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Evaluating green bond premium and the credibility of greenness of corporate green bonds

Empirical evidence of USD and EUR dominated corporate bonds

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ABSTRACT:

The demand for environmentally sustainable investments has been growing rapidly, leading to a significant increase in the total amount of green corporate bond issuances - in 2021 a record high of $228 billion worth of green bonds was issued. As the green bond market expands rapidly, it has become increasingly important to assess the real impact of green bonds. However, prior research on corporate bonds is not unanimous and has yielded mixed results.

This study analyzes a sample of bonds issued between 2014-2021 and compares the issue prices of green and non-green bond portfolios. After conducting a matching process, 75 bond pairs are selected and evaluated using the Mann-Whitney U-test. The results suggest that, after strict matching procedures, the green and non-green bond issue prices are not significantly different. Although there is weak evidence to suggest that green bond issue prices are slightly higher than their non-green counterparts, the difference is statistically insignificant.

Six variables, including certification, sector, ESG risk level, issue amount, and green exchange variable, are studied to evaluate the credibility of greenness. A cross-sectional analysis is conducted to study the impact of these characteristics on the issue prices. The results indicate that certification is a significant factor, as certified bonds are issued at a premium. Additionally, if the bond is issued at Luxembourg Green Exchange, the premium increases substantially. Furthermore, ESG risks are not found to be significant determinants.

Corporate green bonds are a relatively new concept, and prior research in this area is limited. Additionally, the current green bond principles and standards are fragmented, making it difficult to compare the greenness of different bonds. Therefore, there is a need for more research in this area to understand the benefits and drawbacks of corporate green bonds fully. By studying corporate green bonds, investors can better understand the credibility of the green bond market and make informed decisions about investing in environmentally sustainable projects.

KEYWORDS: Green premium, Green credibility, Green drivers, Corporate green bonds, Sustainable finance

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Tiivistelmä:

Ympäristöystävällisten sijoitusten kysyntä on kasvanut nopeasti, mikä on johtanut merkittävään ympäristöystävällisten yrityslainojen liikkeeseenlaskun kokonaismäärän kasvuun - vuonna 2021 yritykset laskivat ympäristöystävällisiä joukkovelkakirjoja liikkeelle ennätykselliset 228 miljardin dollarin arvosta. Ympäristöystävällisten joukkovelkakirjojen markkinoiden laajetessa näin nopeasti on kuitenkin tullut entistä tärkeämmäksi arvioida ympäristöystävällisten joukkovelkakirjojen todellista vaikutusta. Aikaisempi tutkimus yrityslainoista ei kuitenkaan ole yksimielistä ja on tuottanut ristiriitaisia tuloksia.

Tämä tutkimus analysoi vuosien 2014–2021 välillä liikkeeseen laskettuja joukkovelkakirjoja ja vertailee vihreiden ja tavallisten joukkovelkakirjojen liikkeeseenlaskuhintoja. Matching-menetelmää hyödyntämällä valitaan 75 joukkovelkakirjaparia, joiden hinnoitteluEroja arvioidaan Mann-Whitney U-testillä. Tulokset viittaavat siihen, että tiukan matching-menettelyn jälkeen vihreiden ja tavallisten joukkovelkakirjojen liikkeeseenlaskuhinnoissa ei ole merkittävää eroa. Vaikka tulokset antavat heikkoja viitteitä siitä, että ympäristöystävällisten joukkovelkakirjojen liikkeeseenlaskuhinnat olisivat hieman korkeammat kuin ei-ympäristöystävällisten vastineidensa, ero ei ylitä tilastollista merkitsevyyttä.

Kuutta muuttujaa, mukaan lukien sertifiointi, toimiala, ESG-riskitaso, liikkeeseenlaskun koko ja kestävän rahoituksen markkinapaikka, tutkitaan vihreyden uskottavuuden arvioimiseksi. Poikkileikkaustutkimuksessa tarkastellaan näiden ominaisuuksien vaikutusta liikkeeseenlaskuhintoihin. Tulokset osoittavat sertifioinnin olevan merkittävä tekijä ja näiden joukkovelkakirjojen nauttivan preemiota liikkeeseenlaskun aikana. Lisäksi, mikäli joukkovelkakirja liikkeeseen lasketaan Luxemburgin vihreässä pörssissä, preemio kasvaa merkittävästi. ESG-riskeillä kuitenkaan ei havaita olevan merkittävää vaikutusta hinnoitteluun.

Yritysten vihreät joukkovelkakirjat ovat suhteellisen uusi käsite ja aikaisempi tutkimus tällä saralla on vielä rajoittunut. Nykyiset vihreiden joukkovelkakirjojen periaatteet ja standardit ovat epäyhtenäisiä, mikä vaikeuttaa joukkovelkakirjojen vihreyden vertailua. Siksi tarvitaan lisää tutkimusta tällä alueella, jotta voidaan ymmärtää täysin yritysten vihreiden joukkovelkakirjojen hyödyt ja haitat. Tutkimalla yritysten vihreitä joukkovelkakirjoja sijoittajat voivat paremmin ymmärtää vihreiden joukkovelkakirjamarkkinoiden uskottavuutta ja tehdä tietoon perustuvia päätöksiä sijoittamisesta ympäristöystävällisiin hankkeisiin.

Avainsanat: Vihreä preemio, Vihreä uskottavuus, Vihreän preemion ajurit, Vihreät yrityslainat, Kestävä rahoitus

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1 Introduction

Economic consequences will be substantial due to global warming. Extreme weather events such as hurricanes, floods, and wildfires can cause significant damage to infrastructure and property, resulting in high economic costs for repairs and reconstruction. This can also lead to disruptions in supply chains, business operations, and transportation systems, affecting economic activity and growth (NOAA, 2020a). During 2015 – 2019, the U.S. confronted ten or more different disasters that each induced over $1 billion worth of damage (NOAA, 2020b). Globally, climate-related disasters caused damages worth $320 billion in 2017, and over 1,200 were killed due to massive floods in South Asia (New Climate Economy, 2018). According to an estimation by the Economist Intelligence Unit report (EUI, 2015), the Value at Risk for the asset management industry will be $4.2 trillion by the year 2100. If global warming accelerated further, and the average temperature would be six degrees higher by 2100, the VaR would rise to $13.8 trillion, approximately 10% of the total worth of the assets. In 2015, the Paris Agreement was ratified by 196 parties, who committed to fighting climate change by reducing their greenhouse gas emissions.

Professional investors and institutions are actively investing in green alternatives. For instance, Portfolio Decarbonization Coalition (PDC) is an initiative that encourages its members to shift their assets into low-emission portfolios. The PDC has gained high popularity and has gathered 32 investors with aggregate assets under management (AUM) of over $800 billion (Portfolio Decarbonization Coalition, 2016). Similarly, launched in 2014, the Montreal Carbon Pledge engages its members to disclose the carbon footprints of their investment portfolios. The pledge was quickly signed by 120 investors with AUM over $10 trillion, implying that the interest in the topic had rapid development in the 2010s. (UNPRI, 2016). The US-SIF (2018) report states that of the assets under professional management in the US, every fourth dollar was allocated for SRI strategies in 2018. Only two years later, in the beginning of 2020, the figure increased further, and the sustainable assets accounted for 33 percent of the total AUM, respectively. That is, every third dollar invested by US asset management firms and institutions are allocated for sustainable investments (US-SIF, 2020).

Five hundred institutional investors were interviewed for an Edelman Trust Barometer Report (Edelman Trust Barometer, 2018). According to the report, 89 percent of the investors announce that their companies have changed to consider ESG risks more carefully. Ninety-three percent of attendees state that their companies believe ESG criteria to be an important driver for long-term value creation besides financial performance. Most interestingly, 87 percent declare that their companies would consider investing in sustainable or impact investing categories even if the yields were lower.

That is, the demand for green investment alternatives is increasing rapidly, and the trend can be seen from the green bond issuances. The amount of green bond issuances has increased rapidly since 2007 when the first climate-awareness bond of $1 billion was issued by the European Investment Bank (EIB, 2020). The amount of issued bonds has hit records year over year, and despite the weak beginning of the year due to the pandemic, bond issuances amounted to a record $269.5bn in 2020, as the cumulative issuances exceeded $1 trillion. According to the Climate Bonds Initiative, the total amount of green corporate bond issuances reached a record high of $228 billion in 2021, up from $174.8 billion in 2020. This represents a significant increase in the issuance of green corporate bonds, indicating that more corporations are recognizing the importance of sustainable finance and are willing to commit to environmentally responsible investments. (CBI, 2021). Even though the green bond market is a fraction of the global fixed-income market of $123.5 trillion in 2020 (Sifma, 2021), the green bond market is trending at the moment, and there is no slowing down in sight.

1.1 Purpose of the study

According to Fama (1970) and the efficient market theory, investors' rationality makes the capital market efficient – this being true, green corporate bonds and conventional corporate bonds should yield the same return if the bond characteristics are the same except for the greenness. However, prior research provides evidence of how the market

differentiates green investments from ordinary investments. That derives from the fact that investors are willing to give up their returns for the responsibility.

