mandate and long-term horizons, which influences positive CAR. In addition, Flammer (2021) tested for the existence of green premiums to understand whether issuers could benefit from cheaper funding costs. Matching methodology Larcker and Watts's (2020) was used, and no green premium was found, denying the cost of capital argument. This finding also matches the results obtained by Tang and Zhang (2020). Flammer (2021) supported signaling channel with three testable hypotheses. The author points out that the signal of green bond issuance reduces asymmetric information problem, which appears when investors know way less information than companies. First, the presence of a signaling argument is supported by the paper's main empirical

study, where positive CAR is found. Solid CAR results are found for certified green bonds and first-time issuers. Flammer (2021) conducted an empirical study on the whole universe of corporate green bonds data collected from Bloomberg to assess these claims. Second, Flammer (2021) also found that firms signaling their commitment to sustainable developments showed an environmental performance increase in the future after bond issuance. The author found that CO2 emissions decreased, which supported issuers' commitments to reduce emissions. It is pointed out that improved environmental performance might not be a causal effect of a project funded with green bond proceeds but rather an overall company's strategic shift to sustainability. This finding supplements Tang and Zhang's (2020) signaling argument. Third, the third support for the signaling argument comes from changes in the investor base. Institutional ownership increases slightly, while long-term and green investors' share increases significantly by 1.8% and 2.9%.

All three studies found positive and significant abnormal returns on the aggregate first-time issued green bond level. However, the effects were more significant for green bonds that are certified and issued for the first time by the issuer. Self-labeled green bonds and subsequent issues did not result in significant CAR. Tang and Zhang (2020) and Flammer (2021) arrived at similar conclusions when looking at rationales for companies to issue green bonds. Both studies denied the cheaper cost of capital argument since no meaningful existence was found. In addition, studies arrived at similar conclusions regarding the signaling argument. Signaling of environmental commitment to the market by the issuer mainly drives positive CAR as well as a rationale to issue green bonds. Observed increases in stocks liquidity and changes in investor composition of having more institutional, long-term, green investors support the signaling argument. However, these studies were based on datasets until 2018, and the green bond market has grown exponentially since then. Therefore, new research is needed as updated certifications and newly established regulations might lead to different conclusions. Moreover, results from these papers are based on different data samples since different bond selection methods and criteria were used. In my opinion results can be biased due to different geographical areas or unaccounted effects, therefore universal conclusion might lack external validity. A fitting example of the bond yield size effect was shown when Baulkaran (2019) found negative CAR for green bonds with high yields. The growing corporate green bond market opens the possibility to conduct research that is more focused on specific markets while having data samples that are big enough to find more credible results.

1.4 Key Findings and Insights from Literature Review

Green bonds in the last decade started to live up to their expectations but are still facing many challenges. Severe issues must be addressed to reach sustainable market growth. First, more credibility should be imposed around green labeling frameworks. As presented in section 1.2, voluntary green labeling methods are prone to credibility issues. Self-selection bias might exist when only firms that are confident in their environmentally friendly projects, choose obtain labels like GBP. There is more credibility when issuances are certified with third-party verifiers, as required by CBS. However, standards being voluntary, there are few regulations to punish if the issuer fails to comply with the selected standard. Also, the more complex and credible standard gets, issuing costs increase which can make green bonds less attractive than conventional bonds. Although EUGB is set to be voluntary, it still is one of the most promising developments for green bond markets. EU officials currently argue how wide-reaching this standard should be. There is even a proposal that all bond issuances in the European market should disclose their use of proceeds. Also, positive strides could be made by CBS's fourth version, which is currently in development as well as continuously improving GBP. Altogether this builds a promising outlook that some consensus will be reached on green bonds in the near future.

One of the questions related to green bonds is what benefits issuers can receive from this new funding tool. An innovative word was established called greenium and became one of the most exciting and popular research topics related to green bonds. From the current research standpoint, evidence for greenium is all over the place, and it seems that its existence usually depends on the methodology used to calculate it. However, many studies have shown that greenium can exist especially looking on industry or issuer-specific level. Another green bonds benefit is related to risk management. Against increasing environmental risks, green bonds were shown to have safe heaven properties amid market turmoil or as a hedge against environmental risks. They can be used as a diversification tool. Some researchers argue that green projects themselves are often subject to higher risk coming from climate change. For example, rising sea levels could damage solar panels built close to the seashore.

Issuance of green bonds was shown to affect firms' valuation in the financial markets. Section 1.3 compared three comprehensive studies looking at green bond announcement effects for stock prices and, using event study methodology, showed that abnormal returns are positive. The effect was especially strong for first-time issuances and securities having externally verified green labels. The observed positive abnormal returns in all three studies were driven by a signaling argument of issuers

commitments to sustainability to the market. Evidence suggested that institutional and impact investors increased their share in such companies. In contrast, a highly expected argument that stock prices increase due to the ability for issuers to borrow money at cheaper costs was not supported in any study, as green premiums were not found to be present at the issuance.

2. Methodology of Green Bond Issuance Impact on Firms Value

The main purpose of this thesis is to conduct an empirical study investigating effects on company's stock prices after green bond issuance announcements. Green bonds are still a relatively new instrument in global financial markets. New continuous research is still needed to improve understanding about green bonds and their implications to financial markets. One of the most obvious questions is why companies choose to issue green bonds rather than conventional "brown" bonds. From literature review it is quite clear that cost of issuing green bond can be much higher and create bureaucratic, compliance burdens. Therefore, to understand rationale to issue green bond in this thesis short-term effects on company's stock prices are investigated using event study methodology based on which cumulative average abnormal returns (CAARs) are calculated. Following methodologies used by Tang and Zhang (2020) and Flammer (2021) this study also investigates potential drivers for abnormal returns. The methodology section is structured as follows: first subsection 2.1 presents hypotheses development, main research questions, subsection 2.2 explains event study methodology in detail. In subsection 2.3, the data collection procedure is described.

2.1 Hypotheses

To reach thesis aims several hypotheses are developed in this empirical study. Green bond announcement effect on firms' value is investigated by looking at short term stock price reaction around green bond issuance announcement.

- **Hypothesis 1:** Publicly listed firm's stock prices react positively after green bond issuance announcements. Period (2013-2023).
    a. **Hypothesis 1.1:** Period (2013-2020).
    b. **Hypothesis 1.2:** Period (2020-2023).
- **Hypothesis 2:** Positive CAARs are observed around first-time and subsequent green bond issuances. Period (2013-2023).
    a. **Hypothesis 2.1:** Period (2013-2020).
    b. **Hypothesis 2.2:** Period (2020-2023).
- **Hypothesis 3:** Different CAARs are observed across issuers from different industries separated by BIC codes. Period (2013-2023).
- **Hypothesis 4:** Different CAARs are observed between investment graded and non-investment grade issuers. Period (2013-2023).

The first main hypothesis is relatively straightforward, using event study methodology aim is to determine whether CAARs exist. Some positive findings for this hypothesis can be found in recent literature Tang and Zhang (2020), Flammer (2021), Baulkaran (2019). However, latest data from those studies goes only until 2019 Flammer (2021), and as seen in green bond market overview in subsection 3.1., market grew exponentially, more than doubled, in recent five years, which makes a good case to update these studies with new data. Second, a study investigates whether observed effects hold if only first-time issuances or subsequent issuances are considered. It is likely that second-time green bond issuance does not result in CAAR since market priced in environmental commitment of the company after the first issuance. Also, it is unclear whether the CAARs effect is homogenous among various issuer types. The third hypothesis investigates what effect issuers industry has on abnormal stock market reaction. Different industries are separated by Bloomberg Industry Classification Standard (BICS) Level 1 codes. Lastly, the fourth hypothesis investigates how issuers credit rating impacts abnormal returns. Specifically, it is being looked at whether issuers being investment grade benefit more from green bond issuance than non-investment grade issuers.

Four hypotheses are performed on full period datasets. While sub-hypotheses for first two hypotheses are aimed to test whether market perception towards green bonds changed over the years. Data sample split before and after 1st of January 2020, is selected for several reasons. First, most global studies conducted similar event studies using bonds issued until 2020. Second, after 2020 global markets experienced multiple "sea changes" due to COVID-19, economic stimulus packages, war in Ukraine, monetary policy decisions. Moreover, markets are becoming increasingly familiar with green bonds, and the number of first-time green bond issuers is increasing slower than subsequent bond issues. Therefore, it is interesting to investigate if issuers can still benefit their shareholders' value by issuing green bonds. Literature about conventional bond issuance effects on shareholder value most often find no or even negative effect on stock prices. The rationale behind these findings is that a firm increasing its debt can negatively affect a company's profit outlook, especially if company already has substantial amount of debt. Results from sub-hypotheses should help answer the question, whether green bonds in recent years are seen as conventional bonds by the market.

The intuition behind the main hypothesis is that with green bond issuance a company should experience positive effects on its stock performance. However, effect itself might not provide enough useful information for decision makers without investigating underlying drivers that result in positive CAAR. One of the most popular explanations in literature is that new green bond issuance attracts

investor attention, often referred to as signaling argument. In theory, issuing a green bond reveals new information to market participants, which has a material impact on issuers' share price.

2.2 Event Study Description

Table 4

Event Study Steps

	Step	Description	Selection
1	**Data Collection**	Gather green bond dataset representing bonds issued by European corporates listed on stock exchanges. Retrieve historical time series of daily stock and index returns.	**Data sources:** Bloomberg terminal, Yahoo finance API, Investing.com.
2	**Data Manipulation**	Mapping each issuer with its most representative stock market index. Checking for ad hoc events that happened during event window are unrelated to the issuance announcement.	**Ad hoc events:** stock splits, mergers & acquisitions, dividend payments.
3	**Event Identification**	Defining green bond announcement dates as the main event dates.	Green bond announcement dates are obtained from Bloomberg.
4	**Event Window**	How many days before and after the exact event date should be included to estimate event effect.	**Event windows:** [-10, 10], [-5, 10], [0, 10], [-4,4], [-3, 3]
5	**Estimation Window**	Determination of how many days before predetermined event cutoff date before the event date should be taken into account to estimate parameters of capital market model.	**Estimation window:** [-300, -51]
6	**Calculation of Abnormal Returns**	Using estimated capital market model parameters expected stock returns are calculated and compared with actual returns during the event window for each distinctive green bond issuance event.	Eq. (1-4), (8-10)
7	**Calculation of Cumulative Average Abnormal Returns**	Using abnormal returns cumulative average abnormal returns are calculated to reveal aggregate effect green bond announcements have on issuers stock prices.	Eq. (5-6)
8	**Robustness Checks**	Using parametric and non-parametric significance tests accustomed to the event study, significance of results is checked.	**Parametric test:** Standardized Cross-Sectional. Eq. (11-17) **Non-parametric test:** Wilcoxon Rank. Eq. (18-21)
9	**Event Study Results**	Interpret and compare event study results with other similar event studies obtained in the literature.	

Table constructed by the author.

