# What drives the sustainability premium? The influence of credit risks and maturity effects on sustainable bonds.

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January 31, 2023

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## Abstract

Sustainable finance has evolved majorly from green bonds to include social, sustainable, and sustainability-linked bonds. A rich literature has focused on the pricing differences between green bonds and non-green comparable bonds exploring the existence of a greenium.

This paper proposes to estimate a sustainable premium on sustainable bonds and further explores its driving forces. In order to estimate this premium, we use a matching method to estimate the yield differential between listed sustainable bonds and comparable conventional bonds traded on the European secondary market between January 2018 to March 2022.

Our results suggest a small positive premium indicating that the yields on sustainable bonds are higher on average than the yields on comparable conventional bonds. It iterates the signaling theory where issuers pay for sustainability improvement and signals a commitment to sustainability targets whilst investors benefit from a premium. On average, the premium is 1.6 basis points for our sample. Our results show that both credit risks and maturity period of the bonds have significant impact on the sustainability premium.

Keywords: Sustainable Bonds, Sustainability Premium, Credit Risks, Maturity Effects

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JEL Classification: G10, G14, G20, G3

# 1. Introduction

Amidst the diverse challenges of the 21st century, climate change mitigation remains a global priority and continues to resonate most international agreements. The private and public of financial industry has already taken engagement to help with the transition to a net-zero economy by 2050 (OECD, 2017).

In this respect, climate finance refers to financing that comes from a variety of public, private, and non-governmental sources. In order to make meaningful reductions in emissions, large-scale investments in climate mitigation necessitate climate finance. To deal with the negative effects and decrease the negative impacts of climate change, sustainable financial investment is required (Bakken, 2021).

Climate finance is vital for adaptation and mitigation of climate change. In the wake of this development, the global financial landscape is witnessing an evolution of sustainable financing as the current COVID-19 pandemic has highlighted the need to not only address the impact of climate change on the environment but also to uncover measures to sustainably recover from the adverse social impacts (Tolliver, Keeley & Managi,2020). An increasing amount of private sector support for sustainable finance, national policies for sustainable financing, and academic research into sustainable finance all point to a growing awareness of the need of sustainable finance (Kuhn 2020; Cunha, Meira, and Orsato 2021; Thistlethwaite 2014). Sustainability in finance has been defined by several academic research. To put it another way, Ryszawska (2016) defines sustainable finance as financial support for sustainable development in three combined dimensions: the economic, the ecological and the social. A sector or activity is defined as sustainable if it contributes to the attainment of at least one of the necessary sustainability characteristics, according to Migliorelli (2021). Sustainably financed investments consider environmental, social, and governance (ESG) considerations, according to Gerster (2001).

Investing decisions in the financial sector should consider environmental, social, and governance (ESG) factors, according to Ozili (2021). Investment decisions that consider environmental, social, and governance (ESG) factors are referred to as sustainable finance by Bakken in 2021. According to Sommer (2020), sustainable finance is the mobilization and distribution of capital to support a more sustainable economy. Sustainable finance, according to the International Capital Market Association, includes climate, green, and social finance, as well as considerations for the organizations receiving funding in the long term, as well as the function and stability of the financial system (ICMA 2020).

Total worldwide green, social, sustainability and sustainability-linked bond issuances have reached a cumulative volume of USD 3.3 trillion in the first half of 2022 of which USD 1.9 trillion is attributed to green bonds (CBI, 2022). Sustainability bonds, like green and social bonds, have grown steadily since their debut. The first sustainability bond went on sale in 2012 to finance both environmental and social initiatives. Also, a growing number of business practitioners and regulators are embracing sustainable bonds to balance the interests of both shareholders and stakeholders at the same time (OECD, 2019).

The motivations of investors and issuers of green bonds have been largely examined. Companies are issuing green bonds for a variety of reasons, according to Flammer (2021), including signalling, greenwashing, and financial justifications. The primary reason is to send a message to investors about a company's dedication to environmental stewardship. In the second case, green bonds are being used as a greenwashing tactic, in which case the company is simply pretending to be environmentally conscious. The final reason is to reduce the cost of capital. Flammer’s findings are consistent with the signalling theory, which states that corporations use green bonds to communicate their commitment to the environment.