The purpose of the study is to investigate if green corporate bonds are issued at a premium compared to matching non-green bonds. Further, by analysing a constructed green corporate bond sample, possible green credibility drivers and their influence on issuing prices are evaluated. Prior research is relatively ambiguous. Several researchers have studied the green premium and ended up with mixed results. Karpf and Mandel (2018) find a negative eight bps green premium in municipal bonds, whereas Baker et al. (2018) end up with an opposite result of a positive six basis points premium. However, these studies may have been impacted by irrelevant firm and bond characteristics (Larcker & Watts, 2020). According to them, the green premium, negative or positive, can be derived from characteristics such as bond maturity, coupon rate, or credit ratings. In this thesis, the intended contribution is to confirm or reject the premium by cleaning the data from all irrelevant bond, firm, and other characteristics. Since there are mixed results in the prior studies about the green premium, this thesis tries to clarify the ambiguous literature.

Kapraun et al. (2021) state that the mixed results are due to sample selection and the empirical methods used in the studies. When investigating the actual impact of greenness on the bond price, firm-specific factors must be eliminated entirely. If we want to know investors' willingness to give up returns for these non-pecuniary characteristics, the sample should consist of only issuers that have issued both green and non-green bonds. There are some problems in the studies where the comparison is made between different issuers. For example, investors may perceive some firm-specific factors from the green bond issuance, which can have an influence on the bond price due to the signalling hypothesis (Flammer, 2021). That is, investors can appreciate the management's ability to control environmental risks, for instance. These firm-specific factors must be eliminated if the goal is to evaluate only the effect of greenness.

Moreover, this thesis evaluates the drivers of so-called green credibility. As the amount of green bond issuances expands continuously, the risk of greenwashing rises, where issuers

make misleading or exaggerated claims about the environmental benefits of their bonds to attract investors. This can lead to a lack of trust in the market and undermine its effectiveness in promoting sustainable development. In accordance with Kapraun et al. (2021), the determinants of green bond premium are also investigated. This thesis sheds light on the drivers of green premiums, thus finding possible determinants for the possible valuation differences in the prior market.

1.2 Development of the hypotheses

There are some arguments for and against whether green bonds should trade at premium. Firstly, Flammer (2021) finds that green bond issuances, in general, have been noted to widen the investor clientele and increase the number of long-term investors. Secondly, the stock market tends to respond positively to eco-friendly actions (Flammer, 2013; Glavas, 2020), indicating that green initiatives are perceived as a positive signal for a company's future in general. On the other hand, Flammer (2021) and Larcker and Watts (2020) interviewed several portfolio managers, traders, and other financial professionals, who all agreed that they would not invest in green bonds if they did not offer competitive returns. The most sophisticated market practitioners would not pay a premium for green bonds if the yield were lower than the equivalent non-green bonds. Interestingly, that finding collides strongly with the statement by the Edelman Trust Barometer (2018) report.

The green bond market is a relatively new concept, and researchers have not reached a consensus on whether green bonds are issued at a premium or not. For example, Tang and Zhang (2020) find evidence that green corporate bonds are issued at a discount of 6.94 bps, leading to a negative yield premium. Parallel results are found by Ehlers and Packer (2017), Baker et al. (2018), and Nanayakkara and Colombage (2019). Conversely, Flammer (2021) examines the primary market and finds no pricing difference between green and conventional corporate bonds.

As can be seen, the results of prior studies are highly divided. McAskill et al. (2021) conclude that approximately 56 percent of prior studies find evidence for premiums in the

primary market. In accordance with that consensus, the first hypothesis is constructed as follows:

H1: Green bonds are issued at a premium compared to conventional bonds.

Given the mixed results in previous studies, it is important to determine if there are some relevant drivers impacting the premium. Febi et al. (2018) interpret maturity to have an explanatory power to the premium, and Bachelet et al. (2019) discover that third-party verification is an important determinant. Zerbib (2019) finds that within secondary markets, a rating and sector impact the significance of negative yield premium.

Kapraun et al. (2021) approach the matter with a 'green-credibility' aspect. They study the bond and issuer characteristics and try to find the drivers that lead to the green premium. In addition to the determinants mentioned above, Kapraun et al. (2021) find that the green-credibility improves when the amount of the bond increases, the bond is listed on a certain green exchange, and the issuer's ESG score is high. Hyun, Park, and Tian (2019) end up with similar results. They conclude that both investors and issuers value high the non-pecuniary factors. As this thesis focuses on the green-credibility, the second hypothesis is thus as follows:

H2: The credibility of greenness drives green bond premiums in the primary market.

1.3 Contributions and limitations

This thesis provides an in-depth analysis of the fragmented research results on the topic. The objective is to shed light on the issue and help investors to evaluate green bonds that are genuinely aligned with environmental objectives versus those that may be more loosely associated with environmental themes and, therefore, may not deliver on their stated environmental promises. This can help to better inform investors about the true environmental impact of green bonds and potentially lead to more effective investment decision-making.

Secondly, studying the green credibility of green bonds and its impact on premiums can help to better understand the role of market signals in promoting environmental sustainability. This can lead to better policy-making decisions by governments and other organizations, as well as to more informed investment choices by investors.

Studying green bond premiums and the credibility of greenness can provide insights into the overall efficacy of green bonds as a mechanism for mobilizing capital towards environmental goals. This can help to inform the development of new financial instruments and policy measures that can better support the transition to a more sustainable economy. Overall, studying the green credibility of green bonds and its impact on premiums can provide valuable insights into the role of finance in promoting environmental sustainability and can contribute to more informed investment and policy-making decisions.

However, when studying green bond premiums and the credibility of greenness, there are several research limitations to consider. One limitation is the need for more standardization in green bond certification, which can lead to uncertainty about the environmental impact of the underlying projects. Another limitation is the relatively short history of the green bond market, which limits the availability of data for analysis.

Additionally, factors beyond the "greenness" of a bond may affect its pricing, such as issuer credit risk or overall market conditions. Furthermore, there may be differences in investor demand for green bonds across regions and sectors, which can also affect pricing. Finally, it is vital to consider the potential for endogeneity, as companies that are more environmentally responsible may be more likely to issue green bonds in the first place.

1.4 Structure of the thesis

This thesis aims to provide an in-depth analysis of corporate green bonds and the growing need to understand the credibility of the greenness of corporate green bonds. Chapter 2

introduces the concept of corporate green bonds, the evolution of the green bond market, bond characteristics, and their role in the financial markets. Chapter 3 presents a theoretical literature review that examines the existing research on green bonds, including green bond pricing and the green bond premium, their drivers, challenges, and implications.

Chapter 4 focuses on the methodology and data used in this study, including the selection of issuers, data sources, and analytical techniques. Chapter 5 presents the empirical results of the study, including the analysis of the factors that influence the issuance of corporate green bonds and their impact on the issuer's financial performance.

Finally, chapter 6 summarizes the findings of the study, discusses their implications for the financial markets and sustainable development, and provides suggestions for future research. Overall, this thesis aims to contribute to the growing body of literature on green finance and corporate sustainability, providing insights that can inform policy, practice, and research in this area.

2 Corporate green bonds

The amount of capital needed to transition to a zero-emission environment is enormous. According to the Organization for Economic Co-operation and Development (OECD), global investment needs for infrastructure alone are estimated to be around USD 6.9 trillion annually between 2016 and 2030. Green bonds can help fund projects contributing to this infrastructure gap, providing companies and governments with access to much-needed funds for sustainable development (OECD, 2017). Green bonds can play a significant role in narrowing the gap between the required and available funds for environmentally sustainable projects.

Corporate social responsibility (CSR) is an old and well-known concept referring to improving corporates' objectives and values besides increasing shareholders' value. Carrol (1999) illustrates in their review the evolution of CSR from the 1950s to the late 2000s. Today, the concept advocates social acceptability in a company's operations, recruiting, and societal aspects. Socially Responsible Investing (SRI) belongs to the same ideology as CSR. As Berry and Junkus (2013) demonstrate, there is no comprehensive measure to the SRI, since investors prioritize different values and expect different actions from the companies they have invested in. In general, for instance, gun and tobacco industries are excluded from the socially responsible industries.

2.1 The concept of green bonds

Green bonds are identical to conventional bonds in the extent of their financial structure. They are both fixed-income securities where the investor borrows a certain debt to the issuer in exchange for coupon payments and the initial debt at maturity. The basic framework for a green bond is similar to a conventional bond, except for the bond proceeds, as explained above. A green bond can be issued, among others, by a government, municipality, state, or company. They are publicly traded debt instruments where the issuers (debtors) and the investors (lenders) have agreed on the terms of a loan. That is, in general, the

debtor pays a fixed interest for the lender during the term of maturity, and the whole principal at maturity (Gitman et al., 2011, p. 363).