To measure green bond announcement returns, event study method developed by Krüger (2015) is used in this thesis to test main hypothesis. In literature this methodology is popular to be

used in determining abnormal returns on stock prices after various events. There are multiple expected return models that can be used in event studies. Popular "Market Adjusted Model" obtains AR by subtracting market return from stock return on day t. Another used model, called "Comparison Period Mean Adjusted Model," calculates AR by stock return on day t subtracting by the mean stock return obtained from estimation window. For this thesis market model is used, where AR are calculated by estimating expected stock price return using the based-on capital asset pricing model (CAPM). Also, Fama-French 3 Factor (FF-3F) model is used to validate the results. The main steps of the event study are presented in Table 4, which are explained in detail in the following paragraphs.

The market model is implanted based on event study design used by Tang and Zhang (2020). Here, identical event study estimation windows are incorporated which enable close comparison of part of the results obtained in this and other similar studies. The first step is to estimate CAPM parameters α and β for each company's stock price. Event window of [-300; -51] before green bond announcement is determined, Using ordinary least squares (OLS) regression CAPM parameters α and β from eq. (1) are estimated, where *i* is company stock return, *t* is day, $R_{mt,}$ is market return, R_{rf} is risk free rate and ε_i is error term.

$$R_{it} = \alpha_i + \beta_i \times (R_{mt} - R_{rf}) + \varepsilon_i \ (1)$$

$$R_t = ln(\frac{P_{t+1}}{P_t}) \ (2)$$

Market daily returns are calculated by subtracting annualized 10-year German government bond yields divided by 360 from daily market returns. Both stock and market daily returns are calculated according to eq. (2). Government bond yields here act as selected risk-free rate. Important to note that companies are listed in different markets, thus daily market returns are calculated using different indexes.

The following step is to estimate stock returns for period of interest using parameters obtained from the OLS regression. As shown in eq. (3) β_{it}^*, estimated stocks' return is calculated by multiplying estimated α and β with stock market return.

$$R_{it}^* = \alpha_{it}^* + \beta_{it}^* \times R_{mt} \ (3)$$

Final abnormal return AR_{it} is calculated by subtracting estimated daily return from actual stocks return as shown in eq. (4).

$$AR_{it} = R_{it} - \beta_{it}^{*} \ (4)$$

After abnormal returns are calculated it is possible to obtain cumulative abnormal returns (CAR) for each issuance individually by summing ARs in the selected event window as shown in eq. (5). The default event windows for this study are ten days before and after the announcement [-10; 10] and ten days before and five days after [-5;10]. Event study timeline can be seen in Figure 1. Average abnormal returns (AAR) for specific event day *t*, on aggregated level are calculated using eq. (6). The last step is to obtain cumulative average abnormal returns (CAAR). This can be accomplished in multiple ways. In this study I take average CAAR from all observed CARs, as shown in eq. (7).

$$CAR_i = \sum_{t=T_1+1}^{T_2} AR_{i,t} \ (5)$$

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{i,t} \ (6)$$

Where T_1+1, T_2 denotes the start and end dates of the event window.

$$CAAR = \frac{1}{N} \sum_{i=1}^{N} CAR_i \ (7)$$

The rationale behind selecting event windows around announcement dates is to consider potential information leaks concerning the new green bond issuance. In addition, for robustness checks CAARs are calculated for other event windows around announcement [-20; -11] and [21;60], which are expected to be insignificant as green bond announcement effects should have already disappeared.

To evaluate whether comparable results are obtained if different expected returns model is used, results of first hypothesis are reevaluated using Fama-French-3 factor model (FF-3F) to estimate expected stock price returns during the events. Model is defined as follows below.

$$E(Ri) = Rf + \beta m, i(Rm - Rf) + \beta s, i(SMB) + \beta v, i(HML) \ (8)$$

$$SMB = \frac{1}{3}(Small\ Value + Small\ Neutral + Small\ Growth) - \frac{1}{3}(Big\ Value + Big\ Neutral + Big\ Growth) \quad (9)$$

$$HML = \frac{1}{2}(Small\ Value + Big\ Value) - \frac{1}{2}(Small\ Growth + Big\ Growth) \quad (10)$$

Where *E(Ri)* is the expected return of stock *i*, *Rf* is the risk-free rate, *βm,i* is the sensitivity of stock *i* to the market factor, *Rm* is the market return, *βs,i* is the sensitivity of stock *i* to the size factor, and *βv,i* is the sensitivity of stock *i* to the value factor. *Rf, Rm, SMB, HML* are obtained from the Kenneth R. French calculated Fama-French 3 Factors for Europe[2].

Figure 1

Chronology of the event study

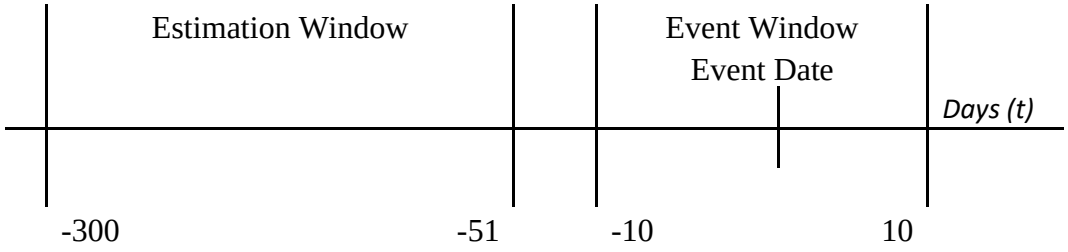


Figure constructed by the author.

The event studies focus on determining whether there are abnormal returns during or around the time of an event (referred to as the event window) that are of significant magnitude. To assess this, usually a formal hypothesis test is performed, where the null hypothesis specifies that the expected value of a certain random variable is zero. If the null hypothesis is rejected, it indicates that the event had an impact. The literature generally utilizes two-sided tests, which specify as alternative hypothesis that the expected value is different from zero, rather than larger or smaller. To find whether CAARs obtained from the study are significant I perform two significance tests, one parametric and non-parametric test. It is a widespread practice to assess significance of event study results with a parametric test and ensure test robustness with a non-parametric test. Usually in the field of event studies parametric tests assume that each firms' abnormal returns are normally distributed, while non-parametric tests are "distribution free" and do not require such assumption. In practice, it is difficult

[2] Kenneth R. French - Description of Fama/French Factors. (n.d.-b). http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_3developed.html

to test whether stock returns are normally distributed. Often this assumption is violated. However, if sample size is large enough, calculated p-values can be trusted even if normality assumption is violated. It is considered that if sample has more than 50 observations, parametric test can be used to evaluate results. If sample size is low and stock returns are likely to not be normally distributed, usually non-parametric tests are preferred.

The one conducting event study can choose from multiple significance tests. For this event study, to test the significance of CAARs I chose parametric standardized cross-sectional test introduced by Boehmer, Musumeci and Poulsen (1991). This test in literature is often called BMP test. It is robust against the way in which ARs are distributed across the (cumulated) event window. This test accounts for event-induced volatility and serial correlation. However, as with most parametric tests BMP is sensitive to serial correlation. BMP tests null hypothesis is shown in equation (11), and t statistic calculations is described with equations (12) – (17).

$$H_0: E(CAAR) = 0 \ (11)$$

$$S_{AR_i}^2 = \frac{1}{M_i - K} \sum_{t=T_0}^{T_1} AR_{i,t}^2 \ (12)$$

For any given firm *i*, S_{ARi} denotes the sample standard deviation of the returns during the estimation window, which is given as the square root of the corresponding sample variance. Formula is presented in equation (12). M_i is non-missing returns in the estimation window. *K* is degrees of freedom, for CAPM *K=2*, for FF 3-factor model *K=4*. T_0, T_1 are the start and end dates of an estimation window. Next step is to calculate S_{CARi}, which denotes the forecast-error-corrected standard deviation for the market model.

$$S_{CAR_i}^2 = S_{AR_i}^2 \left(L_2 + \frac{L_2}{M_i} + \frac{\sum_{t=T_1+1}^{T_2} \left(R_{m,t} - \overline{R_m}\right)^2}{\sum_{t=T_0}^{T_1} \left(R_{m,t} - \overline{R_m}\right)^2} \right) \ (13)$$

$A = \pi r^2$denotes mean index return in estimation window. L_2 denotes days in the event window. $\overline{R_m}$ meant market return from the estimation window. T_1+1, T_2 denotes start and end dates of the event window.

$$SCAR_i = \frac{CAR_i}{S_{CAR_i}} \quad (14)$$

$$\overline{SCAR} = \frac{1}{N}\sum_{i=1}^{N} SCAR_i \quad (15)$$

$$S^2_{\overline{SCAR}} = \frac{1}{N-1}\sum_{i=1}^{N}\left(SCAR_i - \overline{SCAR}\right)^2 \quad (16)$$

BMP test statistic calculation is shown in equation (17) and its approximate null distribution is $t \dot{\sim} t_{M-1}$.

$$t = \sqrt{N}\frac{\overline{SCAR}}{S_{\overline{SCAR}}} \quad (17)$$

As a non-parametric test, for this event study, Wilcoxon (1945) test (W-test) was used. This test considers whether AR is positive or negative and its magnitude. W-test is a non-parametric version of the paired t-test. The W-test in this event study evaluates whether distribution of CAARs is symmetric around 0. One potential issue with this test appears if CARs are skewed. W-tests assumes that ARs are independent and identically (i.i.d.) distributed and that positive AR has probability of 0.5, which in case of skewed ARs might result in false positive, significant ARs. The W-test is calculated by assigning ranks to absolute CARs and summing positive and negative ranks T^+, T^-. Test statistic W, expected value of W and standard deviation are calculated as shown in equations (18), (19), (20).

$$W = min(T^+, T^-) (18)$$

$$\mu_W = \frac{n(n+1)}{4} \quad (19)$$

$$\sigma_W = \sqrt{\frac{n(n+1)(2n+1) - \sum\frac{t_i^3 - t_i}{2}}{24}} \quad (20)$$

In practice if sample size is higher than 20 often normal distribution is assumed, and z-values are calculated as shown in equation (21). As most sample sizes of interest in this study have more than 20 observations, normal approximation to obtain p-values from z statistic is used.

$$z = \frac{W - \mu_W}{\sigma_W} \quad (21)$$

One potential improvement regarding significance tests, could be use of Generalized Rank T test, which was suggested by Kolari and Pynnönen (2011). It is a non-parametric test which has been shown to be more robust to cross-sectional dependence of stock returns. This test also accounts for event induced volatility like BMP test, and considers cross-sectional, serial correlation of returns.