By studying sustainable bonds (SBs), we add to the literature on sustainable finance. SBs are compared to their non-sustainable counterparts to see how much they cost, who pays for the sustainability (that is positive or negative premium), which we explore in our study and what factors drive the sustainability premium. The primary objective of this research is to broaden and enhance the literature on sustainable finance from a primary focus on green bonds to include other sustainable finance instruments especially sustainability bonds. We address two main questions. First, whether there is a premium on sustainable bonds listed on the European exchange as compared to conventional bonds. Secondly, we investigate the research question of what factors drive the sustainability premium. To test this hypothesis empirically, we examine whether there is sustainability premium, that investors are willing to pay or benefit from to subscribe to investing in sustainable bonds. As an example, we study sample of sustainable bonds listed on the European markets issued between 2018 and 2022, and compare their yields to conventional bonds across every metric (issuer, maturity, coupon, currency, rating). Sustainable bonds do not have a large premium, which suggests that investors' interest in this sustainable product does not lead to an increase in bond prices and lower loan costs for issuers. It further reiterates that issuers are willing to issue these bonds at a higher cost which confirms the signalling theory. Although there is a lot of traction on green bonds in terms of literature, there is very little work done on exploring the premium on sustainable bonds and the factors that influence the premium. To the best of our knowledge, this paper will contribute to bridging the literature gap in this regard.

Our paper proceeds as follows. Section 2 highlights the theoretical framework, literature review and hypothesis development. Section 3 describes research design and methodology, the results and discussion, conclusion and recommendation and future research.

## 2. Theoretical Framework, Literature Review & Hypothesis Development

### *2.1. Theoretical Framework*

According to the ICMA, sustainability bonds are issues where proceeds are used to finance or re-finance a combination of green and social projects or activities. These bonds can be issued by companies, governments, and municipalities, as well as for assets and projects and should follow the Sustainability Bond Guidelines from ICMA, which are aligned with both the Green Bond Principles (GBP) and Sustainable Bond Principles (SBP). They can be unsecured, backed by the creditworthiness of the corporate or government issuer, or secured with collateral on a specific asset. The doughnut economic theory can be used to explain the advent of sustainability bonds, where activities funded results in both positive environmental impact and necessary social progress. The theory of the doughnut formula is a change of economic model as a response to humanity's major challenge: eradicating global poverty all within the means of the planet's limited natural resources. The Doughnut consists of two concentric rings: a social foundation, to ensure that no one is left falling short on life's essentials, and an ecological ceiling, to ensure that humanity does not collectively overshoot the planetary boundaries that protect earth's life-supporting systems. The core of the doughnut hypothesis is that there should be an ecological pressure ceiling that we should not exceed and a social foundation of wellbeing that no one should ever fall below. The issuance of sustainability bonds finances activities that meets the two needs without overlooking the other. Green bonds only use proceeds to finance activities with positive environmental impact whilst social bonds use proceeds to finance activities with positive social impact. The limitations of both green and social bonds are being solved by the issuance and development of sustainability bonds. From 1981 to 2018, Granier and Rigot (2021) conducted a bibliometric study of sustainable finance studies. They found that the sustainable finance discussion is structured around five themes: the performance of socially responsible investment (SRI) funds, corporate social responsibility, the performance of responsible enterprises and stock market indices, and the investment strategies of financial actors. Recent studies show that firms prefer to issue green bonds to get lower funding (Zerbib, 2019; Gianfrate and Peri, 2019). However, firms' preferences for sustainability and environmental responsibility may also influence their choice between green and conventional bonds. For instance, businesses may use green bonds to signal to investors their dedication to the environment and reduce the risk to their finances and reputation (Flammer, 2013). Companies may also profit from green bonds' propensity to enhance financial and environmental performance at the corporate level (Flammer, 2021). We look into probable factors that could influence firm's involvement in sustainability bonds based on the aforementioned theoretical viewpoints since sustainability bonds are in the same instrument class as green bonds. When analyzing the factors that influence a firm's demand for financing, we pay particular attention to the issuance and issuer characteristics. Empirical research on green bonds has shown that their lower financing costs draw corporate issuers by making them more financially accessible than other bonds with comparable features. However, green bonds are no longer the preferable option if issuance costs increase (Gianfrate and Peri, 2019). Proceeds from green bonds are only ever used to fund legally permissible environmental sustainability projects, both new and old. Because of this restriction on how the profits can be used, green bonds are less practical for meeting larger financial needs (Chiesa and Barua, 2019). Furthermore, companies prefer to issue green bonds to satisfy a reduced debt demand while benefiting from enhancing their green reputation because they are not the primary options for funding. Recent research findings (Kölbel and Lambilon,2022) also demonstrates that Sustainability-Linked Bonds (SLBs) incentivize sustainability improvements by offering a lower cost of capital whilst some companies that do not benefit from a sustainability premium issue SLBs to signal their commitment to sustainability targets. Conventional bonds are superior because a longer bond maturity would necessitate a higher issue size and increase the financing cost (Lin and Su, 2022). Whilst the signaling theory and greenwashing has been thoroughly explored by a myriad of research, our results give credence to institutional theory where firms in order to maintain legitimacy in structural environments will adopt trending practices such as sustainable bond issuances without enjoying a premium. Asymmetry information theory can also be explained as a backing for sustainable bond issuances especially since these bonds can be used in the financing of either projects that are environmentally friendly or social in nature without necessarily specifying the exact project type to investors. This serves as a source of information gap between issuers, investors and regulators especially following the advent and advance of Environment, Social and Governance (ESG) rules and regulations.