Green bonds can be zero-coupon or callable bonds, and municipalities, governments, corporations, and organizations can issue them. (Karpf & Mandel, 2018). That is, the basic structures of the green and conventional bonds are similar. However, assets claimed through green bonds contribute to so-called green investments in accordance with a sustainable standard giving it the 'green' label. Issuers decide to form the bond as green and are in charge of following the sustainability standards.

A comprehensive standardization system for green bonds has not yet existed, which has caused friction in developing the green bond market. The European Green Deal Investment Plan stated in early 2020 that the European Commission would announce an EU Green Bond Standard in the near future (European Commission). At least until the European Commission standards, the dominant Green Bond Principles (GBP) aggregated in 2014, were updated by a consortium of investment banks in 2018. This is the most recent set of principles, now managed by the International Capital Market Association (ICMA, 2018).

The current ICMA (2021) Green Bond definition states that:

"*Green Bonds are any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects -- and which are aligned with the four core components of the GBP.*"

Green Bond Principles are discretionary recommendations for issuers. This means that issuers are not obligated to follow all the components strictly. Nevertheless, the more precisely the components are fulfilled, the more likely third-party verifiers approve the bonds as Green Bonds. These verifiers evaluate the issuer's disclosed information and provide their independent second option about the bond, thus helping investors to make their

conclusions on the greenness (ICMA, 2021). The main intention is that companies would provide transparent information and details about the proceeds of green projects and give assurance to investors that the proceeds from green bonds are being used for environmentally sustainable projects. Thus investors, banks, and other market participants can rely on the green bond label. The components are:

1. Use of proceeds
2. Process for Project Evaluation and Selection
3. Management of Proceeds
4. Reporting

Use of proceeds refers to the obligation that the funds from green bonds must be allocated to green projects. The projects should have a clear, positive impact on the environment, such as preventing pollution, moderating global warming, and controlling the usage of natural recourses. However, the proceeds are not predetermined, and issuers may use the collected funds quite flexibly, use of proceeds must be 'green' enough in order to fulfil the requirements of the label. (ICMA, 2018).

The Process for Project Evaluation and Selection means that issuers should illustrate to investors the determinants that the project is eligible to label as a Green Project and state the sustainability target of the investment (ICMA, 2018). This component thus encourages issuers to increase the transparency of the investment process in order to diminish the possibility of greenwashing.

The Management of Proceeds component encourages issuers to separate the net proceeds of green bonds from other bonds. The net proceeds should be in balance with the allocations to Green Projects the whole time until the Green Bond expires (ICMA, 2018). Again, the importance of transparent operations is emphasized by the ICMA.

Reporting is the last of the four components. According to the component, issuing companies should provide available up-to-date information about the fund allocation. In

addition, issuers should show the development of Green Projects annually and demonstrate the impacts of the investments. These data should be in an accessible form so investors can effortlessly understand the investment process. (ICMA 2018).

2.2 Evolution of green bond market

The very first bond was issued in 2007 by the European Investment Bank (EIB) and was labeled as Climate Awareness Bond (EIB, 2020). The following year, the World Bank issued its first green bond targeted at institutions. After these two pioneering bonds, the development of the green bond market has been rapid. According to the CBI (2015) report, new green bond issuances were $36.6bn in 2014, leading the total cumulative issuances to exceed $50nb. Two years later, in 2016, the green bond issuances jumped to $81bn, as China entities joined the market with their $23bn issuances (CBI 2017). The total amount of issued green bonds set a record of $155.5bn in 2017, an 78% increase compared to the previous year (CBI, 2020). The strong trend has continued as the green bond issuances amounted $257.7bn in 2019 (CBI, 2020). In 2022 the cumulative amount of green bond issuances exceeded $2 trillion, while the total issuance was $332,5 billion (CBI, 2022). Although the volumes have gained a substantial increase among the improved interests, the green bond issuances are still shallow compared to the massive $123.5 trillion outstanding bond market in 2020 (SIFMA 2021).

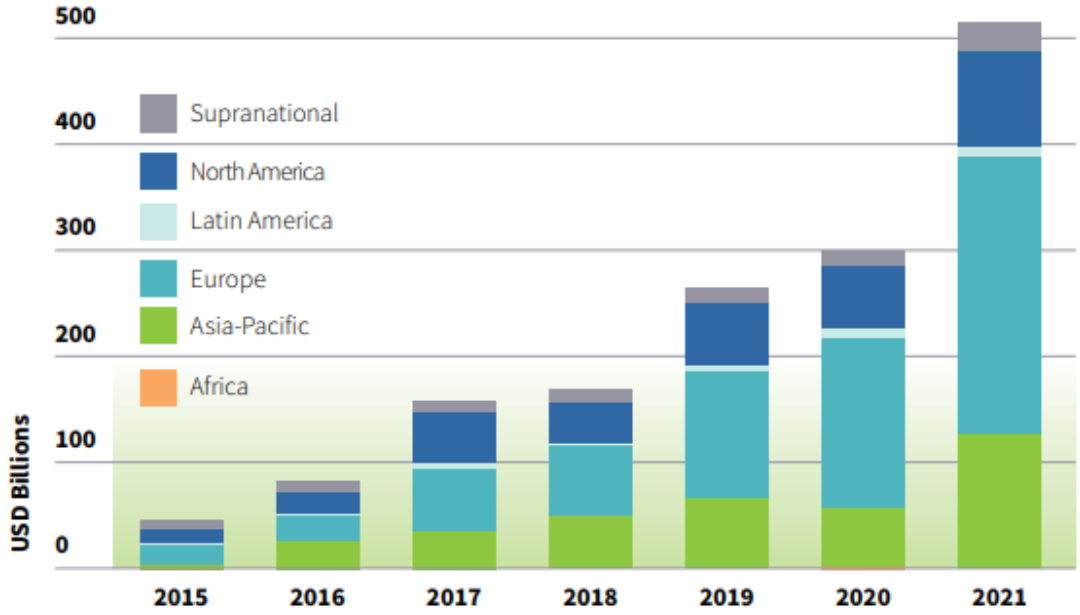

Figure 1. Green bond issuance volumes by region (CBI, 2021)

Companies were not involved in the green bond market at all until 2014. Since then, the accretion of corporate green bond issuances has been increasing annually. According to the CBI (2019), non-financial corporates accounted for a cumulative $59.3bn, representing 23% of the whole 2019 issuance. The development has been fast in this sector too, as the non-financial issuances exceeded $73 billion in 2022, being 22% of the total green issues. (CBI, 2022). The U.S., China, and France have been for several years the top three issuer countries. Their share of the total issuances in 2019 was 44%. France and China contributed $61.4bn together, and the U.S. $53.1bn (CBI, 2020). The U.S. dollar, Chinese Yuan, and euro are the most common currencies.

2.3 Green label in capital markets

Why would a company issue any bond as green when the same amount of debt could be earned through a conventional bond? There is no reason why a company could issue a conventional bond and use the proceeds to eco-friendly investments and save the trouble of certificating the bond, especially when the third-party assurance costs are approximately US $20 – 100 thousand, according to a report by Green Finance Study Group

(GFSG, 2016). However, as the market evolution illustrates, companies are willing to go through that trouble in order to issue their bond in particular as green.

Increasing awareness of the importance of sustainability among companies and investors is a significant driver behind the rapid development. When issuing a bond as green, a company wants to signal that it is also considering non-pecuniary factors. Thus, companies seek ways to demonstrate their commitment to sustainability and environmentally-friendly practices. By issuing green bonds, companies can showcase their dedication to reducing their environmental impact and transitioning to a low-carbon economy. Green bonds are also an effective tool for companies and governments to demonstrate compliance with environmental regulations and policies. Flammer (2021) studies the relationship between green bond issuances and corporates' environmental performance. She finds that after the issuance, the environmental performance improved by 8.7 percent, as measured by the ASSET4 rating. Similarly, CO2 emissions decreased by 12.9 percent on average.

In addition to only signalling effects, green issuances have other effects too that may drive companies towards green bonds. Tang and Zhang (2020) investigate institutional ownership of companies that have issued green bonds and find that the ownership increases by almost 8 percent after bond issuance. Institutions are thus interested in companies engaged with such companies. Furthermore, both institutions and other investors are more likely to hold their bonds and stocks to enhance their own ESG scores, making the issuer's bonds and stocks more resilient in market disruptions.

Tang and Zhang (2020) find correlations between companies' green issuances and stock reactions. Subsequent to issuances, the interest among investors increases in the company, which positively affects stock prices. They measure the bid-ask spread of issuers' stocks and show that the liquidity improves significantly. According to Tang and Zhang (2020) the result comes from the increased media attention, which leads to increased transactions in the stock market. Their finding supports the wider clientele aspect that Flammer (2021) also notes in her study.