2.3 Green Bond, Stock, and Index Price Datasets

The data used in thesis was collected from three distinct sources. The dataset of green bonds was obtained from the Bloomberg terminal using SRCH and W (worksheets) functions. Nice feature about Bloomberg green bond data is that it includes announcement date of an issuance which is a crucial metric for event study conducted in this thesis. Moreover, Bloomberg green label is aligned with GBP principles and in literature, this dataset, is recognized for providing great coverage of all green bonds issued in the world. To get target bonds the following filters were applied. First all bonds needed to have a green label and be issued by a corporation which itself or its parent company is domiciled in one of the countries withing European Economic Area (EEA) plus Iceland, Liechtenstein, Norway, and Switzerland from European Free Trade Association (EFTA), plus United Kingdom. In the remainder of this thesis this country group will be referred to as Europe. Also using BICS Level 1 industry identifier all government corporates were excluded. Finally, issuances were filtered using a date filter which was applied to get bonds issued between 2013-01-01 and 2023-01-01. Unfortunately, Bloomberg does not have an identifier whether issuer or issuer parent is a listed company in a stock market. Therefore, each issuer or parent issuer was manually checked whether it is a publicly listed company. To check whether manual mapping was correct Bloomberg function, to get stock price of the issuer or parent issuer using ticker ID, was used to determine which corporates have stock price and are listed on the stock exchange. Also using ticker ID and Bloomberg function relevant stock market index for each issuer was obtained. After these filters were applied the final dataset resulted in 125 unique issuers having 412 green bond issues. The following steps involved cleaning the data. Some observations were excluded from dataset, because green bonds were issued before the issuer's IPO date or after issuer has been delisted. To estimate CAPM parameters it was

required that issuers stock price has 300 trading days history. If this requirement was violated, observations were excluded from the dataset.

Another essential element for event study is stock price and index price data, which is matched to each green bond issuance. Most financial data was obtained using Yahoo finance API. For several stocks and a couple indexes Yahoo dataset did not have enough historical observations, so data was manually downloaded from Investing.com database. After green bond, stock and index price datasets were obtained and cleaned, each bond issuance was mapped with stock and index price data around the announcement date. Primary columns in dataset were issuer, parent issuer Yahoo ticker and announcement date. This ensured that each separate green bond issuance had its own relevant stock, index price data. Nice feature about Yahoo finance API is that in addition to stock price, it provides data about stock splits, and dividend payments. If the issuer had any of these two events happen during the selected event window, observation was excluded from the study. Mapping and all following calculations required for event study were performed using Python programming language used in Jupyter Notebook. Moreover, to explore different CAR effects on more detailed level, green bonds were separated based on characteristics like country, issuer industry, issuance amount, maturity, coupon size. Final descriptive dataset will be presented in the first part of empirical results.

3. Empirical Study Review

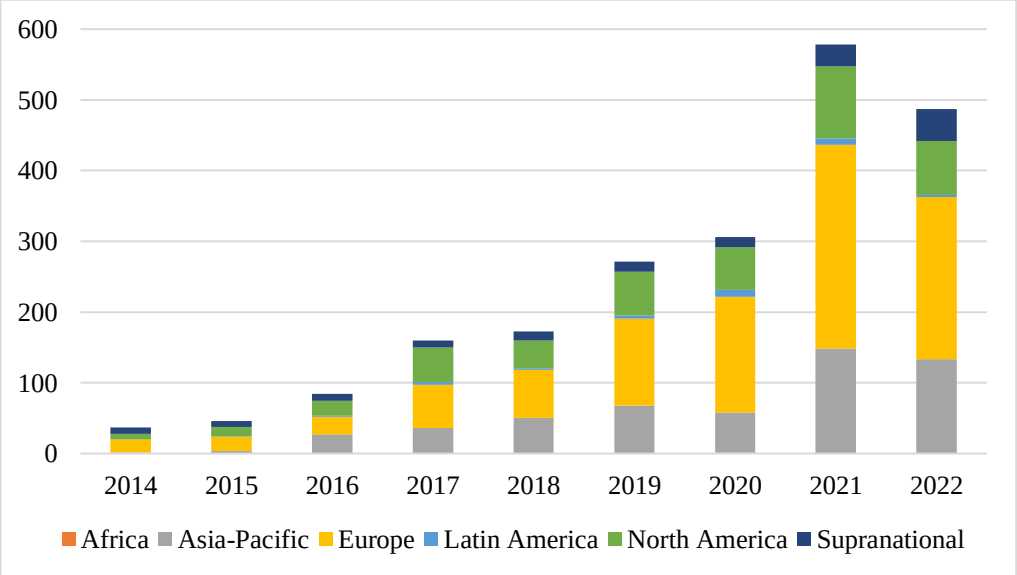
Before looking at the descriptive statistics and results of the empirical study, section 3.1 presents a concise overview of the green bond market development over the recent decade.

3.1 Green Bond Market Overview

According to Climate Bonds Initiative (CBI), in Q3 of 2022, cumulative green bond issuance broke through the $2 Trillion mark, while the $1 Trillion milestone was reached just in December of 2021. From the first green bond issued by the European Investment bank in 2007, it took six-seven years for the green bond market to start growing significantly. In 2014 annual issuance amount was only $37b. However, after the famous Paris climate agreement in 2015, the green bond market started snowballing, and already in 2016, annual issuance was $85b. In the 2021 annual green bond issue, broke have a trillion-dollar mark for the first time, out of which European region issuers contributed almost $289b. Mostly all green bonds are issued in three regions Europe, Asia-Pacific, and North America. Over the last few years, the European region has been significantly issuing more green

Figure 2

Annual Green Bond Issuance ($bn)

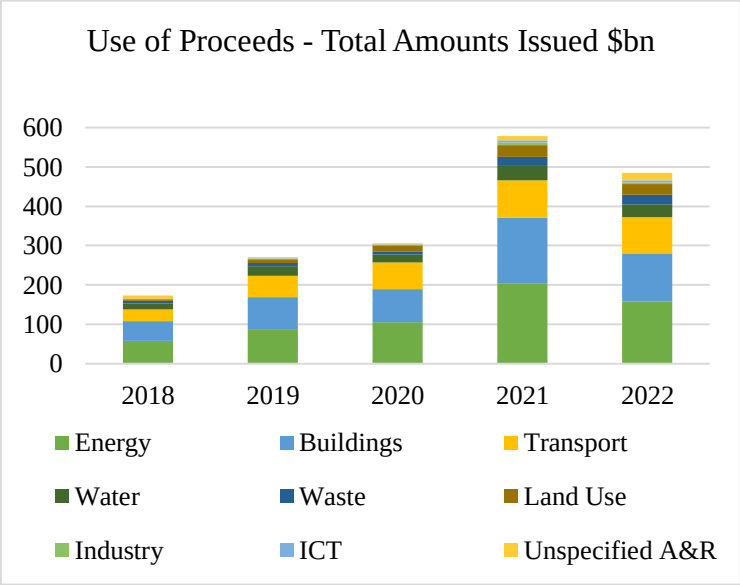


Notes: Figure based on data obtained from climatebonds.net/market/data/
Figure constructed by the author.

bonds than the other two. Market exponential growth can be clearly seen from Figure 2. CBI forecasts that in 2025 cumulative global issuance will reach the $5 Trillion milestone, which makes an excellent argument to further research green bonds.

Figure 3

Use of Proceeds - Total Amounts Issued $bn.



Notes: Figure constructed by the author and based on data obtained from climatebonds.net/market/data/

The share of financial and non-financial corporate issuers currently are the largest two issuer types, each having 26% share of total issued amount. Annex Figure A1 presents issued amount share per issuer type. In 2021 financial corporate issuances grew by +143% while non-financial by +111% compared to 2020. The third and fourth largest issuer types are sovereigns and government-backed entities. While overviewing the green bond market, it is essential to investigate developments in the use of proceeds, represented in Figure 3. According to CBI, in 2022, energy, buildings, and transport remained the most extensive use of proceed categories, while Water, Land Use and Waste were runner-ups. The combined cumulative issued amount for Energy and Buildings categories in 2022 results in more than $1 Trillion, which indicates that these categories are the most favored by issuers.

In this study the focus is put on non-financial corporate green bond issuances. All corporate financial issuers are excluded from the primary dataset, because they use proceeds obtained by green bonds to finance green loans instead of investing in sustainable projects directly. To conduct further analysis, it is interesting to look at yearly European corporates green bond issuance amounts. Financial and non-financial European corporate yearly issued amounts are presented in Figure A2. Over the years non-financials green bond issuance amounts are growing steadily, aligned with global trends.

3.2 Descriptive Statistics of Collected Green Bond Dataset

This subsection describes the European green bonds landscape before finally adjusting for methodology-specific criteria. In addition to the already mentioned filters used to compile the green bond dataset in the Bloomberg terminal, the final dataset includes public and private bond placements if parent companies are listed around issuance date. The final green bond dataset for this study of non-financial corporates listed in Europe, as shown in Table 5, consists of 412 bond issuances from 125 individual issuers. Column (2) presents the number of bonds issued each year. It is important to note that some issuers announced and issued more than one green bond on the same date. In this event study, such issuances are seen as one unique event. Once multiple bond issuances on the same day coming from the same issuer are merged, the total number of bonds, presented in column (2), decreases from 412 bonds to 326 issuances. Column (3) presents how many unique issuers issued bonds in a corresponding year. Column (4) shows the aggregated amount of all issuances in Euro currency. The descriptive table suggests that many firms had subsequent green bond issuances. Second hypothesis will compare the first and subsequent green bond issuances effect on shareholder value. Also, Table 5 shows that, especially after the 2015 Paris Agreement, the number of issuances is steadily increasing over the years, with a peak during the COVID-19 pandemic years. To our knowledge there are few studies investigating green bond issuance effect on firms' equity after 2020 focusing on European markets. The number of new issuances after 2020 enables this study to reevaluate existing evidence about abnormal returns.

Table 5

Non-financial corporate green bonds in Europe

Year	No. of Bonds	No. of Unique Issuers	Amount Issued (€bn)
2013	1	1	1.40
2014	10	8	4.76
2015	7	5	3.32
2016	10	5	6.62
2017	25	15	11.74
2018	23	17	9.75
2019	65	36	29.01
2020	82	40	30.18
2021	98	59	31.47
2022	91	50	37.79
Total	**412**	**125**	**166.03**

Notes: Amounts were converted to EUR as of May 7th, 2023. Table constructed by the author based on obtained data from Bloomberg terminal.

Looking at Table 6, most new issuances happened in utilities (184) and industrials (98) industry sectors. This finding is not surprising and is consistent with the purpose of green bonds to finance sustainable green projects. Flammer (2021) also noted that green bonds are more prevalent in

Table 6

Non-financial corporate green bonds issued in Europe by industry

Industry (BICS Level 1)	**No. of Bonds**	No. of Bonds (2013-2020)	No. of Bonds (2020-2023)	**No. of Unique Issuers**
Communications	**13**	2	11	**7**
Consumer Discretionary	**40**	9	31	**12**
Consumer Staples	**15**	3	12	**10**
Energy	**23**	14	9	**11**
Health Care	**5**	1	4	**4**
Industrials	**99**	32	67	**29**
Materials	**30**	3	27	**12**
Technology	**1**		1	**1**
Utilities	**186**	77	109	**39**

Notes: Table constructed by the author based on obtained data from Bloomberg terminal.

industries where environment is financially material. Accordingly, health care and technology sectors have the lowest number of green bonds. These industries compared to industrials or materials sectors usually have lower exposure to activities directly damaging the environment. Therefore, the justification to use green bonds might be more difficult in these sectors. During CAAR calculations, a sample size of more than 20 observations is required to get robust results while testing significance with parametric BMP test. Supplementary non-parametric Wilcoxon test can evaluate significance for smaller samples. Therefore, CAAR across industries would only be calculated for some industry categories. Columns (3) and (4) of Table 6 exhibit how many bonds were issued in two periods, before and after 2020. Hypothesis 3 will focus only on the *Industrials, Utilities, Consumer Discretionary, and Materials* industries.