### *2.2 Literature Review*

Studies looking at whether green bonds are more expensive than conventional bonds have found conflicting evidence of a "greenium," or "green bond premium" (Ehlers and Packer, 2017; Baker, Bergstresser, Serafeim, and Wurgler, 2018; Hachenberg and Schiereck, 2018; Karpf and Mandel, 2018; Zerbib, 2019; Larcker and Watts, 2020; Flammer, 2021; Rannou et al,2021). Research shows that green bonds have a moderate premium, which means that companies benefit from lower capital cost on green bonds, while more recent papers based on tighter matching procedures find no such greenium and suggest that companies can issue green bonds even if it is costly to signal their commitment to sustainability. Recent works based on tighter matching processes reveal no such greenium, suggesting that corporations may issue green bonds even if it is expensive to communicate their commitment to sustainability (Larcker and Watts, 2020; Flammer, 2021; Bhutta et el. 2022).A number of previous studies have looked at how green bonds are priced and whether they are more expensive than non-green bonds (i.e., brown bonds), such as Karpf and Mandel (2017), Baker et al. (2018), and Zerbib (2019). Municipal bonds (as well as sovereign and a few corporate bonds) are the primary subject of these research. Their conclusions are mixed. A positive yield difference for green bonds is found by Karpf and Mandel (2017), Zerbib (2019), and Baker et al. (2018). It has been some time since Larcker, and Watts (2020) revisited these investigations. Methodological design errors, they claim, are to blame for "biased estimates" and "mixed evidence" from previous studies. According to Karpf and Mandel (2017), the comparison of taxable and non-taxable securities (ie, taxation in the municipal securities market) is biased toward discovering a green bond discount. The technique used by Baker et al. (2018) to determine a green bond premium fails to consider variations between green and brown bonds. Each green bond is matched to a nearly similar brown bond by Larcker and Watts (2020) to evaluate the likelihood of a green bond premium (or discount) in fine detail. They discover that the green bond premium is practically non-existent when they apply a more precise matching method. Sustainable bonds, on the other hand, are largely unexplored territory in the aforementioned literature. Earlier literature have found consistent mixed evidence with regards to premium on green bonds (Ehlers and Packer 2017; Karpf and Mandel 2018; Zerbib 2019; Flammer 2021; Bhutta et al. 2022; Baker et al. 2018). A few recent literature have delved into the study of novel sustainable debt instruments like sustainability-linked bonds (Liberadski et al.,2021 ; Kölbel & Lambillon, 2022 ; Berrada et al. 2022) and found results that confirm outcomes of studies relating to green bonds. According to Kölbel and Lambillon's study on SLBs, the sustainability premium is higher for callable bonds and bonds with bigger coupon step-ups. They also demonstrate that for some SLB issuers there is a "free lunch," as their financial savings exceed the possible penalty and they have a call option to lessen this penalty. While their research indicates that most SLBs encourage sustainability improvements by providing a cheaper cost of capital, some businesses that do not receive a sustainability premium appear to issue SLBs to demonstrate their dedication to sustainability goals, further supporting the signaling theory. The "free lunch" theory, however, raises the possibility that SLBs may potentially be a type of greenwashing if they are granted just for financial optimization rather than with a genuine desire to carry out sustainable changes. Other factors are drivers of the greenium and studies from (Fatica, Panzica et al.,2021 ; Boutabba and Rannou,2022) mention liquidity risks related to investor strategies (i.e. buy-and-hold), bond maturity and to a lesser extent credit risks determining the level of greenium. Boutabba and Rannou found a liquidity clientele effect on the ask side that has an impact on the liquidity premium, indicating a maturity segmentation where green bond buyers choose the purchase and hold strategy to get paid for the liquidity risk along the maturity curve. Fatica, Panzica et al, have findings that suggest that companies with high environmental performance benefit from a lower cost of debt. Furthermore, they found that green bonds with external review benefit from a larger premium compared to self-labeled green securities following the replacement of private market standards such as the ICMA, GBP and CBI by the EU Taxonomy which act as public standards (Rannou and Albert-Cromarias, 2022).