2.4 Bond characteristics and green label enhancers

When investing in bonds, investors lend money to an issuing company. As a lender, a company's solvency is the primary determinant of the interest required on a loan. The importance of solvency is especially high for corporate bonds. If the risk that a company will not manage either the interest or principal payments is high, investors should raise the required return for bearing that risk. The face value and the bond's coupon rate are relevant factors when valuing the bond. The face value will be paid back at maturity, and the coupon determines the interest payments, either semi-annually, annually, or monthly. The issuer and credit rating could be perceived as firm-level characteristics, whereas the maturity date, coupon, and face value as bond characteristics. The characteristics are composed in Table 1 below.

Table 1. Bond characteristics (Gitman et al. 2011, p. 369 – 371)

(Issuer)	financial vs non-financial (zerbib)
Credit rating	Evaluation of solvency
Coupon	Fixed interest paid
Face value	Principal to be paid back at maturity
Maturity	Date of repayment of principal

Green bonds are typically similar to traditional bonds in terms of financial characteristics, such as maturity, coupon rate, and credit quality. In addition to the well-known universal bond characteristics, several additional characteristics are found to be green-enhancing factors. These factors are explained in this chapter and evaluated later in chapter seven.

Due to the discretional nature of reporting to investors on the use of proceeds, it is difficult to determine the environmental impact that the bond has precisely. Even though the standardization and third-party certifications help investors to evaluate greenness, they are not flawless. As an illustration, Krebbers (2019) explains in his article how the Mexico City Airport Trust claimed $6 billion through a green bond, and the proceeds were allocated for a new airport. Nevertheless, it is well known that the aviation industry is a major polluter in the world, ICMA’s Green Bond Principles were fulfilled, the bond was verified

by a second party, and it was finally awarded as a green label by two rating providers. Afterwards, the bond issuance raised a broad discussion about the ethics in the green bond market, and the label was strongly questioned. This drives green bond investors to learn the 'many shades of green', as Krebbers (2019) phrases.

In their study about the reliability of greenness, Kapraun et al. (2021) observe a few additional features that improve the reliability, thus impacting the premiums. According to the study, some bond and company-related characteristics are perceived as a positive signal to a bond's greenness, resulting in a more significant green premium.

2.4.1 Certification

The first characteristic that increases the credibility of green is a certification. The certification implies that the bond is accepted as green by a third party. European Commission is constructing its own green bond certification (European Commission, 2021) – the European green bond standard (EUGBS) – but at least until then, the most used green bond standards are ICMA's Green Bond Principles and CBI's Climate Bonds Standard. There are other standards as well, such as PBoC's China Green Bond Catalogue, and the ASEAN Green Bond Standards.

2.4.2 Currency

Interestingly, the yields of EUR-denominated bonds differ significantly from other currencies. For example, Kapraun et al. (2021) observe that EUR-denominated corporate bonds are traded at a clear premium, yet the premium is not as pronounced in other issuer types, such as supranational bonds or government bonds. One reason might be the high reputation of European regulation, and thus investors are able to rely on the greenness of EUR-denominated bonds. Moreover, the CBI (2017) report states that EUR-denominated bonds enjoy more demand and are more often oversubscribed than USD bonds.

2.4.3 Sector

The sector to which a company belongs can have an impact on how investors perceive its green bond. For example, companies in sectors that are seen as more environmentally damaging, such as oil and gas, may face greater scrutiny and skepticism when issuing green bonds. This is because these companies have a history of causing environmental harm and may be seen as using green bonds as a way to improve their image without making significant changes to their practices.

On the other hand, companies in sectors that are seen as more environmentally friendly, such as renewable energy, may be viewed more positively when issuing green bonds. This is because these companies are already working towards sustainable practices and may have a more robust track record of environmental stewardship.

2.4.4 Issued amount

Another indication of the greenness is the issued amount. Investors seem to perceive large issues to have a more credible environmental impact, as Kapraun et al. (2021) demonstrate. A large amount of green bond issuance signals that the issuing company is committed to sustainability and environmental responsibility. This signals to investors that the company is taking proactive steps to mitigate its impact on the environment and reduce carbon emissions. Furthermore, it can indicate that the company is financially stable and has a strong commitment to sustainability, which can be attractive to socially responsible investors who prioritize environmental concerns.

However, it is essential to note that the size of the bond issuance alone is not enough to guarantee the environmental impact or sustainability of the issuing company. Therefore, it is crucial for investors to evaluate the issuer's environmental and social practices thoroughly.

2.4.5 ESG-score

Investors in green bonds are increasingly using ESG scores and ratings to assess the credibility of green bond issuers. Higher ESG scores and ratings can signal a company's commitment to sustainability and improve the perception of its green bonds. ESG scores are numerical values assigned to companies based on their performance on various environmental, social, and governance issues. ESG ratings, on the other hand, provide a more comprehensive evaluation of a company's sustainability practices and are often provided by specialized rating agencies.

Investors in green bonds are increasingly using ESG scores and ratings to assess the credibility of green bond issuers. Higher ESG scores and ratings can signal a company's commitment to sustainability and improve the perception of its green bonds, as Hachenberg and Schiereck (2018) illustrate. In addition, investors may be more likely to invest in green bonds from companies with strong ESG scores and ratings as they are seen as less risky investments.

Kapraun et al. (2021) suggest that investors do not evaluate all green bonds equally, but they seek issuers that have an overall positive impact on the environment. In the context of green credibility, they estimate the reputation by the ESG score of a company and find evidence that the reputation of a company affects the premium at issuance. That is, the credibility can be improved by focusing on environmental, social, and governmental matters and thus being awarded higher ESG scores by a rating provider, such as MSCI or Bloomberg.

To conclude, green bonds can also have non-financial characteristics that make them distinct from traditional bonds. These non-financial elements often relate to the environmental and social impact of the projects that the bonds fund. Dan and Tiron-Tudor (2021) emphasize the increasing importance of the soft elements determining the performance of bond issuances. That is, these non-financial elements can make green bonds appealing to investors who are looking for investments that align with their values and support

positive environmental and social outcomes, which affects the bond subscription levels, issue prices, or interest costs. Moreover, an improved reputation can also be achieved with repetitive green issuances. Fatica, Panzica, and Rancan (2021) find evidence for an additional premium for repetitive issuers, implying that the issuer returning to the green bond market strengthens the trust of investors since the issuer is clearly determined to have a positive impact on the environment. The finding holds for non-financial corporate bonds in developed markets.

2.4.6 Risk of greenwashing

The powerful trend of sustainability induces a variety of companies to join the movement. Many companies are genuinely taking steps for more sustainable actions, yet there are also companies that have disingenuous objectives behind the announcements of their sustainability. While green bonds offer investors an opportunity to contribute to a more sustainable future, there is a risk of "greenwashing," where issuers make false or misleading claims about the environmental benefits of their projects. This can undermine investor confidence in the market and lead to a lack of accountability for issuers.

Greenwashing occurs when issuers make false or misleading claims about the environmental benefits of their projects. This can involve exaggerating the positive impact of a project or failing to disclose relevant information about the environmental risks associated with the project. Greenwashing can be particularly damaging for the green bond market, as it can undermine investor confidence in the credibility of green bonds as a tool for financing sustainable projects.

That is, they might exaggerate their greenness in order to induce investors, which means that the importance of the perceived green credibility of companies has increased. Investors cannot blindly trust the companies' announcements of sustainability. Thus they need to evaluate the green credibility on their own.

3 Literature review

When investors are screening their investment targets to meet the sustainability requirement, they are simultaneously narrowing their investing universe. Runneboog et al. (2008) emphasize that limiting the investing universe implies declined possibility for diversification, thus shifting the risk-return trade-off unfavourable compared to portfolios without such restrictions. That is, well-performing companies may be outside the investing universe due to their poor sustainability factor, and SRI-oriented investors are not able to invest in them. This ideology is thus controversial to the efficient market hypothesis. Similarly, Chan and Walter (2014) note as well that concentrating investment opportunities on sustainable alternatives is inconsistent with the classical finance theory, as the risk-return trade-off is not optimized.

The agency conflict is another aspect of fighting against the profitability of investing in companies that contribute strongly towards SRI and CSR criteria in their businesses. As Miller and Rock (1985) explain in their early study of how dividend policy may affect agency conflicts, Barnea and Rubin (2010) illustrate this by showing the negative relation between the CSR rating and insiders' ownership. CSR being mainly a pecuniary aspect for firms, high investments for improving the company's social rating can have negative consequences on the financial performance. Corporate management paying too much attention to its CSR rating may thus be destructive to shareholder wealth. The lower the insiders' ownership, the higher the CSR ratings, which demonstrates the agency problem.

Despite the aspects mentioned above, ESG-orientated firms' equity performance is not as poor as one might think. It is true that these companies are deliberately narrowing their business opportunities in order to act sustainably. However, investors seem to accept that. They are willing to give up their returns for the sake of goodness. Riedl and Smeets (2017) examine Dutch investors and find that they hold for socially responsible mutual funds despite the returns and Sharpe ratios being worse and the fees being higher. This finding illustrates the fact that non-financial criteria are gaining more value in decision-making

and will probably gain even more in the future as the amount investors considering the importance of CSR increases.