For this study, the definition "Europe" includes 27 EEA countries + 4 EFTA countries + UK, but only 18 countries have firms that issued green bonds and match the defined criteria for this thesis. As can be seen from Table 7, more than 50% of the issuances happened in Spain, Germany, Sweden, and France. In columns (3) and (4) of Table 7, I present how many bonds were issued in two periods, before and after the start of 2020. Column (4) provides count of unique issuers. Only Belgium, Lithuania and Poland have the equal number of issuances and issuers. Other countries have at least one company which issued more than one green bond, which is essential requirement to test the

second hypothesis. Table A1, highlights firms having the most subsequent issuances. The table is led by Acciona Financion which between the end of 2016 and mid 2022 issued 37 green bonds.

Important to note that the tables present the green bond dataset, which is already filtered to include only publicly issuers that are listed on one of the European stock exchanges. If green bond is issued by subsidiary, which parent company is listed and domiciled overseas, observation is excluded from the study. All corporate green bonds issued by private holders were excluded from the initial dataset obtained from the Bloomberg terminal, which had 823 bonds. Luckily, final sample size is sufficient to conduct a more focused event study and test whether findings from established large-scale studies Flammer (2021), Tang and Zhang (2020), Glavas (2020), Lebelle et al. (2020) still apply.

Table 7

Non-financial corporate green bonds issued in Europe by country

Country	**No. of Bonds**	No. of Bonds (2013-2020)	No. of Bonds (2020-2023)	**No. of Unique Issuers**
Austria	**6**	2	4	**3**
Belgium	**1**		1	**1**
Switzerland	**6**	2	4	**5**
Germany	**57**	20	37	**15**
Denmark	**17**	7	10	**4**
Spain	**78**	27	51	**12**
Finland	**13**	4	9	**4**
France	**46**	21	25	**15**
UK	**26**	10	16	**10**
Greece	**6**	4	2	**3**
Ireland	**2**		2	**1**
Italy	**29**	12	17	**8**
Lithuania	**1**	1		**1**
Netherlands	**44**	17	27	**17**
Norway	**19**	2	17	**10**
Poland	**3**		3	**3**
Portugal	**8**	1	7	**2**
Sweden	**50**	11	39	**18**

Notes: Table constructed by the author based on obtained data from Bloomberg terminal.

In Table 8, bond issuance characteristics are presented. The average issuance amount, converted to €, is around €403M, with the average coupon size of 2.56%. Based on the Bloomberg composite credit index, the share of issuers considered to be investment grade is around 40.05%, and they have an average coupon size of 1.82%. Observation indicates that many issuers are not investment graded and usually promise higher coupon payments to attract investors. Hypothesis 4 will evaluate whether CAARs are different between IG and non-IG issuers. Table 8 also shows that most, ~66%, of green bonds have fixed rate coupons, with the average coupon being 2.19%. There are ~17% of floating rate coupon bonds, which at the time of issuance had largest mean coupon of 3.92%.

Table 8
Firm-level and bond issuance characteristics

	Mean/Share	Average Coupon
Average Amount (€M)	402.99	2.56
Investment Grade (%)	40.05	1.82
Fixed rate bond (%)	66.02	2.19
Floating rate bond (%)	16.99	3.92
Funged rate bond (%)	8.25	2.90
Variable rate bond (%)	8.25	2.59
Other rate bond (%)	0.49	1.75

Notes: Amounts were converted to EUR as of May 7th, 2023.
Table constructed by the author based on obtained data from Bloomberg terminal.

As mentioned in subsection 2.3, stock and index returns are obtained from the Yahoo Finance API and supplemented with the data from the investing.com database. Based on estimation and event windows used in this study, around each bond issuance announcement date, a range of [-300;20] days of stock and index returns of the corresponding issuer and issuer index are mapped. There are 11 bond issuance events where issuers do not have the required 300 days of historical data to estimate historical beta based on 250 days estimation window. Therefore, it is decided to exclude five observations from the dataset with less than 150 days of historical price data within the estimation window. Moreover, five bond issuance observations are excluded from the event study, because issuers had a stock split or dividend payment during the event window. The final number of observations consisted of 321 unique issuance events.

3.3 Event Study Results

This subsection presents results obtained after conducting an event study for the first four hypotheses. First, the focus is put on the general CAARs observed from the full data sample. Following analysis, investigate how results change when the sample is divided into two periods before

and after 2020. Moreover, main CAAR findings are examined by dividing dataset into two samples between IG and non-IG issuers. The second hypothesis tests how results differ between first-time and subsequent-time bond issuances. Following sub hypotheses test whether results are consistent across different periods. The third hypothesis investigates industry specific CAARs. Finally, limitations of event study and potential future areas for research are discussed.

This event study as the primary model to estimate stock returns uses CAPM. Additionally, the study employes the FF-3F model to test robustness. To evaluate all hypotheses, three default event windows (EW) are used: [-10,10], [-5,10], [0,10]. However, some results show significance only for shorter EWs. Therefore, for some sub-hypotheses, EWs of [-3,4], [-4,4] are selected. This choice can be justified because sub-hypotheses are tested on smaller samples. CAAR significance as described in subsection 2.2 is evaluated using two tests. Parametric standardized cross sectional BMP test is considered as the main test, while non-parametric Wilcoxon test is seen as supplementary test in this study.

3.3.1 Stock Market Reaction to Green Bond Issuance Announcements

Table 9 illustrates CAARs observed around green bond issuance announcements based on an entire dataset. The main finding of the event study is presented in column (2). CAAR estimated using CAPM, from January 1, 2013, to January 1, 2023, for European corporate green bond issuers, using EW [-10,10] is **-0.78%** (significant at 10%). For EW [0,10], CAAR **is -0.68%** (significant at the 10%). P-values of parametric BMP test suggest that results are significant at the 10% level, while additional non-parametric Wilcoxon test shows significance only for EW [0,10]. Alternative EW of [-20, -11] and [11,20] are estimated to test whether unrelated trends drive results. As expected, CAARs for these windows are not found to be significant, indicating that there are no unrelated trends affecting stock price before or after the announcement. As can be seen in Table 9 the final total sample consists of 321 unique bond announcements per distinctive days. If an issuer announces multiple bond issuances on the same day, it is seen as one observation, one announcement.

To increase robustness of observed CAARs models are reevaluated using FF-3F model. Looking at the right panel of Table 9, we can see that neither of the results are significant, failing to support findings obtained using the CAPM model. However, the factors used in FF-3F model take only one set of weighted market returns for the whole of Europe and do not map individual issuer stocks with the most relative indices. In addition, daily Fama/French European 3 Factors for FF3-F

model, same as market returns, are taken from the online source produced by Kenneth R. French (2023). Factors are calculated based on 16 European countries and again they do not account for different market specifics. Although the results obtained using the FF-3F model fail to yield significant results, observed CAARs are still negative. FF-3F model findings indicate that stock returns cannot be estimated using only one set Fama-French factors of index returns for whole Europe in this event study. Sometimes in event studies, robustness of results is checked using a broader index. For example, for this study one could take the Euronext 100 Index, which should be used to estimate each issuer's stock returns. However, as seen from FF-3F model, results reevaluated using broad index are not robust. Therefore, study employs only FF-3F model to reevaluate results. Findings from Table 9 show importance of standardized cross-sectional BMP test, which uses cumulative standardized abnormal returns from the estimation period and can test robustness accounting for event induced volatility.

Table 9
CAAR from period (2013-2023)

	CAPM					FF3-F		
EW	[-10, 10]	[-5, 10]	[0, 10]	[-20, -11]	[11, 20]	[-10, 10]	[-5, 10]	[0, 5]
CAAR	**-0.78***	-0.48	**-0.68***	-0.37	0.09	-0.37	-0.12	-0.43
BMP (p-value)	**0.10**	0.27	**0.10**	0.37	0.95	0.39	0.80	0.28
Wilcoxon (p-value)	**0.19**	0.20	**0.09**	0.41	0.77	0.78	0.68	0.23
Obs	**321**	321	**321**	321	321	321	321	321

Notes: **, * denotes BMP test significance at 5% and 10% level.
Table constructed by the author based on event study results.

Figure 4 presents visualized AARs accumulated across the EW [-10,10]. It is clear that stock prices react negatively, and that the most considerable reaction happens a few days after the initial announcement. There seems to be no information leakage problem since accumulated AARs vary in the range of 0%-1% before the announcement and decrease up to -3% only during the days after the announcement. Based on Figure 4, the most significant EW of [0, 10] according to BMP test, is aligned with cumulative AAR drop after the announcement.

In general, obtained results in Table 9 are surprising and deny the first hypothesis raised in this thesis, that stocks react positively amid green bond announcements. Tang and Zhang (2020), using the same estimation window and CAPM model for EW of [-10, 10] days, found a significant positive CAAR of 1.4%. The most probable explanation for divergent results is that Tang and Zhang (2020) used the global green bond dataset from June 2007 to December 2017. Also, Flammer (2021) conducted a global study using a dataset from 2013-2018 and found a significant positive CAAR of 0.49% for EW [-5, -10]. Wang et. al. (2020) and Glavas (2020) found positive CAARs as well. The observed differences in results can be attributed to green bond data samples varying across geographical and time dimensions. Only Lebelle et al. (2020) after conducting a global study focusing on the period (2009-2018) for shorter EWs of [0,1] and [-1,1] found the adverse market reaction of -0.5% and -0.2%, respectively.

Figure 4

Stock Reaction to Green Bond Issuance Announcement

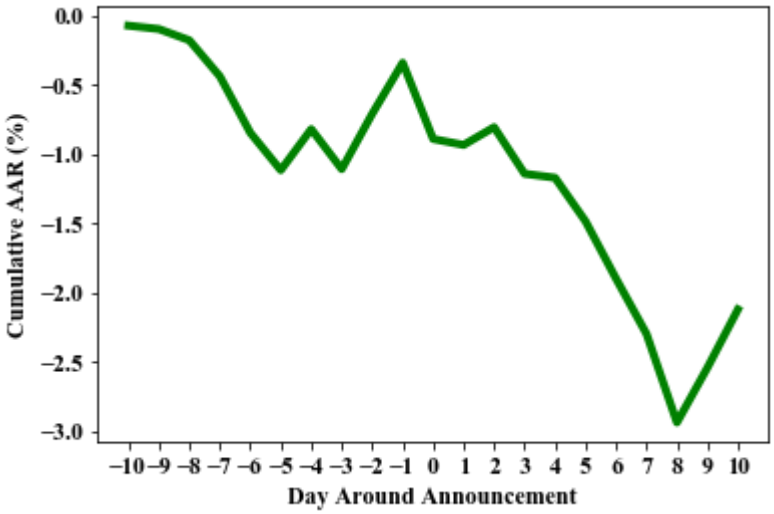


Figure constructed by the author, based on empirical study.