### *2.3. Hypothesis Development*

Mixed conclusions with regards to greenium and the determinants of green bond issuances have been obtained (Boutabba and Rannou, 2022). The socio-economic effects of the COVID-19 pandemic necessitated the increase in issuance of social bonds but to prevent a biased focus on social projects without neglecting the more pressing need of financing projects that will facilitate meeting the net zero emissions by 2050 in influencing climate change, we have seen a growth and an advance in activities with regards to sustainable bonds. These sustainable bonds finance a mix of both green and social projects. Sustainable bonds do not have a large premium, which suggests that investors' interest in this sustainable product does not lead to an increase in bond prices and lower loan costs for issuers. It further reiterates that issuers are willing to issue these bonds at a higher cost which confirms the signaling theory. In the figure A1, we provide an overview of the market for SBs as at the end of 2021 according to issuances by region, market, issuer type and deal size.

[INSERT FIGURE 1]

Sustainable bonds have gained traction and has seen a diversification in the type of issuers of this instrument over the period. Recent research uses statistical analysis of the yield difference between green bonds and non-green counterfactuals as well as matching procedures to support these conclusions. Hachenberg and Schiereck (2018) investigate 63 bonds on the secondary market that adhere to the Green Bond Principles using a matching technique and a panel regression and discover a slight negative premium (-1 bps). Gianfrate and Peri (2019) compare the returns of 121 European green bonds with those of their traditional peers using a propensity score matching study of the primary and secondary markets. Their findings also point to a greenium of -18 bps, which is statistically significant. Similar to this, Zerbib (2019) estimates the yield difference between 1065 European and US green bonds and their counterfactual conventional bonds using a direct matching method followed by a two-step regression procedure and discovers a modest negative premium (-2 bps). Larcker and Watts (2020) compare green bonds to conventional counterfactuals released the same day by the same issuer with a focus on the municipal bond market. Their investigation, which used 640 bond pairs, shows that the greenium is equivalent to zero, in contradiction to earlier research. According to Larcker and Watts (2020), errors in the methodological matching design that result in skewed estimates are the cause of the contradictory evidence from earlier investigations. Flammer (2021), using the approach of Larcker and Watts (2020), finds no greenium for her sample of 152 matched corporate bond pairs, which is consistent with their findings. Therefore, there is conflicting empirical evidence for a greenium so far. A modest greenium may exist, according to some studies, particularly in the municipal bond market. However, the most recent articles with more exact matching methods indicate no green bond premium (Larcker and Watts 2020; Flammer 2021).The motivations of investors and issuers of green bonds have also been examined in recent studies. Companies are issuing green bonds for a variety of reasons, according to Flammer (2021), including signaling, greenwashing, and financial justifications. The primary reason for issuing green bonds is to send a message to investors about a company's dedication to environmental stewardship. In the second case, green bonds are being used as a greenwashing tactic, in which case the company is simply pretending to be environmentally conscious. The final reason is to reduce the cost of capital. Flammer’s findings are consistent with the signaling theory, which states that corporations use green bonds to communicate their commitment to the environment. In studying sustainable bonds (SBs), we add to the body of knowledge on long-term debt instruments. SBs are compared to their non-sustainable counterparts to see how much they cost, who pays for the sustainability (that is positive or negative premium), which we explore in our study and what factors drive the sustainability premium. We address two main questions. First, whether there is a premium on sustainable bonds listed on the European exchange as compared to conventional bonds. Secondly, we investigate the research question of what factors impact the sustainability premium. To test this hypothesis empirically, we look to see if there is a sustainability premium or "sustanium," that investors are willing to pay or benefit from to subscribe to investing in sustainable bonds. By examining the driving forces behind the sustainability premium on sustainable bonds, our research adds to the body of knowledge about sustainable debt instruments. In our article, we compare sustainable and conventional bonds to determine whether a sustainability premium exists. We also discuss how credit risks and maturity effects impacts the yield differential of sustainable and comparable conventional bond.

# 3. Data and Methodology

### *3.1. Data Selection*

To build our data sample to answer these questions, we look at a secondary market sample of sustainable bonds listed on the European markets between 2018 and early 2022 and compare their yields to conventional bonds across every metric (issuer, currency, coupon, maturity type and rating). Our sample of sustainable bonds and their comparable conventional bonds are extracted from a variety of sources including Refinitv, Euronext, Luxembourg Stock Exchange fixed income databases targeting the European markets. We filtered out zero coupon bonds, bonds without ratings and bonds without traded prices. Currencies with less than 5 issuances were also filtered out. All ratings for both sustainable and conventional bonds were available and none of the bond pairs differ in bond rating.