3.1 CSR and cost of debt

The linkage between CSR and the cost of capital has been under investigation for decades. Prior research by Goss and Roberts (2011) study how companies' CSR considerations effect on the costs of bank loans in the US between 1996 – 2006. They find a negative stance towards low CSR-rated companies as they pay up to 18 basis points higher interest rates on bank loans. However, they find no evidence that high CSR rates would decrease the interest rates, as high rates imply that companies put too much effort into their CSR, i.e., they are overinvesting to get better ratings. Magnanelli and Izzo (2017) end up with a similar conclusion in their global sample, as they investigate the interest rates on bank loans during 2005 – 2009.

Earlier, companies' CSR actions have been perceived more as an expense instead of risk management, at least in the case of bank loans. Ge and Liu (2015) and Oikonomou et al. (2014) studied the relationship between CSR scores and new bond issues and, interestingly, find the opposite result – better CSR performance leads to a lower cost of capital. By studying 4260 new bond issues in the US market during 1992 – 2009, they find that high CSR performance associates negatively to yield spreads, meaning that a strong CSR performance decreases the cost of capital, and weak performance increases, respectively. They also find that there is a positive relation between a company's CSR performance and credit rating. Since companies that have better CSR ratings are more often enjoying higher credit ratings, they need to control the credit rating in order to reduce the autocorrelation. However, a lower yield spread is still associated with strong CSR performance.

Huang et al. (2018) concentrate on China's bond market. They study the association between CSR performance and the cost of bonds from 2011 to 2015 and confirm Ge and Liu's (2015) finding of the negative relationship, where better CSR leads to lower cost of bonds (COB). Huang et al. (2018) refer to CSR as 'insurance-like effect', as companies with

high CSR performance are less risky for sanctions and litigations. That way, the risk premium on a bond can be reduced significantly. The opposite situation is with 'sin' equities, as their expected returns need to compensate for the higher litigation risk (Gormley & Matsa, 2011).

Unlike Huang et al. (2018), they examine the quality of disclosed information and find that the negative relationship between CSR disclosures and bond yield spreads varies. More specific, the negative association is stronger for firms with weak governance and if the firm is located in a region where the institutional environment is weak. In addition, voluntary CSR disclosures increase the association substantially compared to mandatory disclosures. The strength of signalling power is thus homogeneous, depending on the quality of CSR information.

3.2 Green premium and green credibility on the primary market

The prior research briefly represented above illustrates why this topic is interesting at the moment. When bank loans were not rewarded with lower interest rates, the bond market has interpreted CSR differently. Investors have appreciated the firms' CSR actions with the lover cost of bonds. In addition, the quality of information is an important factor, as shown by Gong et al. (2018). In the case of green bonds, the quality of disclosure translates into green credibility. This thesis sheds light on the yield differential between green and comparable non-green bonds and which determinants drive the premium.

Ehlers and Packer (2017) study the premiums at issuance of corporations by comparing the credit spreads of 21 bond pairs of the same issuers during 2014 – 2017. By comparing the same issuers' green and non-green bond issuances, firm-level idiosyncratic factors can be controlled. They find a mean spread of -18 bps, i.e. green bonds are issued at a premium of 18 bps on average. The standard deviation in their sample is 27bps, and five out of the 21 bonds were issued at higher spreads compared to conventional bonds. The variation of premiums is thus high, and they cannot comprehensively determine the drivers for the premium.

In a recent study, Fatica et al. (2021) study green bonds issued by supranational institutions, financial corporations, and non-financial corporations between 2007 and 2018. The focus is on global primary bond markets, and they collect their data from the Dealogic Debt Capital Markets database (DCM). The database recognizes 1,397 green bonds, of which 637 obtain either a second-party opinion or CBI certification. They seek yield at issuance differences using a 'green' as a dummy variable and a set of control factors. For the full sample of 1,397 bonds, they find that green bonds are issued at a premium, however the green dummy variable is insignificant. After dividing the sample into supranational, financial, and non-financial corporates, only the financial corporates subsample remains insignificant. In fact, financial corporate bonds seem to sell for a slight discount, whereas non-financial corporate bonds are issued at a 22 bps premium, and supranational bonds at 88 bps. The high premium of supranational bonds is justified by the established reputation of supranational institutions, according to the authors.

Furthermore, Fatica et al. (2021) investigate drivers for the premium. They find statistically significant evidence that non-financial green bonds obtaining a second party opinion or CBI's certification sell for 44 bps premium, compared to non-certified bonds' 22 bps premium. Similarly, repetitive non-financial corporates enjoy approximately 35 bps premium in relation to first-time issuers. Repetitive issuances thus improve issuers' reputation and decrease investors' cost of information, leading to higher premiums.

Kapraun et al. (2021) elaborate on the green credibility of bonds issued during 2009 – 2021, as they try to find drivers for a premium at the time of issue. They construct a sample of 658 bond pairs by using a strict matching method. Their first finding is that bonds issued by supranational entities and governments trade at a significant premium of around 18 bps, and corporates trade, in fact, at a significant 6 bps discount. However, after adding a EUR dummy, the result changes substantially – EUR-denominated corporate bonds sell now at a significant premium of almost 36 bps, while others trade at a discount. Hence, supranational and government bonds are reliable enough to enjoy a price premium, yet corporate green bonds trade at a significant premium only when issued in EUR.

The assumed reason for the result is that bonds issued in Europe align strictly with green bond principles, thus increasing the demand among investors.

The certification and size of issuance play an important role in determining the premiums. According to Kapraun et al. (2021), green certificated bonds are issued at a significant 24 bps premium, whereas non-certified bonds trade at a 24 bps discount. Hence, certified corporate bonds sell for a very clear premium compared to non-certified bonds at the issuance. Similarly, for small and large issues, certified bonds trade both at a significant premium. However, for large issues, the premium is approximately 35 bps, while it is only 16 bps for small and midsize issues. Certified, and especially large certified issues, are awarded substantial premiums. Investors can rely on those bonds to have a real positive impact on the environment, so they are willing to pay a premium for that decreased cost of information, as Fatica et al. (2021) phrased it.

Flammer (2021) finds no evidence for corporate green bond premiums in primary markets. From Bloomberg's fixed income database, she includes bonds that have the information of yield at issuance and are issued from January 2010 to December 2018. The sample consists of 152 green bonds from 65 issuers. Each bond is then matched with the closest possible conventional bond, according to their credit ratings, and by using the Mahalanobis distance. Four characteristics are considered in finding the bond pairs: the bond size, maturity, coupon, and the time of issuance. A weak difference is found in favour of green bonds, yet the result is statistically very insignificant.

Gianfrate and Peri (2019) employ a propensity score matching method to study if it is more convenient to issue green bonds over conventional bonds. Their sample consists of bonds issued during 2007 – 2017, and they investigate bonds issued in EUR. After the data cleaning process, which eliminates bonds with different interests, issue sizes under EUR 200 million, junk bonds, and bonds that are not priced using European rates, they select 781 corporate bonds, of which 43 are green. They find that, on average, corporate green bonds are more convenient to issue, as they are traded at a significant 21 bps premium. This

implies that companies pay around 0.2 percent lower returns for investors in the primary market, thus decreasing their cost of debt.

3.3 Green premium on other bond markets

The closest studies related to this thesis are introduced in the previous sub-chapter. As can be seen, the primary green bond market, especially the corporate green bond market, is still short of research. The majority of studies on green bond premiums investigate secondary markets. Slimane et al. (2020) suggest that the strong focus on secondary markets is due to the unstable supply and demand conditions in the primary bond market. However, this can be controlled by considering the fixed time effects. Due to the lack of studies on corporate green bond markets, studies on other markets are represented as well.

Karpf and Mandel (2018) investigate the term structure of U.S. green municipal bonds and show how the value of the green label on bonds has changed over time. As they study bonds issued during 2010 – 2016, they find that green bonds were penalized for the first five years of their sample period. More specific, in order to invest in green bonds, investors required an additional 7.8 bps yield compared to conventional bonds. Interestingly, their pricing premiums turned positive during the years 2015 and 2016. They suggest that the green label created suspicion towards such bonds at first, yet as the green bond market is saturated, investors' attitudes changed, and the green label was valued at a premium. Febi et al. (2018) end up with a parallel result by investigating yield spread differences between green and comparable non-green bonds in secondary markets. During the first years of their sample period, there is no significant difference between the bonds. However, in 2016, the non-green bonds' yield spread exceeded the green bonds' spread by 69.2 bps. Febi et al. (2018) suggest as well that the maturation of the green bond market explains the result. This changing value of the label is similar to the evolution of CSR and the cost of debt, as illustrated at the beginning of this chapter. At first, CSR and companies' engagement in green investments is perceived as a negative factor to businesses. Later, as these aspects have become more relevant, they actually help companies access to finance, and to lower the cost of capital.