Scholars in literature often attempt to find factors that explain abnormal stock price reactions. Tang and Zhang (2020) and Flammer (2021) provides evidence that green bond issuance signals to the market about firms' commitment towards a sustainable future. This signal increases media and investor attention and attracts a new base of investors. In this study no significant positive reaction is found when considering full dataset, therefore results contradict Tang and Zhang (2020) and Flammer (2021) findings. Contrary study finds negative effect on shareholders' value. It is challenging to understand what drives this effect, but same signaling argument could be "flipped around" saying, that green bond issuance signals to the market about upcoming new projects, commitments that might be less profitable, than ones from the old business model. Another rationale, which is being tested for a positive stock reaction, is that issuance of green bonds enables issuers to attract a cheaper cost of capital. However, often this argument is denied as researchers fail to find significant "greenium" levels compared to conventional bonds. In this study the potential greenium effect is not examined.

But cheaper cost of capital argument is unlikely to drive negative market reaction. It could happen that issuers of green bonds attract more expensive capital, but to evaluate this, further studies are needed. Many scholars also find that abnormal positive market reaction might occur due to changing investor composition. It has been shown, issuers attract more investors having long term investment horizons Tang and Zhang (2020). However, while investigating short term stock price reactions, this argument can be challenged. First, long-term investors with a green mandate, like pension fund, might invest in a new green issuer, with a delay, beyond the scope of the event windows. Second, many companies in European markets are more transparent than in emerging markets, thus investors with green mandates might already have stakes in the issuer. To sum up, negative abnormal returns found in this study, do not seem to be driven by factors like cheaper cost of capital, or changing investor composition, even though these channels are not tested in this event study.

At this point, it is worth recalling studies that have examined the impact of conventional bond issuances on shareholder value, even though this topic does not seem to be studied widely. Over the years, some studies like Shyam-Sunder (1991), Spiess et al. (1999), Fungacova (2020), have found that increasing a company's debt level by issuing bonds has no or negative effect on shareholder value. Acquiring new debt via bonds seems to be a less favored method than getting bank loans. New debt obligations, the strain on cashflows, and capital dilution often explain insignificant or negative stock market reaction to increases in debt. Negative CAARs observed in this study seem to be more consistent with conventional bond studies. The effect of green commitment may have deteriorated since the inception of the green bond market as an increasing number of firms have made public commitments towards sustainability. Furthermore, the issuance of green bonds may not convey meaningful information for investors, particularly for corporations operating in Europe. Many are subject to regulatory requirements that mandate disclosure of sustainability measures and environmental impact. For example, EU taxonomy entered into force on the 12th of July 2020, defining which economic activities should be considered environmentally sustainable. In the ongoing talks about the EU green bond standard, there is a possibility for a requirement for all bonds to disclose their alignment with EU taxonomy, which would make "green label" signal even weaker.

Another potential reason shareholders' reactions might have changed over the years could be related to concerns about profitability. Non-financial green bonds are typically used to finance environmentally friendly projects, which might not always promise higher profits in the future. While it is difficult to measure this argument, it is possible that overselling the profitability of green projects may no longer be effective as investors have become more accustomed to climate-related projects.

For example, Lebelle et al. (2020) interpret negative market reaction to green bond announcement, by suggesting that new issuance announcement, signals to the market about increased uncertainty and upcoming operational and capital expenditure changes that will be required to reach project goals. As a result, investors might reevaluate companies' future profitability based on the new business model as there are no guaranties that current profitability levels will be sustained.

Table 10

CAAR Comparison Between Two Periods

	January 1, 2013 - January 1, 2020				January 1, 2020 - January 1, 2023			
EW	[-10, 10]	[-5, 10]	[0, 10]	[-3, 4]	[-10, 10]	[-5, 10]	[0, 10]	[-3, 4]
CAAR	0.19	0.34	-0.25	**0.81***	**-1.26****	**-0.89***	**-0.89***	**-0.57***
BMP_t	0.80	0.55	0.83	0.09	0.04	0.10	0.08	0.10
P(W)	0.70	0.56	0.79	0.06	0.07	0.06	0.07	0.15
Obs	107	107	107	107	214	214	214	214

Notes: **, * denotes BMP test significance at 5% and 10% level.
Table constructed by the author based on event study results.

Comparing results presented in Table 9 with market reactions found in established global scale studies, it becomes evident that observed CAARs are drastically different. This raises the question of whether observed differences can be attributed to variations in the time periods used in these studies. To investigate whether negative stock market reaction is consistent across the 2013-2023 period CAAR will be recalculated by dividing green bond issuance dataset into two periods. To address this question, the two sub-hypotheses for the first hypothesis reevaluate results by dividing the period into before and after January 1, 2020. The newly obtained results are presented in Table 10. Looking at the period until January 1, 2020, EW of [-3,4] days CAAR is **+0.81%** and is significant based on both BMP and Wilcoxon tests. Default EWs results are not significant. A sufficiently lower sample can explain the lack of significance for default event windows. Looking at the second period, after January 1, 2020, all estimated CAARs are significant and negative. Largest negative CAAR is **-1.26%** (significant at 5%) found for EW of [-10,10]. Market reactions larger than 1% in absolute terms are not too common in similar event studies.

Figure 5

Green Bond Issuance Announcement Impact Pre- and Post- 2020

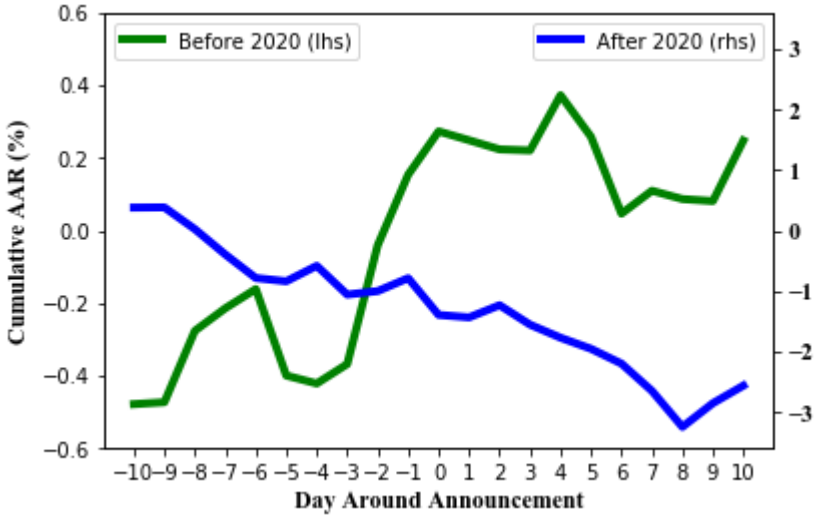


Figure constructed by the author, based on an empirical study.

The findings presented in the left panel of Table 10 are consistent with prior studies, which report positive reactions in stock prices. Given that the green bond dataset used in this empirical study is more narrowly focused than those used in global established studies, the discovery of similar CAAR is reassuring that green bond issuances positively affect publicly listed shareholder's value around announcement dates. Moreover, left panel findings in Table 10 support the common finding of positive market reaction at least until 2020. However, looking at the right panel, two observations can be made. First, CAARs are negative and significant for all estimated event windows. Discovery shows that investors do not reward green bond issuers in stock markets as used to be the case up to 2020. Second, the period after 2020 is shorter, more than twice as many as the first one, but has twice as many unique observations exhibiting rapid development of green bonds. Negative market reactions reported on the right panel of Table 10 for different EWs seem to be the most significant observations in this event study, since almost all parametric and non-parametric tests are significant.

Figure 5 presents AARs accumulated across EW of [-10,10] for two periods. The green line represents AARs obtained before 2020, and the largest positive abnormal returns happened in EW of [-3,4]. The most significant reaction happened just before the announcement date, indicating a potential issue of information leakage. A completely different dynamic appears if we look at the blue line, presenting AARs between 2020 and 2023. The line depicts the most significant negative market reaction occurring within eight days of the initial announcement. These visual findings further support the discussion narrative about the changing stock investors perception towards corporations that issue green bonds. The following hypotheses of this empirical study will evaluate possible reasons how and why this phenomenon occurs.

It is evident that green bond issuers vary on their firm-level characteristics. One popular metric to value a company's credit risk is to look at whether the firm is considered to be investment grade (lowest BBB-) or is non-investment grade (non-IG). One could expect that if a non-IG corporation issues a bond, it increases debt obligations and puts even more strain on cashflows. Therefore, there is little expectation that new issuance would increase the company's market value, even if it signals commitment to be more environmentally sustainable. In contrast, some market participants might see new green bond issuance as greenwashing activity, aimed to benefit from green label. Table 11 presents CAARs discovered after dividing green bond issuers based on investment grade.

Table 11

CAAR Comparison Based on Issuers Credit Rating

	Investment Grade			Non-Investment Grade		
EW	[-10, 10]	[-5, 10]	[0, 10]	[-10, 10]	[-5, 10]	[0, 10]
CAAR	-0.15	-0.12	-0.17	**-1.07****	-0.64	**-0.89***
BMP_t	0.81	0.95	0.76	0.05	0.22	0.10
P(W)	0.53	0.87	0.83	0.06	0.10	0.04
Obs	134	134	134	191	191	191

Notes: **, * denotes BMP test significance at 5% and 10% level.
Table constructed by the author based on event study results.

CAARs in none of the EWs for IG issuers are found to be significant, indicating that green bond issuance does not affect short-term stock prices. This discovery supplements findings observed in Table 11 and shows that IG issuers do not receive a significant negative market reaction. However, looking at non-IG issuers, EW [-10,10] CAAR is -1.07% (significant at 5%). Therefore, they are the main drivers of general negative CAARs. Also, non-IG issuers have more unique bond issuance events than IG issuers. These findings confirm hypothesis 4 that IG and non-IG issuers receive different market reactions. As expected, non-IG issuers' equity value is punished more than IG when debt obligation is increased. This discovery emphasizes the importance to estimate CAAR results taking into account firm level characteristics to understand how new issuance might affect particular firm. Investigating CAAR for subsamples that are distinguished based on firm-level characteristics might be more beneficial.

3.3.2 First vs Subsequent Time Issuance

Table 12 presents CAARs calculated after dividing the data sample between first and subsequent green bond issuances for each issuer. Looking at the stock market reaction after first-time issuances, CAAR for the EW of [-4,4] is **+0.85%** (significant at 10%). For subsequent issuances, only significant CAAR is found for the EW [0,10] of **-0.68%** (significant at 10%) market reaction. These findings reject the second hypothesis of this study, due to subsequent issuances showing significant negative CAAR. The results indicate that equity value is increasing after issuing green bond for the first time, and that there is a negative effect on firm values after seasoned issuances.

Table 12

CAAR Comparison Between First & Subsequent Issuances

	First Time				Subsequent Time			
EW	[-10, 10]	[-5, 10]	[0, 10]	[-4, 4]	[-10, 10]	[-5, 10]	[0, 10]	[-4, 4]
CAAR	-0.10	0.32	-0.46	**0.85***	-1.05	-0.88	**-0.68***	-0.54
BMP_t	0.63	0.60	0.88	0.07	0.14	0.12	0.09	0.18
P(W)	0.64	0.99	0.38	0.04	0.21	0.10	0.15	0.14
Obs	120	120	120	120	201	201	201	201

Notes: **, * denotes BMP test significance at 5% and 10% level.
Table constructed by the author based on event study results.