*Matching Procedure*: The first step in building our sample was to select from these databases sustainable bonds and their comparable conventional bonds with identical issuer, currency, coupon type, maturity type and rating. In terms of maturity, we concentrated on bonds at maturity and excluded callable bonds. In the second step, we select the conventional bond with identical issue date, maturity date and issue size. The matching parameters in the second step are;

*Issue date*. We restricted the difference between the issue dates for the bond pairs to a maximum of 4 years.

*Maturity*. We restricted the difference in maturity between the sustainable bonds and the conventional bonds also to a 4-year period.

*Issue size*. We restricted the issue size difference is to a factor of 4, maximum size of the comparable conventional bond being a maximum 4 times that of the sustainable bond or minimum 0.25 times the size of the sustainable bond. This was done to control for any liquidity differential.

*Rating*. We restricted our sample selection to include bonds that had rating from either Moody's, S&P or Fitch. The ratings were then converted with on a scale of 1 to 5 with 1 representing prime rating and 5 lower grade rating.

Finally, our matching process resulted in a representative sample size of 100 bond pairs from 24 issuers. Price history on average is 4 years and we used a matching procedure to compare the yields of sustainable bonds with the conventional bonds. The daily ask and bid prices were obtained from Refinitv. The prices were filtered to exclude all holidays and non-tradeable dates. The prices dates of the sustainable bonds were aligned to the conventional bonds. The daily traded yield prices of these sustainable and conventional bonds were calculated individually using the ask close prices, coupon, and maturity dates. Table 3 provides a summary statistic for the sample of bond pairs of SBs and comparable bonds. Our matching process yields a sample of bond pairs with an average difference in maturity of under two months and a slightly larger issue size (average ratio of 1.56). We restricted our sample selection of sustainable and conventional bonds to same day issuances, so the difference in issue dates between our bond pairs was typically less than a month. Both the sustainable and their equivalent conventional bonds' average coupon, expressed in basis points (bps), are shown in Table 3. We observe that the coupon on sustainable bonds are at an average 5bps higher than their comparable conventional bonds. At a surface glance,the yield differential is 1.6bps which shows that the sustainable bonds in our sample do not benefit from a sustainability premium.

### *3.2. Regression Model*

We use a matching strategy at the bond level to expound on our research question and check for the existence of a sustainability premium. Our matching process aims to pair an SB with a conventional bond issued by the same issuer that are as identical other than for the associated sustainability features. This process enables us to evaluate and assess the yield disparity in a subsequent step since, after accounting for all of their differences, conventional bonds and SBs issued by the same issuer are both subject to the same financial risk. Our matching process is analogous to research on the greenium(Flammer 2021; Zerbib 2019). In the first instance, we have a sample size of 4 years daily pricing for sustainable bonds and their comparable conventional bonds.. We calculate the yield to maturity (YTM) of these bonds with ask prices. We then compute the difference between the YTMs. Sustainability premium is the yield differential between a sustainable bond and an otherwise identical conventional bond on the secondary market. Said differently,

$$Premium\ \Delta Y = Yield^{SLB} - Yield^{CB}$$

First, we examine the significance of the yield difference between the SBs and comparable conventional bonds. Both a nonparametric Wilcoxon rank sum and a parametric, paired t-test are used to examine the difference.

The results are tested for robustness in a second step by estimating an OLS regression and adjusting for matching, issuer, and bond parameters. Therefore, for each bond pair$_i$ the dependent variable is the yield difference between the sustainable bond and the comparable conventional bond. The OLS regression is expressed as follows:

$$\Delta Yield_i = \beta 0 + \Sigma\beta_j \cdot Matching\ differences_{ji} + \Sigma\beta k \cdot Bond\ pair\ characteristics_{ki} + Year\ dummy + Firm\ dummy + u_i$$

Two categories of independent variables are present. Due to our matching approach, the first class of variables is related to the matching differences$_{ji}$ and is meant to reflect the differences between the sustainable bond and the comparable conventional bond. This includes variations in issue dates, maturity dates, and issue volumes (issue ratios). The second class of variables ; Bond pair characteristics$_{ki}$, is targeting to control variables such as coupon,maurity and rating. Table 1A, provides an overview and description of all variables.