Karpf and Mandel's (2018) research was criticized as they do not consider the effect of taxation on green bonds. Baker et al. (2018) emphasize that taxation significantly impacts the pricing of U.S. municipal bonds. That is, opposite to Karpf and Mandel (2018), they do not find such positive yield premia, but an average of 6 basis points premium at issuance, and this result is after-tax premium. Their sample consists of 2,083 U.S. municipal bonds during 2010 – 2016, and they employ the OLS method. Similar to Fatica et al. (2021), Baker et al. (2018) find how significant is the external certificate on green bonds – the premium is up to three times higher for CBI-certificated bonds versus self-labeled bonds. More specific, with similar characteristics and timing, conventional bonds have 26 basis points higher yields than certified green bonds, as green bonds are priced at significantly higher prices.

The most extreme premium found so far is the one by Nanayakkara and Colombage (2019). They investigate 27,953 daily observations during 2016 – 2017 globally, and they use Option Adjusted Spread (OAS) method to compare the credit spreads between green and conventional bonds. After controlling bond-level characteristics, macroeconomic factors such as GDP, and global features influencing the credit spreads, they find a substantial premium of around 63 basis points for green bonds. While a majority of studies use the yield spread to compare the pricing differences, Nanayakkara and Colombage (2019) argue that the credit spread would be more relevant to be investigated. The main reason to prefer credit spread over yield spread is the difficulty of identifying bond pairs between GBs and CBs, according to them. By studying the credit spreads, they are thus able to utilize bonds with varying maturities and cash flows and find that corporate bonds carrying a green label are priced at a clear premium. They emphasize that corporates have a strong incentive to issue their new bonds as green due to the lower cost of capital.

Zerbib (2019) finds evidence for a small but significant premium for green bonds on the secondary market. The sample consists of a variety of bonds, such as corporate, supranational, financial, and municipal bonds, and the sample period is between 2013 and 2017.

For every green bond, he constructs a synthetic bond pair from two conventional bonds bearing as similar characteristics as possible. That is, both the green and the synthetic bonds must match by their coupon type, rating, seniority, structure, and currency. Moreover, the size and time of issuance are controlled so that the only thing separating these bonds is the greenness. By employing a fixed-effects panel regression to the matched bonds, a significant 2 basis points premium is detected.

In consistence with Karpf and Mandel (2018), and Febi et al. (2018), Zerbib (2019) find evidence for the premium to remain negative from 2016 onwards. This confirms the suggestion that the green bond market has been suffering from uncertainty and lack of knowledge among investors, but it has become more mature in recent years. In Zerbib's (2019) study, the type of issuer and credit rating are significant drivers for the premium. For the full sample, the average and median premia are 1.8 bps and 1 bps, respectively. Financial bonds exhibit an average premium of 2.3 bps, and AA-rated bonds 2.9 bps premium. Although the premiums are small, these results are highly significant at the 99 percent level of confidence. Both EUR and USD-dominated bonds show significant premiums compared to other currencies.

Larcker and Watts (2020) find no significant pricing differences between green and conventional bonds. Their sample consists of 640 strictly matched municipal bond pairs, and the sample period is between 2013 and 2018. According to their observations, the vast majority of green and conventional bonds are priced identically at the time of issuance. Although they show a slight pricing difference, the result is explained by a few extreme outliers in the sample. They show that around 85 percent of the yield differentials are zero. However, 40 percent of the outliers indicate the pricing premium to be positive and 60 percent negative, illustrating that municipal green bonds are more likely to be traded at a discount rather than a premium. They believe that prior studies have either matched the green and non-green bonds insufficiently or the employed methodologies have not been accurate enough to investigate the impact of greenness on bonds. These lead to the mixed results of high green premium or green discount.

4 Data and methodology

This chapter presents the data and methodology utilized in this thesis. The main point is to study whether green bond premium depends on the bond and firm characteristics. Before that, however, it is interesting to check if green bonds are issued at a premium compared to conventional bonds. Thus, two bond portfolios are constructed – green bond portfolio and conventional bond portfolio. These portfolios or otherwise close to identical, except for the green factor that is under investigation.

4.1 Data collection and sorting

The bond data is gathered from the Refinitiv Eikon database provided by the University of Vaasa. Numerous variables can be obtained from the database, which are used for the matching procedure and evaluating the premium differences within green bonds. Since the green bond market is relatively new, the first green bonds issued between 2007 – 2013 are extracted from the examination due to the insignificant quantity. That is, the bond sample consists of bonds issued between 2014–2021.

The raw data gathered from the Refinitiv Eikon consisted of approximately 80.000 conventional corporate bonds and 1.400 green bonds. In this thesis, only bonds with fixed coupon type are examined to simplify the results. After eliminating bonds missing a Moody's rating that the database provides, the remaining sample consists of only a few other than EUR and US Dollar dominated bonds, so this thesis elaborates only on EUR and US Dollar dominated corporate bonds. At this point, 307 green bonds are left. For further examination where the green premium drivers are examined, ESG scores are collected from the Sustainalytics database that provides ESG scores for 259 green bonds.

4.2 Bond pricing

The basic idea of bond pricing is to value the future cash flows a bond offers to its present value. Each coupon and the principal payment at the maturity is discounted by the required yield of return, which then produces the present value of a bond:

$$P_o = \sum_{t-1}^{n} \frac{I_i}{(1+i)^t} + \frac{PV_n}{(1+i)^n} \frac{I_i}{(1+i)^2} \quad (1)$$

where,

P_0 = estimated value of a bond
I_t = coupon payment
I = required return
PV_n = Par value at the maturity
n = number of years to maturity (Gitman et al., 2011, p 413).

This model is the basic idea of determining the bond price at the time of issuance. Hence, from the fundamental point of view, green and comparable non-green bonds should be priced equally. If not, the difference could be interpreted as a market anomaly since there is no fundamental reason to pay a premium or discount for a bond with identical characteristics. However, if the required return varies due to investors' preferences for non-pecuniary characteristics, it has an impact on the bond price. An assumed positive environmental impact that a bond will have, for example, may be a reason for investors' willingness to lower their required return for the bond. The lower the required return for a bond, the higher the price investors are willing to pay for it.

The required return is also referred as Yield-To-Maturity (YTM), and it is the most employed measure to value bonds (Gitman et al., 2011, p. 416). YTM consists of all the basic ingredients of the valuation – interest payments, price appreciation, and future cash flows. Hence, YTM is the rate of return that an investor gains, with the assumption that the bond is held to maturity, the issuer overcomes all the predetermined payments, and the reinvestment assumption is fulfilled.

4.3 Evaluating pricing differences

As stated above, a matching method is utilized in this thesis. The difference between green and conventional bond issue prices could be evaluated by ordinal regressions as well and use the greenness as a dummy. However, a clear consensus has not been achieved within previous studies, as presented in the literature review. The main reason for that may be the problem of multicollinearity. When studying the issuing price differences by ordinal regressions and using the greenness as a dummy, there is a high risk for multicollinearity. This problem can be reduced by utilizing the matching method, similar to Kapraun et al. (2021).

The first step is to determine whether green bonds are issued at a premium compared to conventional bonds. The first research question thus is:

1. Are green bonds issued at a premium compared to conventional bonds?

The null hypothesis states that there is no statistical premium over ordinal bonds, but they are issued at equal prices. On the contrary, the alternative hypothesis states that there is a difference between the two bond issuances:

H_0 = The average issue prices of green bonds are equal to conventional bond issuances

H_1 = The average issue prices of green bonds vary from the conventional bond issuances

4.3.1 Matching method

The first step is to find for the 307 green bonds a conventional bond pair by the same issuer. By matching the issuers, several qualitative characteristics can be controlled simultaneously, such as reputation, company's maturity, and location, that might influence the issuing prices. Other variables that must be the exact same are 1) currency, 2) Moody's rating, 3) coupon type, 4) the frequency of interest payment, and 5) debt seniority. Other

variables that cannot be matched exactly to the green bond, are controlled as follows: 6) coupon rate must not be less or more than 0,5% compared to the green bond pair, 7) the issued amount must be between 25% and 400% of the green bond issuance, 8) the issue date must be maximum of five years before or after the corresponding green issuance, 9) the bond maturity date must be maximum of three years before or after the corresponding green bond. After conducting the matching process, 75 bond pairs are found. The matching procedure utilized in this thesis is parallel to the matching method that Zerbib (2019) use in his survey.

4.3.2 Mann-Whitney U-test

In order to evaluate the different issue prices between the portfolios that are constructed, Mann-Whitney U-test is conducted. Ordinal t-tests apply poorly to this evaluation due to the non-normally distributed population. The distribution of issue prices is presented in Figure 2.