Findings support investor attention argument, commonly used to explain abnormal returns in similar studies. If corporate has already issued at least one green bond, with subsequent issuances it should not receive same benefit from the market. If after the first-time issuance, green label had a positive effect and signaled to the market about firms' commitment to be "green," reduced asymmetric information problems, it is likely that market will have learned this and will not receive a lot of new meaningful information with following issuances. Therefore, subsequent issuances might be seen as conventional bond issuances by the market. This rationale currently is the most prevailing explanation for positive abnormal market reactions. However, it does not explain why in this study subsequent issuances result in negative CAARs. The effect of the green label on asymmetric information problems in the European market can be argued. Currently large firms in Europe need to adhere to environmental regulations like The EU Non-Financial Reporting disclosure (2019), hence market participants might have enough information about the companies "eco friendliness". Moreover, a

green label might provide less useful information in Europe compared to other emerging markets, where transparency is lower compared to European markets.

Findings from Table 12 do not support the idea that positive market reaction is driven via firms' fundamental channel due to improved future profitability. On the contrary, market participants might see green bond issuance as a commitment to be more sustainable, but less profitable projects. Tang and Zhang (2020) expected to observe positive market reaction with all first and subsequent issuances. Scholars argued that each event provides meaningful information to the market about potentially improved firms fundamentals, like ability to acquire capital at a cheaper rate or new profitable projects. However, their findings did not support this hypothesis as around subsequent issuances no significant market reaction was observed. Most studies in literature fail to prove that companies are able to obtain cheaper costs of capital. As discussed in the literature review, it is challenging to prove the existence of greenium. If improved firm fundamentals assumption is relaxed, it might be that sometimes green bond issuance signals to the market about potential reduction in firms' profitability. Therefore, negative market reaction might be explained due to changed fundamentals. Further research is required to examine this channel.

Results from Table 12 are somewhat consistent with similar literature stream of studies, where scholars also find differences between first and seasoned issuances. For example, Flammer (2021) found a significant CAAR of +0.798% for first-time issuers, while for subsequent issuances, the result was not significant. Similarly, Tang and Zhang (2020) obtained a significant CAAR of +1.39% for first-time issuers and not significant CAAR for seasoned issuances. This study adds to the existing knowledge by discovering that subsequent time issuances can result in negative market reaction, if different geographical and time constraints are applied. It is difficult to explain what drives negative market reaction specifically. It might be that bond is seen as conventional bond and negative reaction is driven by new burden of additional debt and not due to green label effect. Another explanation could come from damaged firms' fundamentals leading to reduced expected future profitability.

After dividing the data set between the first and subsequent issuances, the number of observations is sufficient to investigate how findings from Table 12 hold if data is sliced into two different periods. Therefore, stock market reaction is reevaluated for first- and subsequent-time issuances before the 1st of January 2020 and after, for the whole data sample ranging from 1st of January 2013 to 2023. Findings are displayed on four panels of Table 13. Panels on the left focus on the period before 2020. The top left panel for EW of [-4,4] days has a CAAR of +1.37% (significant

at 10%). In comparison, the bottom left panel, focusing on seasoned issuances, exhibits insignificant results. These two observations are consistent with findings from multiple prior studies, supporting the argument that only first-time issuances have positive stock market reactions before 2020. Accordingly, the right panel presents findings after 2020. The top right panel does not provide any significant support for the argument that the first-time issuance result is a positive stock market reaction. The bottom right panel of Table 13 finds significant negative CAARs of -1.55% for [-10,10] and -0.86% for [-4,4] EWs. Considering this negative reaction, it can be argued that nonsignificant results for first-time issuances after 2020 are actually a positive market signal. The main takeaway from Table 13 is that after 2020, investor reaction to the green bond issuance announcements has changed, for both first and subsequent green bond issuances, to the more adverse market reactions. Almost anecdotal observation can be made that significance levels moved by one step across periods. First-time issuances before 2020 are positive and significant, but after 2020 are insignificant. Accordingly, subsequent issuances shift from insignificant CAARs to negative and significant.

Table 13

Comparison Between First & Subsequent Issuances Across Periods

EW	[-10, 10]	[-5, 10]	[-4, 4]	[-10, 10]	[-5, 10]	[-4, 4]
	First Time (Before 2020)			First Time (After 2020)		
CAAR	0.56	1.22	**1.37***	-0.63	-0.39	0.43
BMP_t	0.74	0.20	0.06	0.28	0.61	0.41
P(W)	0.57	0.50	0.05	0.31	0.54	0.29
Obs	53	53	53	67	67	67
	Subsequent (Before 2020)			Subsequent (After 2020)		
CAAR	0.30	-0.26	0.32	**-1.55***	-1.11	**-0.86****
BMP_t	0.79	0.75	0.49	0.08	0.11	0.05
P(W)	0.87	0.91	0.79	0.12	0.07	0.06
Obs	54	54	54	147	147	147

Notes: **, * denotes BMP test significance at 5% and 10% level.
Table constructed by the author based on event study results.

Lebelle et al. (2020) find that first-time issuances result in negative market reaction, while after subsequent issuances the market does not react significantly. Scholars explain this phenomenon by arguing that increased costs, uncertainty around a new business plan is being priced in with the first green bond issuance, and subsequent ones do not give any new and important signals to the market. Looking at CAARs presented in Table 13 it is clear that largest, negative effect for firms'

value happens with subsequent issuances after 2020. Therefore, Lebelle et al. (2020) argumentation does not seem to hold looking at latest data, but the rationale about business model change might still be one of the drivers for adverse market reaction. If a company issues one green bond, which proceeds will be used in a project that does not have significant effect on companies' business plan it might not have enough impact that would lead to large repricing of equity value. However, if large energy company like Orsted A/S. starts to issue multiple green bonds (between end of 2017 and end of 2022 issued 7 green bonds, with total amount EUR 4.2b), markets might price in impact of new sustainable projects impact on companies' profitability with a delay, after seasoned green bond issuances. However, this argumentation depends on the type of issuer and its business plan. One potential area for further research is to investigate whether the future profitability outlook improves or not for companies that change their business model to be more sustainable.

The discoveries observed from Table 13, considerably, are the most important contribution to current literature about green bond announcement effects from this study. By dividing dataset into two periods, event study successfully shows that effect of positive CAAR diminished overtime and in case of seasoned issuances even turned negative. This raises multiple questions for further research. How did investors views towards green bonds are changing over time? If investors are not rewarding companies, what are the motivations to issue more and more green bonds? Additionally, these findings offer valuable insights for European corporations seeking to assess the potential impacts of issuing a green bond in the current environment. By considering these results, companies can make more informed decisions, manage expectations of market reaction better and avoid potential misinterpretations of results based on previous research.

3.3.3 Industry Specific CAAR Comparison

The concluding analysis in this study concentrates on examining potential variations in stock price abnormal returns among issuers categorized according to their industry types. This comparison aims to investigate whether and to what extent there are differences in market reactions across various industries. Use of green bond proceeds can drastically differ among different industries. For example, an energy company using a lot of cheap coal to produce electricity might receive negative market reaction if a firm decides to switch towards more renewable energy sources. This business model shift might mean increased debt levels and lower margins which can negatively impact profitability. It is important to examine the market perception of green bond issuances for different types of issuers.

Table 14

Comparison of CAARs Across Industries.

	Full Period				
	CAAR [0, 10]	BMP_t	CAAR [-5, 10]	BMP_t	Obs
Utilities	**-0.36**	0.62	**-0.34**	0.82	152
Industrials	**-1.07****	0.05	**-0.50**	0.36	78
Consumer Discretionary	**-0.11**	0.76	**0.59**	0.94	23
Materials	**-1.41**	0.58	**-1.76**	0.39	21
Energy	**-3.53***	0.04	**-1.52**	0.28	16

Notes: **, * denotes BMP test significance at 5% and 10% level.
Industry categories with less than 10 bond issuances were excluded from CAAR calculations.
Table constructed by the author based on event study results.

Divided accordingly on Bloomberg-assigned industry categories BICS, CAARs are recalculated for the whole sample period. Due to insufficient observations comparison across periods is not performed. Table 14 exhibits results obtained for issuers from five different industry categories. Communications, consumer staples, health care, and technology industry categories are excluded from the analysis due to insufficient sample sizes shown in Table 6. As a result, only two significant CAARs are presented in Table 14. First, one of the largest green bonds issuing sectors, industrials, in EW of [0, 10] exhibit CAAR of -1.07% (significant at 5%). Second, for the same EW, a CAAR for energy industry issuers of -3.53% (significant at 10%) is obtained. However, the later result is based only on 16 observations and might lack robustness. Interestingly, the utilities industry, having the largest sample size in this analysis, does not show any significant market reaction. The same reaction is seen for consumer discretionary and materials industries.

Although industry comparison in this study could be more prosperous, it supports the argument that CAARs can differ across industries. On the aggregate level, differences likely occur due to industry-specific factors, like exposure to environmental risks or regulatory support and policy environment. A notable example of tax exemption, although unrelated to the scope of this thesis, happens in the US, where municipal green bondholders do not pay taxes on acquired interests CBI (2023). Therefore, municipalities can borrow money with lower interest rates. Another form of support to US municipalities to issue green bonds comes from direct government subsidies via cash

rebates to subsidize interest rate payments. These are just a few examples of how industry specific tax incentives can be and are applied to some issuers. For example, if Germany provides tax subsidies for energy companies to issue green bonds, the issuer's ability to be more profitable could explain a positive stock market reaction.

3.4 Limitations of The Event Study Methodology

Results obtained in this study might suffer from several limitations that event studies face. In the following paragraphs, the most significant drawbacks are reviewed, and some improvements for future studies are suggested. Understanding all assumptions and potential biases that affect event study results is vital to determine the findings' external validity. This empirical research aims to provide helpful information for firms planning to issue green bonds, policymakers, and researchers investigating green bonds, corporate social responsibility, and impact investing. Unfortunately, the event study methodology is usually exposed to many assumptions and potentially biased selections by the author. Therefore, comparison results obtained from similar studies are challenging to compare, and they rather complement each other and cannot be thoroughly compared.

The most apparent issue with event study is potential biases arising during the selection of estimation and event windows characteristics. For example, if all else held equal, one decides to use an estimation window of [-200: 0], and other [-300: 0], observed results most likely will be different. The same bias occurs defining event windows, which selection can often be determined by the result's significance level. To avoid these biases, in this study, estimation and event windows are taken based on Tang and Zhang (2020) and Flammer (2021). Other biases might occur during data sample selection. For example, Baulkaran (2019) hand-picked green bond issuers, meaning that there is a risk that scholar missed some of them. This study partially solves this issue by taking data from the Bloomberg terminal, which should have a sound representation of all green bonds universe. However, it is not guaranteed that all relevant green bonds were included in the study. In addition, time frame selection bias might significantly affect results, as seen in subsection 3.3.2. Therefore, this study was conducted on the largest possible dataset until the beginning of 2023. Final sample selection bias might occur from geographical study preferences. Defining which countries should be included when focusing on European issuers is not straightforward. Countries included under the definition of Europe will likely be different across studies focusing on Europe. As long as all assumptions and selections are made clear, event study should still be seen as robust empirical work.