[INSERT TABLE 1]

# 4. Empirical Results

## *4.1. Descriptive statistics*

In the first step of the empirical analysis, we estimated the sign,magnitude and significance of the yield differential between the sustainable bonds and the comparable conventional bonds within our sample. We conducted both non-parametric and parametric test using the Wilcoxon signed rank test (median equality testing) and the paired t-test to analyze the differences. The wilcoxon signed rank test gave us a significant probability value which indicated the rejection of the null hypothesis which connotes that there is no difference between the yields of SBs and the yields of comparable conventional bonds.

[INSERT TABLE 2]

The significant probability value of the signed rank test indicates that, there is a statistically significant difference between the yield of the sustainable bonds and the yield of the comparable conventional bond. Furthermore, the directional hypothesis test of the signed rank test indicates that the yields of the sustainable bonds are significantly larger than the comparable bond yields. Specifically, it is evident from the probability values of both the one-sided and the two-sided test that the median of sustainable bonds are far higher than that of the comparable bonds.

Table 3 provides the results of our parametric test using the t-test.

[INSERT TABLE 3]

The result of the paired t-test is also consistent with the Wilcoxon signed rank test which indicates that a significant difference exist between the sustainable bond yields and the comparable conventional bond yields. More specifically, the two-sided test of the paired test with the probability value of 0.002 in Table 3 shows that the null hypothesis which asserts the mean difference between the two respective bonds yields is zero (i.e. the yields of the bonds are the same) is rejected. Hence, a significant difference exists between the yields of the sustainable bonds and comparable bonds.

Table 4 provides summary statistics for the bond pairs sample of sustainable and comparable conventional bonds.

[INSERT TABLE 4]

The summary statistics shows our matching process yielded a sample of bond pairs with an average difference in maturity of under two months and a slightly larger issue size (average ratio of 1.56). Due to the close same day issuance restriction applied to our sample selection of sustainable and conventional bonds, the difference in issue dates between our bond pairs was typically less than a month as seen in Table 4. Both the sustainable and the comparable conventional bonds' average coupon, expressed in basis points (bps), are shown in Table 4. We observe that the coupon on sustainable bonds are at an average 5bps higher than their comparable conventional bonds. This explains that investors are willing to bear the cost of sustainability. At a surface glance,the yield differential is 1.6bps which depicts that the sustainable bonds' yield on the secondary market is larger as compared to conventional bonds. The positive yield differential implies that investors are willing to pay higher for a sustainable bond and thus incur some cost which is similar to issuers signaling their commitment to issuing sustainable instruments (Flammer,2021). The average difference between the years to maturity for a sustainable bond on the secondary market is less than two months to that of comparable conventional bonds. This shows that an investor who is inclined to buy and hold to maturity will be influenced mainly by the yield applicable at the point of trade execution.

### *4.2. Regression Results*

We perform a series of linear OLS regressions on the yield differential with different set of control variables. The results of the regression specifications are summarized in Table 5.

The model 1 controlled for the matching differences which includes the issue date difference,maturity years difference and the issue size ratio. Model 2 controlled for the bond pair characteristics variables which comprises of the maturity years, coupon and rating of bond pairs. Model 3 controlled for both matching differences variables and bond pair characteristics variables. We obtained very significant results; impact of rating and maturity years on the yield differential (premium). Whilst the maturity years of the sustainable bonds had a negative impact on the premium, the maturity years of the comparable conventional bond had a positive impact on the premium. The ratings however had a reverse reaction with sustainable bonds ratings having a positive impact on the premium whilst the comparable conventional bonds rating had a positive impact on the yield differential. Given the magnitude of our rating coefficient, we indeed hypothesize that both credit (rating) and maturity profile impact the sustainability premium paid by investors as is the case for green bond issuances at different maturities( Zerbib, 2019; Boutabba and Rannou, 2022).

[INSERT TABLE 5]

## 5. Conclusion

Our study proposes to estimate the size of the sustainability (bon) premium all in exploring its determinants. We find is a small but significant sustainability premium of 1.6bps in line with premia found on green bonds (Zerbib, 2019). However, this premium is significantly lower than the premium measured on sustainability linked bonds by Kölbel and Lambillon (2022) and probably due to the fact that they consider worldwide issuances of sustainability linked bonds that differ significantly from each other. From our regressions we realized there are two main drivers of sustainability premium at present; credit risks (via rating) as is the case for green bond issuances studied by Fatica and Panzica in 2019. Maturity effects also have significant impact on the sustainability premium and this also confirms the study conducted by Boutabba and Rannou (2022) which concluded high-risk (*resp.* low-risk) investors buy short-term (*resp.* long-term) green bonds and hold them until maturity thereby adapting a buy and hold strategy to benefit from liquidity effects premium. We are limited in this study by the difficulties prevalent in capturing and translating ESG factors in determining the creditworthiness of a sustainable bond. In our data collection and analysis, we realised sustainable bonds had better credit ratings as opposed to the comparable conventional bond. Since both bonds have the same issuer, the expectation of equal credit rating on the bond pair is not far fetched. How significantly rating impacts the premium lends credence to exploring information asymmetry and its on secondary market transactions. A disparity between an investor and an issuer in their knowledge of relevant factors and details that can impact the rating of a bond would have significant consequence on either party.