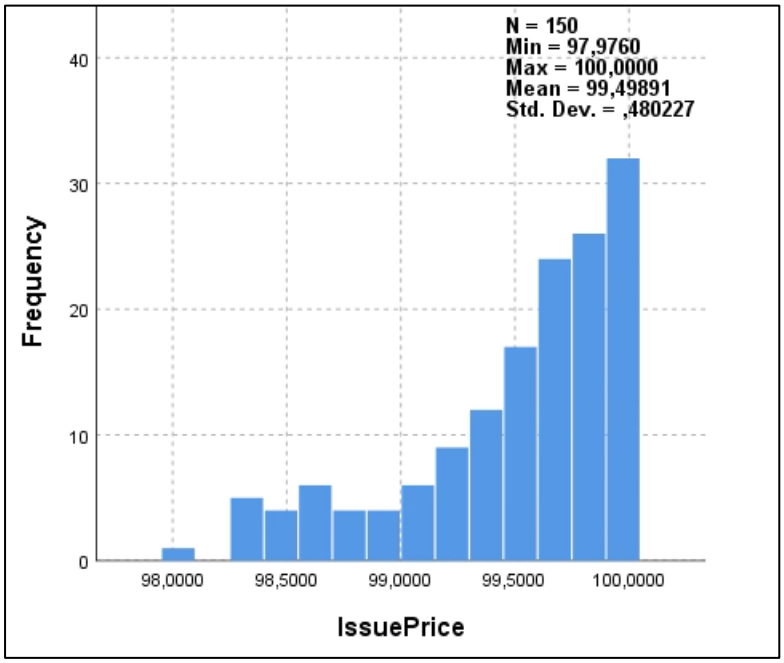

Figure 2. Distribution of issue prices of the data set

Hence, non-parametric Mann-Whitney U-test is more suitable for testing two independent samples where the sample variances are close to each other. To ensure the test suitability and the similarity of sample variances, F-test is conducted. As can be seen in the figure below, the variances are almost equal.

F-Test Two-Sample for Variances		
	Issue price green	*Issue price brown*
Mean	99,53	99,47
Variance	0,2307	0,2320
Observations	75,00	75,00
df	74	74

Figure 3. Statistics for the green and brown samples

Mann-Whitney U-test can be applied when estimating the difference of distribution of two samples, i.e the distribution of green bond issue prices is higher or lower than conventional bonds', or vice versa (Nummenmaa, 2009, p. 261). The U-statistic is stated as follows:

$$U = n_1 \times n_2 + \frac{n_1(n_1+1)}{2} - R_1 \qquad (2)$$

,where

U = U-statistics

n_1= Observations in sample 1

n2 = Observations in sample 2

R1 = The sum of ranks

4.4 Drivers for green credibility

The second part of the thesis examines the variety of characteristics that may influence the issue price of green bonds. Here, the assumption is that investors differentiate green bonds from each other, depending on the green credibility of the bond. As mentioned earlier in this thesis, the fact that the green bond market has expanded significantly during recent years and the green bond framework is still fragmented, there is a reason to assume the "greenness" of bonds to vary within green bonds. Thus, it is interesting to investigate whether investors are willing to pay a premium for other green bonds and undervalue others. The second research question is thus:

2. Do bond characteristics have an impact on green bond issue prices?

This thesis examines the green credibility by six variables, which are parallel with the survey by Kapraun et al. (2021). These variables are certification, sector, low ESG risk and high ESG risk, large issue amounts, and a green exchange variable. The certification variable is one of the most critical factors when evaluating the greenness of a bond. Certification should increase the trust among investors that the bond, in fact, is green and the bond proceeds are allocated to green projects. The sector variable is taken into account, since interesting to investigate if the sector where a company operates influences the issue prices. ESG ratings are separated into two dummy variables – bonds that carry low ESG risk, and bonds that are evaluated to carry very high or severe ESG risk. The ESG scores are collected from the Sustainalytics database. Similar to Kapraun et al. (2021), the largest quartile of the sample comprises the fifth factor. Large issues are included in the green-credibility variables due to their significant impact aspect. The more significant the issue amount, the more positive impact bond is assumed to have. The last variable is the green exchange factor. Bonds that are included in the Luxembourg Green Exchange (LGX), are assumed to be priced at a premium compared to other bonds. The reason is that the LGX has strict requirements for bonds to get listed there. This is assumed to improve the green credibility among investors. The studied drivers are represented in the below Table 2 as well.

Table 1. Green-credibility enhancing characteristics

Certification	Dummy variable whether the bond has a third-party certification or not
Sector	Companies are divided by their sectors
Large issues	The largest quartile of data sample
LGX listing	Dummy variable whether the bond is listed in LGX or not
Low ESG risk	Sustainalytics rate of ESG risk of 20 or under
High ESG risk	Sustainalytics rate of ESG risk of over 20
Rating	AAA rated are coded as 18, and lowest rated bond as 1.

From the research question above, zero and alternative hypotheses are constructed as follows:

H_0 = Green bond issuing prices are not driven by individual bond or issuer characteristics

H_1 = Green bond issuing prices are driven by individual bond or issuer characteristics

The interest is to evaluate such green premium enhancers and find out whether investors are willing to pay premium for green-credibility or not.

4.4.1 Testing the green credibility variables

This section examines green bonds only, as the data sample consists of 259 green bonds as explained in subchapter 4.1. Issue prices are thus compared within green bonds, so this thesis does not consider greenness as a dummy variable, which would be another method

to evaluate the green-credibility aspect. Here, the 259 green bonds form a bond sample that is analysed.

To study the impact of represented characteristics on the issue prices, a cross-sectional analysis is conducted. The cross-sectional least-square regression analysis is a suitable method to analyse the effects, as the main interest is at the time of bond issuance. Thus the dependent variable, Yield at issue, and the control variables are associated simultaneously. In order to test the second hypothesis H2 of the thesis, the following regression is applied:

$$Y_b = B_0 + B_1(LogAmount) + B_2(Coupon\ Freq.) + B_3(currency) + B_4(Life\ at\ Issue) + B_5\ (controls) \quad (3)$$

, where

Y_b = Yield of bond b

B_0 = constant

B_2 = The frequency of coupon payment

B_3 = currency coded 1 if bond is EUR, 2 if USD

B_4 = Bond maturity at the time of issuance

B_5 = controls applied in the study.

The equation above is the basic equation conducted in the thesis. The controls presented above are added into the equation as B_5 control variables. The equation is run several times. Minor adjustments have been made to the equation during the analysis, and they are explained in the next chapter.

5 Empirical results

5.1 Results for the green premium on green bonds

In order to test whether green and conventional bonds' issuance prices vary with each other, a Mann-Whitney U-test for independent samples is conducted. Both samples consist of 75 bonds (N = 75) that are matched with each other. The mean rank of 78,29 is slightly higher for green bonds compared to conventional bonds of 72,71. This may indicate a weak signal for the existence of a green bond premium. The distribution of issue prices is presented above, 1 indicating green bonds and 0 for conventional bonds.

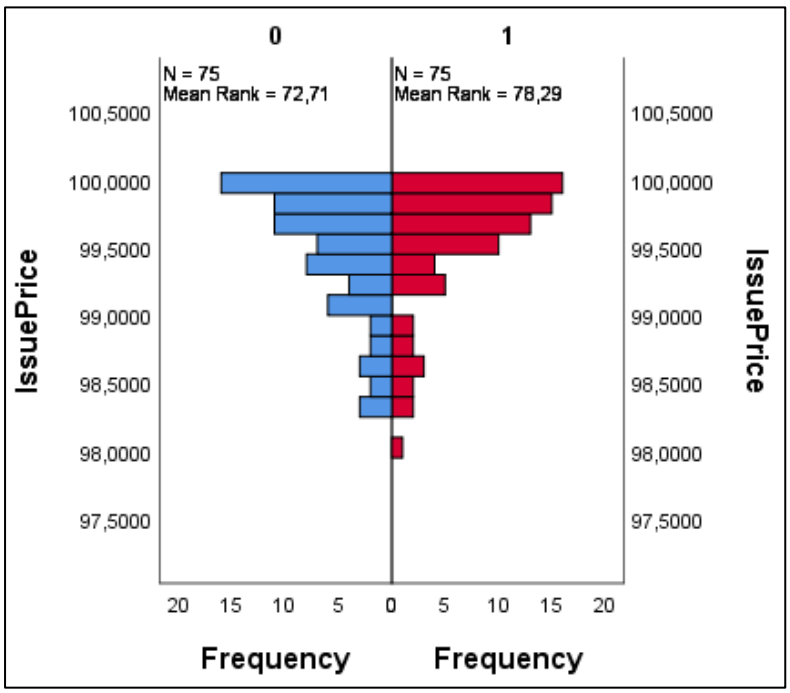

Figure 4. Distribution of issue prices between green and conventional bonds

The test statistics of the U-test shows that the sum of ranks for conventional bonds is 5453,50, and 5871,50 for green bonds. Thus, the sum of rank is higher for green bonds. The value of independent-samples Mann-Whitney U is 2603,50 for the test, and the Z

value is -0,786. The p-value is 0,432. Due to the high p-value the null hypothesis will be retained since it exceeds the significance level of 0,05. Although there are signs of a variety of issuance prices between green and conventional bonds, there is no statistical difference between the two bond groups.