A significant limitation of most event studies is the assumption that a determined event is the cause of abnormal return. In practice, abnormal market reactions might occur due to factors unrelated to the event. To avoid this issue, most scholars manually exclude some observations from the sample. For example, if a company, during estimation or event window, has a dividend payment, stock split, management change, merger, or is affected by some ad hoc event, such observation would be removed. Also, some scholars remove observations from samples in case stock prices move more than 40% in the event window or similar. However, there are two problems with such data reduction. First, removing observations reduces sample sizes and makes studies less representative. Second, it does not fully solve the problem and ensure that stock price movements in event windows are unrelated to other factors. In this study, most of the mentioned methods, except observation exclusion if stock price changes by x amount, are used to increase robustness. One prominent unrelated event that might have driven stock prices negatively is the stock market turmoil due to the COVID-19 pandemic.

Another obvious drawback of event studies is that results are usually estimated for short-term periods, often up to ten days around the event date. For the empirical study conducted in this thesis, the efficient market hypothesis, first introduced by Fama (1970), is vital. This underlying theory claims that the securities price reflects all available information to investors. However, in practice, new public information about security might be priced in with a delay. Also, sometimes the market expects certain news; if they occur, the stock price might not be affected because the news were already priced in. Therefore, it is a challenging task for the one conducting the event study to ensure that the determined event, in this case, green bond announcement, if it is seen as a significant event impacting firms value, is being priced in within a predetermined event window.

One of the limitations of the event study results is the potential problem of low external validity. For example, this thesis's event study relies on a sample of listed, non-financial European green bond issuers, which might not fully represent similar issuers on a global scale. Moreover, evidence obtained on a European level might not be fully generalized on a country level. Although most of the countries in the study adhere to the same European regulations, some country-specific factors, like tax exemptions, might result in different findings. Therefore, country-level analysis is a potential extension of this thesis. Additionally, event studies have difficulty determining causalities. Even though abnormal returns are observed around green bond issuance, establishing a direct link that caused the market reaction is a complex tax. Industry-specific, country-specific factors and market trends make it difficult to isolate the effect of green bond issuance. It is also very challenging

to understand precisely what about green bond issuance caused the reaction. Explanations often are not backed by substantial empirical evidence. This issue is prevalent in this study as well. One potential improvement would be to conduct a questionnaire of market participants exposed to securities of interest. This hopefully would provide guidance for researchers to investigate new channels green label affects firms' equity.

Finally, significance tests are one of the most critical design parts of event studies. It is easy to calculate abnormal returns, but it is difficult to determine if the result is significant. Scholars use a wide variety of parametric and non-parametric tests. Their choice can be biased, as the researcher might want to choose the tests that support his hypothesis. A popular test in event studies calculating abnormal returns is a parametric T-Test. It assumes that within estimation and event windows, abnormal returns are identically distributed, i.i.d. with zero mean and unknown variance, which is a rare case in practice. To assess average abnormal returns popular test is the Pattel Z test, which calculates standardized abnormal returns from the estimation window. For this event study, the BMP test was chosen, as it builds on the Pattel Z test and finds statistic that is robust to event-induced variance. Most parametric tests assume a normal distribution of stock returns. This assumption is often violated, but if sample sizes are large enough, with more than 20 or 30 observations, p-values can still be trusted according to the literature. On the other hand, non-parametric tests do not rely on normality assumption, which means they can be used for lower samples. Therefore, many scholars supplement parametric tests with non-parametric ones like the Wilcoxon test. A possible improvement in event studies significance test space is using the non-parametric Generalized Rank T test introduced by Kolari and Pynnönen (2011). This test not only accounts for event-induced volatility, does not require normal distribution assumption, but also accounts for cross-sectional and serial correlation of returns. Some Monte Carlo studies support the idea that this test is a more robust cross-sectional dependence of stock returns.

As can be seen from event studies limitations and dangers described above, this method to investigate event impact on stock returns is sensitive to model design. These limitations highlight that the results of event studies need careful interpretation, a high degree of study transparency, and consideration of alternative research methodologies.

Conclusions and Recommendations

The literature review highlights key points. Firstly, the pace of advancement in green labeling frameworks and their ability to address credibility issues remains uncertain. The development of tools to penalize issuers deviating from sustainable claims is a key aspect that requires clarity. The heightened utilization of climate bonds without established “gold” standards poses a risk to the overall validity of the green bond market. Multiple studies show that self-labeled bonds severely lack credibility and usually do not provide benefits compared to conventional bonds. According to some studies, one of the advantages of green bonds to the issuers is cheaper funding costs, existence of greenium. However, the existence of greenium is difficult to prove and often depends on calculation method. Engaging in sustainable projects can attract investors with a green focus and a preference for green bonds, potentially driving demand for both bonds and stock. While existing research highlights the appeal of green bonds to long-term investors, most studies were conducted during the initial stages of the green bonds market, necessitating further investigation. Attracting more long-term institutional investors can reduce speculation and volatility tied to short-term investors, like hedge funds. Overall, the prevailing expectation is that firms issuing green bonds and committing to a sustainable future should enjoy lasting benefits in financial markets, like investors having more patience and maintaining positions in the company's stock for longer periods.

Another takeaway from the literature review is the beneficial properties of green bonds in risk management practices. It is shown that green bonds perform better than "green" stocks during market turmoil and can function as a safe heaven instrument. Another dimension to take into account is that climate bond proceeds, being invested in sustainable, environmentally friendly projects, usually face fewer risks coming from climate change, especially increasing regulations and costs. However, some sustainable projects, can also face risks from climate change, for example, extreme weather events that damage solar panels or wind turbines.

By looking at three well established studies investigating corporate green bond announcement effects on stock prices, we can see that companies get some positive abnormal returns after issuing green bonds. However, these returns are not very high, and they tend not to be present for subsequent issuances. The explanation of such phenomena is that green bonds send a positive signal about firms’ commitment to a sustainable future, which is seen as the main reason behind these stock gains. But this positive effect seems to happen only after the first issuance. Scholars also explore whether the existence of greenium can provide cheaper funding costs for issuers. However, the greenium effect is

not found to be present. Important to note that studies are conducted on datasets ranging only up to 2019, excluding many green bonds issued during the COVID-19 pandemic.

Empirical event study results significantly expand the literature concerning green bond announcement effects on issuers stock prices in the short term. Results show that established evidence about positive stock market reactions might not hold in the current market environment. One of the main findings shows a negative CAAR of -0.78% for EW of [-10, 10] for the dataset of green bonds issued within 2013-2023. From the thorough exploration of results by dividing the dataset into two parts by issuance announcements that happened before and after January 1, 2020, it seems that market reaction has shifted over the years. CAAR for EW [-3, 4] before 2020 is +0.81% but is negative at -0.57% after 2020. To our knowledge, none of the established studies were investigating whether and how the perception towards green bonds evolves from the market participants. This study finds corresponding evidence of positive effects to stock prices until 2020, but on aggregate level and after 2020 effect is found to be significantly negative. Latest results suggest that green bonds are seen as conventional bonds by the market participants. The finding that green bond issuance might negatively affect shareholders value and once found a positive effect might not be present anymore in current market conditions is one of the key takeaways from this study.

A shift in market perception is also observed, examining whether markets react differently between first and subsequent green bond issuances. Results based on a full data sample show that first-time green bond issuances have a significant positive abnormal stock market reaction of 0.85% for first-time issuances. This finding is commonly found in similar global studies as well. However, for seasoned issuances observed CAAR is negative at -0.68%. It seems that the market positively reacts only to first-time issuance. One potential driver could be the signaling effect, which deteriorates with the following issuances as markets price in a company's environmental profile. The adverse market reaction seems more consistent with the conventional bond effect on shareholders' wealth, where increased debt obligations might damage company’s profitability outlook.

In line with the first hypothesis, this study examines both first-time and subsequent issuances within two distinct periods. For first-time issuances in the EW [-4, 4] window before 2020, the CAAR is +1.37%. Conversely, the abnormal stock price return for subsequent issuances is deemed insignificant during this timeframe. Shifting the focus to the period after 2020, it is observed that first-time issuances do not elicit any significant stock price reaction. However, a notable negative reaction of -0.86% is identified for subsequent issuances, presenting unexpected findings. Notably, in both

periods, subsequent issuances exhibit a more detrimental effect on firms' equity value. Furthermore, both first and subsequent issuances result in worse effects to stock prices in later period. In recent years, markets have reacted differently and worse towards green bond issuances from firms' valuation perspective. Findings are thought proving and inviting researchers to explore changing market dynamics and to answer the question of whether green bond issuances are seen as conventional bond issuances.

Abnormal stock price returns can also depend on the industry green bond issuer is operating. Event study results show that companies operating in the energy and industrial sectors receive the most negative effects from the market after issuing green bonds. Likely, markets do not see a commitment to green projects as something that will improve the profitability outlook for corporations operating in industrial sectors. Another prominent firm-level characteristic that might affect stock market investors' reaction to acquiring new debt is firms' credit rating. Study results support the argument that if a corporation is seen as investment grade, market reaction is more positive after issuing a green bond than non-investment grade. On the entire dataset, CAAR for IG issuers is not found to be significant, while for non-IG issuers for EW of [-10, 10] is -1.07%. Finding exhibits issuers credit rating significantly influences stock market reaction to the increase in issuer indebtedness.

This master thesis acknowledges the limitations and drawbacks of the event study methodology. The study emphasizes the importance of assumptions and biases that affect the external validity of results. A large focus is put on significance tests, which are crucial to determining which calculation can be considered robust. Also, many bias-related issues can arise during the selection of event and estimation windows length. It is also problematic to ensure that the abnormal market reaction was caused by a predetermined event and not some ad hoc stock price shock. Despite limitations, the results of this master thesis provide valuable insights for firms, policymakers, and researchers interested in green bonds and social responsibility.

Recommendations

The findings of this master thesis point to several recommendations that can guide future research. First, existing evidence of greenium, change in investor composition, and positive effect on shareholders' value after issuing a green bond should be reevaluated on a more granular level with the latest data. Currently, the changing market perception towards green bonds needs to be researched to understand the main drivers of it. It is important to further investigate the benefits and disadvantages

of green bonds compared to conventional bonds. Moreover, we recommend monitoring greenium existence and continuing the development of robust methodologies to calculate it. It is also important to closely monitor the new EUGBS standard and its implications on green bond markets.