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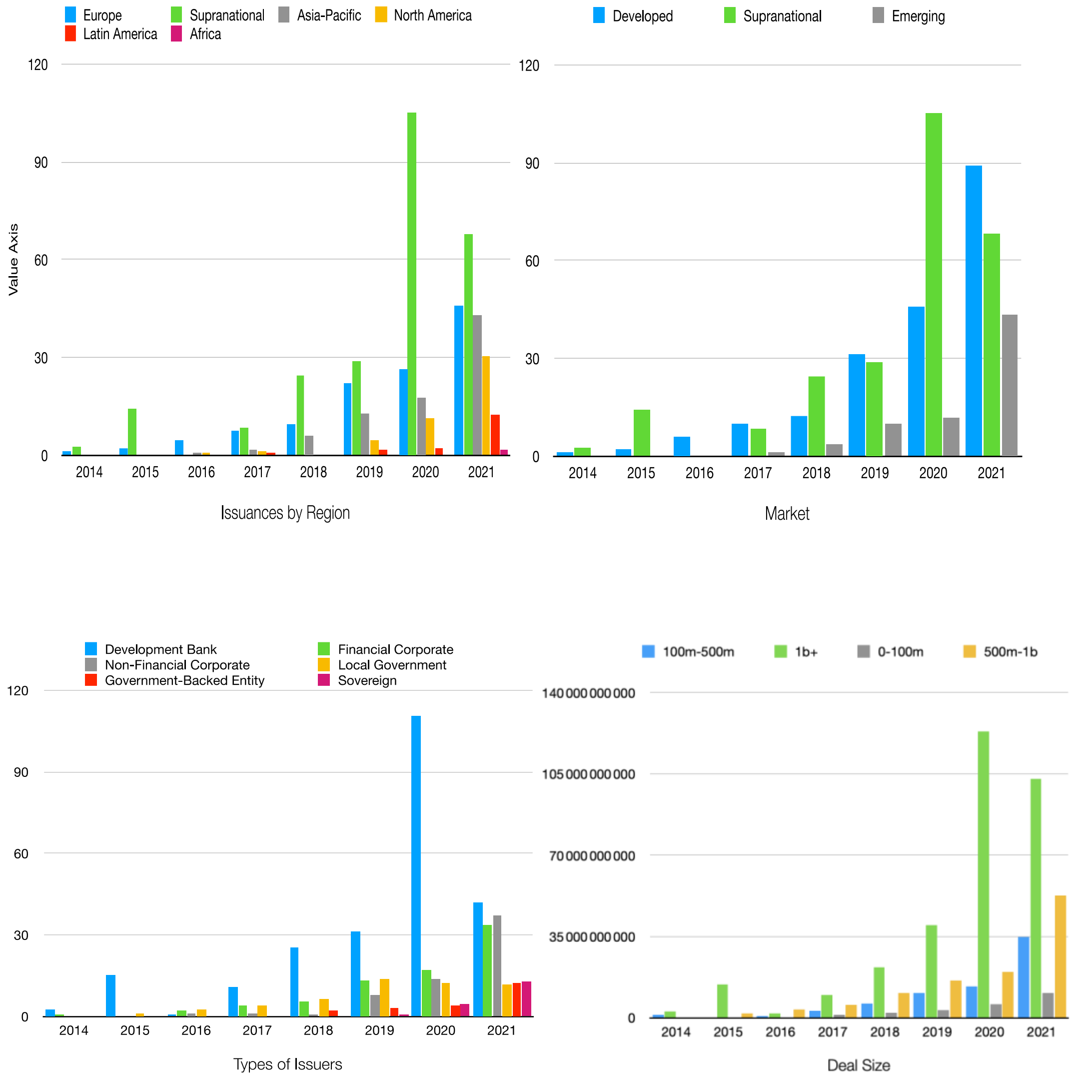
# Appendix