5.2 Results for the green credibility factors

To estimate the impact of green credibility factors on issuing prices, six regressions are run with OLS cross-sectional model. The dependent variable is the price of a bond at the time of issuance, and the regressed control variables are presented in the table above. The model illustrates the base model, and models 2 – 6 estimate the impact of green credibility factors. The coefficients are quite low, albeit statistically significant in several models. Similarly, standard errors that are reported in the parentheses are low, indicating that the observations are close to the fitted lines. The values are rounded to three decimal points, thus there are some values reported as zero value.

Table 2. The impact of green credibility factors on issue prices.

Model	(1)	(2)	(3)	(4)	(5)	(6)
Sector		0.014				
		(0.020)				
Certification			0.100*			
			(0.059)			
LGX				0.227**		
				(0.114)		
Large issues					0.162	
					(0.103)	
Low ESG risk						-0.062
						(0.062)
High ESG risk						0.054
						(0.072)
Rating	-0.020*	-0.021**			-0.012*	
	(0.010)	(0.010)			(0.010)	
Log amount	-0.250*	-0.252*	-0.316**	-0.320**	-0.422**	-0.346**
	(0.145)	(0.144)	(0.140)	(0.139)	(0.179)	(0.148)
Coupons	0.319	0.265***	0.291***	0.305***	0.244***	
	(0.188)	(0.06)	(0.062)	(0.063)	(0.061)	
Currency	-0.056					
	(0.185)					
Maturity	-0.011***	-0.011***	-0.012***	-0.012**	-0.011**	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	100.908***	100.888***	100.976***	100.995***	101.909***	100.067***
	(0.841)	(0.840)	(0.837)	(0.834)	(1.042)	(0.128)
Observations	255	255	255	255	255	255
R^2	0.181	0.182	0.177	0.180	0.189	0.138
Adjusted R^2	0.164	0.166	0.164	0.167	0.172	0.120

Note: Standard errors are presented in parentheses. *, **, and *** illustrate the statistical significance of 10%, 5% and 1%, respectively.

The results of estimating the impact of green-credibility drivers on issue prices are presented in Table 3. The dependent variable is the bond issue price. That is, when the coefficient is negative and statistically significant, the variable is estimated to decrease the issue price. On the contrary, positive and significant variables are estimated to increase the price. In this case, the yield of a bond decreases, indicating that investors are willing

to accept lower yields in order to invest in more environmental-friendly bonds. Model 1 estimates the drivers accordingly the equation (3) presented in Chapter 4. The first model acts as a basic model, which is further adjusted during the examination.

Model 2 is otherwise similar to model 1, only the currency variable is replaced with the sector variable. In this model, the impact of the sector is estimated to be statistically insignificant, p-value being 0.4475. According to the finding, the pricing of green bonds does not vary between different sectors, for instance electric service and transport.

The result of the model 3 indicates that third-party certification has a clear impact on bond prices. The certification decreases the yield up to 10 bps, and it is statistically significant at 10% level. The finding is parallel to Hyun et al. (2019), who find a 7 bps decrease in yields, and Kapraun et al. (2021), who estimated the difference to be 24 bps when comparing conventional bonds and certified green bonds. Similarly, Fatica et al. (2021) state in their study that investors are accepting lower yields when investing in corporate green bonds. Among diversified results on whether green bonds are issued or traded at a premium, the third-party certification tends to have the most explaining power, as mentioned in this thesis.

Model 4 conducts an interesting finding, as the LGX variable constitutes up to 23 bps increase on issue prices. This indicates that investors accept significantly lower yields on bonds that are listed on a green exchange. However, the Durbin-Watson statistic of 0.283 implies that there is a serial correlation. The serial correlation might derive from the fact that the Luxembourg green exchange requires all listed bonds to be certified, and the bonds tend to have high credit ratings. That is, after the robustness test of serial correlation, the LGX dummy variable becomes statistically insignificant.

Conducted regressions estimate log(amount) control variable to be consistently negative, implying that an increase in issued amount decreases issuing prices, which thus leads to higher bond yields. Model 5 estimates the relation between exceptionally large issuing

amounts and the issuing prices. Interestingly, the sign of the coefficient changes to positive, albeit insignificant. Even though the log(amount) control variable is consistently negative, there is some indication that investors may perceive the largest issues to have a more positive impact on issuers' way of doing business. However, the finding is statistically insignificant, and thus large issues cannot be interpreted as enhancing the green credibility.

Lastly, model 6 estimates the relation of ESG risks to issuing prices. Some studies, such as Hyun et al. (2019) and Baker et al. (2018), find that positive ESG reporting and ESG scores decrease bond yields since investors are willing to pay higher prices on bonds that carry less environmental risk. In this thesis, companies' ESG risks are collected from the Systainalytics database, and the issuers are divided into two groups – low ESG risk and high ESG risk depending on their ESG scores. In contrast to Hyun et al. (2019) and Baker et al. (2018), low ESG risk is estimated to decrease prices, and high ESG risk to increase, respectively. Both results are, however, highly insignificant. Thus ESG risk is not perceived as a green enhancing variable among investors.

5.3 Discussion

The fact that there is no significant pricing difference among a variety of sectors is interesting. In general, it could be assumed that bonds issued by companies operating in high-emission sectors, such as transportation, were penalized by investors in the sense of lower prices. Another interesting finding is that ESG risk does not have a statistically significant impact on prices. One explanation could be that the ESG score accounts for social and governmental risk as well, and thus high governmental risk, for instance, biases the overall ESG score at some level. In addition, if a company that possesses a high ESG risk issues a green bond, that may signal that the company is taking steps to improve its environmental issues, which is awarded by investors.

As assumed, certification is still an important green credibility aspect. Seems that investors rely on third-party verifiers. It is true that it may be relatively difficult to evaluate the greenness by studying bond issuances. Moreover, since the green bond standards and principles are still fragmented, investors pay a lot of attention to the certification. If the standards are more united in future and investors can rely on the greenness of a green bond, the aspects studied in this thesis will gain more materiality.

6 Conclusions

In recent years, the issue of climate change has become increasingly urgent, and the need for environmentally sustainable investments has never been greater. At the same time, many investors are looking for investment opportunities that not only generate financial returns, but also have a positive impact on the environment. Green bonds have emerged as one way to bridge this gap between the need for sustainable investments and the availability of investor funds. Green bonds are debt securities issued by companies, municipalities, and other entities for the purpose of financing environmentally sustainable projects. These bonds are typically used to finance renewable energy projects, energy efficiency upgrades, and other environmentally friendly initiatives. The proceeds from these bonds are earmarked for specific projects, which are required to meet certain environmental criteria.

Ehlers and Packer (2017) study the premiums at issuance of financial and non-financial companies. They find that green bonds are issued at a premium of 18 basis points on average during 2014 - 2017. Fatica et al. (2021) find that non-financial corporates to issue green bonds at a premium of 22 basis points. They also find evidence that financial companies issue green bonds at a discount, however the result is not statistically significant. Karparaun et al. (2021) study corporate green bonds between 2009 and 2021 and find that EUR-dominated bonds sell for a clear 36 basis points premium. Kapraun et al. (2021) also elaborate their study to investigate the green credibility of bonds by focusing on bond determinants. Here, large and certified issues are found to lead to significant positive premiums.

The objective of this thesis is to investigate whether green corporate bonds are issued at a premium. The premiums on green bond issuances are evaluated by a matching method, similar to Zerbib (2019) and Kapraun et al. (2021). After strict matching procedures, green and non-green bond issue prices are found not to be significantly different, albeit there is weak evidence that green bond issue prices are slightly higher than their non-green counterparts. However, the results show that the difference is statistically insignificant.

Further, this thesis examines whether green bond characteristics drive the green premium in green bonds. There the main findings are that the sector does not affect the premiums. Certification is found to be a significant factor, as the certified bonds are issued at a premium of 10 basis points. Similarly, if the bond is issued at Luxembourg Green Exchange increases the premium by almost 23 basis points. However, after a robust test of autocorrelation, the significance turns out to be statistically insignificant. Another interesting finding is that ESG risks are not found to be significant determinants.

There are several intriguing aspects to investigate in the relatively new field of corporate green bonds. Firstly, given that the European Green Bond Standard is expected to become more comprehensive in the future, it would be interesting to investigate how this development will affect the pricing of green bonds and their impact on investors. Secondly, as the green bond market continues to expand, there will be more data available to investigate the relationship between green bond characteristics and the pricing of these bonds.

Furthermore, research can also focus on the signalling power of green bonds and how the issuance of these bonds affects a company's reputation and perceived greenness. This can help shed light on how companies can use green bonds as a tool to attract socially responsible investors and enhance their image as environmentally friendly organizations.

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