Concerning the event study investigating green bond issuance effects on short-term issuers stock prices several recommendations can be made. First, it is important to use robust significance tests. The study from this master thesis could be improved using a non-parametric Generalized Rank T-test. Moreover, future research should focus more on the explanation of found abnormal stock price returns. This study provides valuable findings on the changed market reaction to new green bond issuance. The next step is to understand what drives these abnormal returns. It would be recommended to conduct a study with a questionnaire investigating what reasons drive abnormal returns case by case. Another potential research area should aim to understand how green bonds affect future profitability outlook. Due to the passage of time and more and more maturing green bonds, it is extremely interesting to evaluate whether the planned use of green bond proceeds was successful and if and how firms benefited from commitments to sustainable projects. A similar event study with issuer-specific financial performance metrics analysis could be combined to answer these questions.

To conclude, this thesis contributes to existing literature that explains how investors react to green bond issuances from the stock market perspective. The findings indicate that investments in environmentally friendly projects using green bond proceeds might damage shareholder wealth. It is a worrying finding, which creates a good starting point for an argument that green bond instrument should receive more attention. In order to achieve the goals of The Paris Agreement, it is crucial to make this innovative instrument as effective and as desirable as possible.

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ĮMONIŲ ŽALIŲJŲ OBLIGACIJŲ EMISIJŲ PASKELBIMŲ ĮTAKA AKCIJŲ KAINOMS

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SUMMARY IN LITHUANIAN

62 puslapiai, 14 lentelių, 5 paveikslai, 39 nuorodos

Pagrindinis šio magistro darbo tikslas – atskleisti, kaip naujų žaliųjų obligacijų emisijų pranešimai veikia emitentų akcijų kainas trumpuoju laikotarpiu. Tyrimas orientuotas į listinguotas nefinansines korporacijas, kurios leidžia obligacijas Europos rinkose. Magistro baigiamasis darbas susideda iš trijų pagrindinių dalių: literatūros apžvalga, tyrimo metodika ir empiriniai tyrimo rezultatai.

Literatūros apžvalgoje pabrėžiamos žaliųjų obligacijų patikimumo problemos, susijusios su žalios etiketės ženklinimo būdais. Emitentai gali patys ženklinti obligaciją kaip žalią. Jei emisija gauna sertifikuotą žalią etiketę, tai negarantuoja, kad emitentas įgyvendins užsibrėžtus tvarumo tikslus, o jį nubausti - sunku, dėl neišvystytų baudimo mechanizmų. „Greenium“ įrodymai literatūroje - neaiškūs, ar šis fenomenas egzistuoja priklauso nuo skaičiavimo metodų ir obligacijų pasirinkimo. Žaliosios obligacijos parodė, kad turi vertingų savybių, kaip rizikos valdymo instrumentas.

Metodologijos dalyje pateikiamos keturios pagrindinės hipotezės ir išsamus (angl. *event study*) eigos aprašymas, siekiant ištirti neįprastą emitentų akcijų grąžą paskelbus žaliųjų obligacijų emisiją. Nenormali grąža apskaičiuojama naudojant keletą skirtingų įvykių langų, kurie svyruoja [-10; +10] dienų nuo paskelbimo datos. Didelis dėmesys skiriamas reikšmingumo testo, (angl. *parametric standardized cross sectional test*) pasirinkimui ir aprašymui.

Pagrindinė išvada rodo, kad Europos įmonių žaliųjų obligacijų emisijos nuo 2013 m. sausio 1 d. iki 2023 m. sausio 1 d. neigiamai paveikė emitentų akcijų kainą, neįprasta grąža CAAR -0,78 % (reikšminga 10 %), įvykių langas [-10,10] dienų. Iki 2020 m. sausio 1 d. pastebėta neįprasta akcijų kainų grąža yra teigiama. Rezultatas patvirtina egzistuojančių tyrimų rezultatus. Tačiau po 2020 m. neįprasta grąža tapo neigiama, o tai rodo, kad rinkos požiūris į žaliąsias obligacijas keičiasi. Kiti rezultatai rodo, kad pirmą kartą išleistos žaliosios emisijos sulaukia teigiamos akcijų grąžos, o vėlesnės emisijos neigiamai paveikia įmonių vertę. Tyrimo išvados siūlo, kad neįprasta grąža yra veikiama tiek emitentų kredito reitingo, tiek industrijos.

CORPORATE GREEN BONDS ANNOUNCEMENTS EFFECTS ON STOCK PRICES

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Master Thesis

Finance and Banking Master Programme

Faculty of Economics and Business Administration, Vilnius University

Supervisor - prof. A. Šapkauskienė, Vilnius, 2024

SUMMARY IN ENGLISH

62 pages, 14 tables, 5 figures, 39 references

The main purpose of this master thesis is to reveal how new green bond issuance announcements affect issuers' stock price in the short term. The study focuses on listed, non-financial corporations, which issue bonds in European markets. The master thesis consists of three main parts: the literature review, the research methodology, and the empirical study results.

The literature review highlights credibility issues that green bonds have with labeling frameworks. Issuers are able to self-label bonds as green. Even if the certified green label is obtained, there are lack of stringent regulations in place of greenwashing. The evidence of “greenium” is unclear, existence of it varies based on sample and calculation methods. Green bonds prove to be a valuable risk management tool.

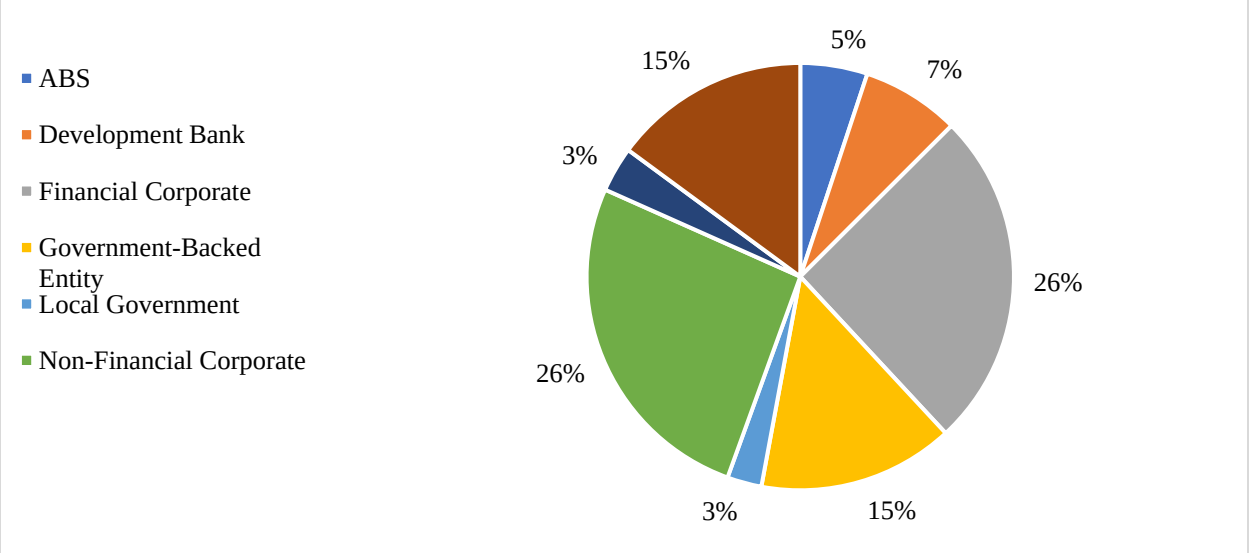
The methodology part develops four main hypotheses and provides a thorough description of the event study setup to investigate abnormal issuers' stock returns after the green bond issuance announcement. Abnormal returns are calculated for multiple event windows, which range from [-10; +10] days around the announcement date. A large focus is put on the description of event study significance tests, such as parametric standardized cross-sectional test.

The main finding shows that CAAR estimated using CAPM, from January 1, 2013, to January 1, 2023, for European corporate green bond issuers, using event window [-10,10] is -0.78% (significant at 10%). Until January 1, 2020, observed abnormal stock price returns are positive, consistent with existing literature. However, after 2020, abnormal returns became negative, indicating market perception shift towards green bond issuances. Furthermore, first-time issuances receive positive abnormal returns, while subsequent issuances negatively affect a firm’s value. The study findings indicate that abnormal returns are influenced by both the issuers' credit rating and the industry.

Annex

Figure A1

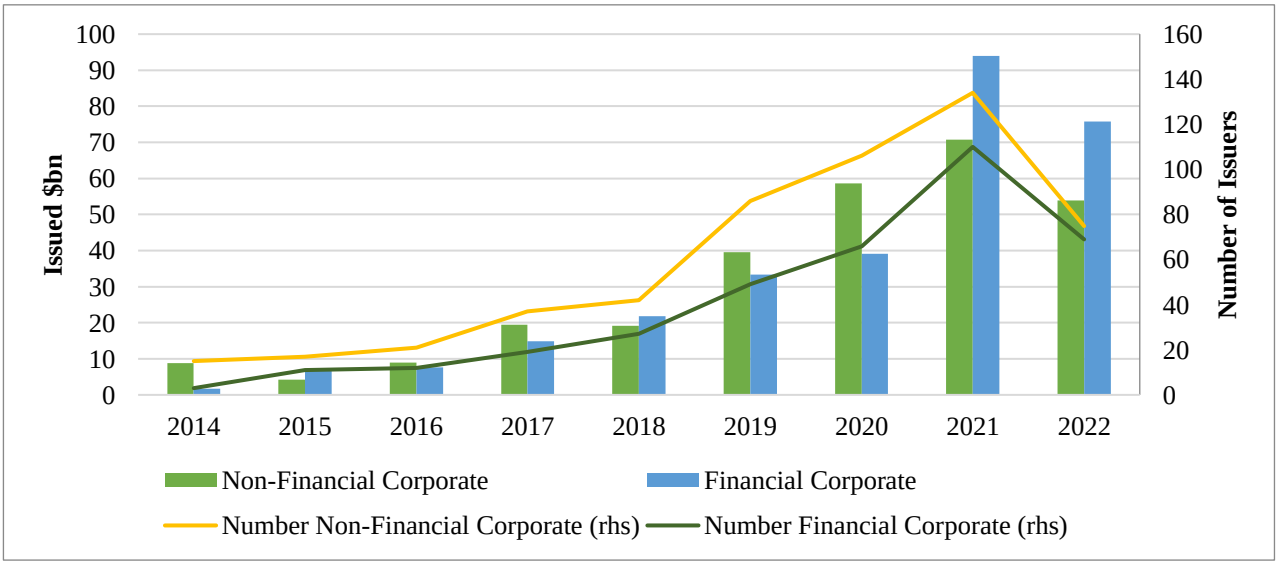
Issued Amount Share per Issuer Type in 2021



Notes: Figure based on data obtained from climatebonds.net/market/data/
Figure constructed by the author.

Figure A2

Issued Amount of Green Bonds in Europe by Corporates



Notes: Figure based on data obtained from climatebonds.net/market/data/
Figure constructed by author.

Table A1

Top Five Issuers by Count of Issued Green Bonds

Issuer Name	No. of Bonds
ACCIONA FINANCIACION FIL	37
ENGIE SA	14
IBERDROLA FINANZAS SAU	12
ELECTRICITE DE FRANCE SA	8
ORSTED A/S	8

Notes: Does not include parent or subsidiaries bonds.
Table constructed by the author based on data obtained from Bloomberg.