## Figure 1.




Source: CBI,2021

**Table 1.** Overview and description of dependent and control variables

| Variable | Description | Type |
|---|---|---|
| △Yield | Difference between yield of sustainable bonds and the comparable bonds. | Basis points |
| Maturity years | The date of maturity of the respective bonds. | Years |
| Maturity difference | Difference between the maturity date of the sustainable bonds and the comparable bonds issued. | Years |
| Issue size | The amount of respective sustainable bonds and comparable bonds issued. | Millions (Eur) |
| Issue size ratio | The ratio between the size of sustainable and comparable bonds issued. | Ratio (0.25-4) |
| Issue Date diff. | The difference between the issue dates of sustainable bonds and their comparable bonds. | Years |
| Ratings | Rating assesses the credit risk related to the bond issuance. | Scale (1-5) |
| Coupon (bps) | The coupon rate of the sustainable bonds and the comparable bonds respectively. | Basis points |
| Yield (bps) | The yield of the bonds. | Basis points |
| Yields diff (bps) | The yield differential between the sustainable bonds and the comparable bonds. | Basis points |

**Table 2.** Wilcoxon Signed Rank Test

| Sign | Obs | Sum ranks | Expected |
|---|---|---|---|
| **positive** | 22657 | 4.95E+08 | 5.34E+08 |
| **negative** | 23566 | 5.73E+08 | 5.34E+08 |
| **zero** | 0 | 0 | 0 |
| **all** | 46223 | 1.07E+09 | 1.07E+09 |

**Table 3**. Parametric T-Test

| Variable | Mean | Std. Err. | Std. Dev. | T-Test | P-Value |
|---|---|---|---|---|---|
| SB_Yields | 184.049 | 1.516289 | 325.9951 | | |
| CMP_Yields | 182.447 | 1.316049 | 282.9445 | | |
| Yield Differential** | 1.602bps | 0.517855 | 111.3363 | 3.0935 | 0.002 |

**Table 4.** Summary statistic of bond pairs

| Variable | Group Bond | Mean | Min | Median | Max |
|---|---|---|---|---|---|
| **Maturity (Years)** | SB | 6.69 | 2.00 | 5.00 | 20.32 |
| | Comparable | 6.84 | 2.00 | 5.00 | 20.00 |
| **Maturity Diff (Years)** | Both | -0.15 | -4.00 | 0.00 | 2.92 |
| **Issue Size (Millions of Euros)** | SB | 937.55 | 2.28 | 450.60 | 7233.27 |
| | Comparable | 689.45 | 0.95 | 249.33 | 5424.96 |
| **Issue size (ratio)** | Both | 1.56 | 0.26 | 1.25 | 3.97 |
| **Issue Date Diff (years)** | Both | 0.03 | -3.35 | -0.08 | 3.95 |
| **Coupon (bps)** | SB | 245.93 | 1.00 | 143.75 | 1325 |
| | Comparable | 240.95 | 1.00 | 155 | 1200 |
| **Yield (bps)** | SB | 184.05 | -71.69 | 68.20 | 4177.85 |
| | Comparable | 182.45 | -81.78 | 70.38 | 3204.45 |
| **Yields Diff (bps)** | Both | 1.601 | -840.41 | -0.13 | 3132.86 |

**Table 5.** OLS Regression results for all bond pairs

| | △Yield | | |
|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** |
| ***Matching differences*** | | | |
| Issue Date Diff | 1.102** | | -7.558*** |
| | (0.505) | | (0.569) |
| Maturity Years Diff | -5.938*** | | |
| | (0.600) | | |
| Issue Size Ratio | -4.816*** | | -7.398*** |
| | (0.482) | | (0.489) |
| ***Bond Pair Characteristics*** | | | |
| SB_MaturityYears | | -2.169*** | -1.533** |
| | | (0.608) | (0.609) |
| CMP_MaturityYears | | 1.721*** | 1.216** |
| | | (0.615) | (0.618) |
| Coupon_SB | | 0.004 | 0.070*** |
| | | (0.010) | (0.011) |
| Coupon_CMP | | 0.105*** | 0.047*** |
| | | (0.010) | (0.011) |
| Rating_SB | | 10.714*** | 6.116*** |
| | | (1.137) | (1.161) |
| Rating_CMP | | -4.001*** | -2.040** |
| | | (0.953) | (0.965) |
| _cons | 8.801*** | -26.887*** | -15.966*** |
| | (0.934) | (1.575) | (1.717) |
| Obs. | 46223 | 46223 | 46223 |
| R-squared | 0.45 | 0.53 | 0.60 |
| Year FE | NO | NO | YES |
| Firm FE | NO | NO | YES |

*Note*: The OLS regressions are performed based on robust standard errors. Standard errors are in parenthesis ***, **, * indicates statistical significance of coefficients at 1%, 5% and 10% levels.