UNIVERSIDADE CATÓLICA PORTUGUESA

ESG versus conventional bonds: A comparative analysis of primary market spreads

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Resumo

Esta dissertação tem como objetivo investigar se as obrigações do tipo ESG, emitidas por empresas não financeiras, apresentam um prémio no mercado primário em comparação com as obrigações convencionais. Em seguida, dividimos a nossa amostra em dois períodos: pré-Covid-19 e Covid-19 para fazermos a mesma análise. Também investigamos se os principais fatores que impactam o *spread* das obrigações ESG são os mesmos que nas obrigações convencionais. Com base nas obrigações emitidas por 8.267 empresas, denominadas em 30 moedas diferentes, de 17 setores, de 2012 a 2022, e utilizando um modelo de regressão linear OLS, não encontramos evidência da existência de um prémio para as obrigações ESG comparativamente às obrigações convencionais. Estas conclusões mantêm-se para o período pré-Covid-19 e Covid-19. Por fim, as evidências mostram que os ratings de crédito são o principal fator para explicar o *spread* das obrigações convencionais. No entanto, de acordo com o nosso estudo, as obrigações ESG não são influenciados por este fator. Os fatores que influenciam o *spread* das obrigações ESG são: ser ou não subordinada, a maturidade, a dimensão da transação, o número de tranches por transação, a existência de risco cambial, terem uma opção de compra e a volatilidade do mercado.

Palavras-chave: Obrigações ESG, obrigações verdes, obrigações sociais, obrigações sustentáveis, pandemia Covid-19.

Número de palavras: 9 823 palavras

Abstract

This study aims to investigate if corporate ESG bonds trade at a premium vis-à-vis comparable conventional bonds in primary markets. Then we split our data into the pre-COVID-19 and COVID-19 periods to execute the same analysis. We also examine if the main factors impacting corporate ESG bonds' spread are the same as for conventional bonds. Using data from bonds issued by 8,267 companies, denominated in 30 different currencies, across 17 sectors, from 2012 to 2022, and employing an OLS regression, we find no evidence of a premium in corporate ESG bonds in comparison to conventional bonds, neither during the pre-COVID-19 or COVID-19 period. Finally, evidence shows that credit ratings are the main driver in explaining the spread of conventional bonds. However, according to our research, they do not influence ESG bond spreads. ESG bond spreads drivers include subordination level, maturity, transaction size, number of tranches, currency risk, callable, and market volatility.

Keywords: ESG bonds, sustainable bonds, green bonds, social bonds, sustainability bonds, COVID-19 pandemic.

Table of Contents

List of Tables

Introduction

Socially Responsible Investments (SRI) are becoming increasingly prominent in the financial world. This is evident not only in the growing number of sustainable bonds being issued and companies receiving Environment, Social and Governance (ESG) funding but also in the voluntary disclosure of ESG data by companies in their reports.

Companies that prioritise environmental protection, human rights, employee relations, and governance are valued by investors (Perote et al., 2023). This could be due to financial incentives or a genuine concern for social responsibility. In addition, the emphasis on SRI implies that private companies and philanthropists or governments can play a role in addressing social or environmental issues. At the same time, many investors are expressing a desire to "do good while doing well" (Paul Brest et al., 2013).

Although many studies recognise the importance of ESG agenda for companies and investors, some branches of literature fail to see its potential value creation. According to a study conducted by Cornell & Damodaran (2020), practicing social responsibility does not benefit all companies equally. The study cautions against making unfounded statements that being socially responsible will increase growth, profits, and value for all companies. From the shareholder point of view, Cornell & Shapiro (2021) found no evidence that ESG benefits shareholders either through implicit claims. On the contrary, setting ESG goals can hinder a company's ability to create value by forcing them to subsidise stakeholders with whom they do not have a business relationship. The writers strongly suggest that only the political process can address ESG concerns fairly and honestly.

Fama (2020) argues that instead of solely focusing on maximising shareholder wealth, companies should shift towards maximising shareholder welfare due to growing interest in ESG issues. Nevertheless, maximising shareholder welfare can

create contractual issues between shareholders and management and additional costs beyond the contract. This includes addressing the differing preferences of shareholders regarding environmental, social, and governance dimensions. Furthermore, it is important to note that prioritising EGS practices are not just about being altruistic. Investors aim to maximise financial returns and minimise the risk of financial loss, while firms view these practices as safeguarding themselves (Fama, 2020).

The question of whether or not companies should prioritise an ESG agenda and if, ultimately, whether capital markets price CSR is still open. Our work aims to clarify this ongoing debate and shed more light on the company's financing policy. When firms have to decide between issuing conventional bonds or ESG bonds to fulfil their needs of financing to execute projects linked to the environment or social area, it only makes economic sense to choose ESG bonds if the yield is low enough to cover the extra costs that these types of bonds are subject. Otherwise, corporations should issue conventional bonds to finance sustainable projects at lower costs.

On the other hand, empirical results vary depending on the samples and methods used. Some studies only involve a small number of bonds, which can be limiting. To address this issue, more recent studies utilise a more extensive, global data set (Kapraun et al., 2021). Furthermore, the studies concentrate on different categories of bonds, such as US municipals, sovereign bonds, or bonds issued by banks and non-financial firms. Certain studies concentrate solely on the primary market (Zaghini, 2023; Caramichael et al., 2022; Fatica et al., 2021; Hinsche, 2021; Crifo et al., 2017). In contrast, others exclusively examine the secondary market (Hyun et al., 2020; Zerbib, 2019; Hachenberg & Schiereck, 2018). There are also studies that analyse both markets simultaneously (Lau et al., 2022; Lichtenberger et al., 2022; Kapraun et al., 2021; Löffler et al., 2021).

The usage of different sample periods can also impact the discrepancies observed in the outcomes attained. Moreover, the maturity level of bond markets and the empirical methodology used can also affect the results obtained. For example, different

authors utilised various statistical methods such as the OLS regression method (Wang et al., 2020), the adverse selection model (Gao & Schmittmann, 2022), the fixed-effects regression (Caramichael et al., 2022), and the matching method, followed by a two-step regression (Zerbib, 2019).

Through our work, we will strive to surpass the limitations mentioned earlier and thereby make contributions to the existing literature. We will concentrate on issuing ESG bonds by non-financial corporations in the primary market, which is considered a more young and less studied market.

In addition, our sample size consists of 1,200 ESG and 29,168 conventional corporate bonds issued worldwide. This is a significantly larger sample size compared to other studies, e.g., Kempa & Moslener (2022), Azhgaliyeva et al. (2022), Cicchiello et al. (2022), Wulandari et al. (2018), Tang & Zhang (2020), Wang et al. (2020) and Zerbib (2019).

The period analysed in this study is from 2012 to 2022, which is a more recent and comprehensive timeframe. The bonds used in the analysis were obtained from the DCM Analytics dataset. Our database includes bonds issued by 8,267 companies, denominated in 30 different currencies, and covering issuers from both advanced and emerging market economies across 17 sectors.

Based on this comprehensive dataset, we employ an OLS regression method similar to Fatica et al. (2021) to examine an unbalanced panel of corporate bonds. Our initial objective is to determine whether corporate ESG bonds have a premium trade value, meaning they have lower yields compared to similar conventional bonds. Additionally, we aim to understand how the COVID-19 pandemic affects this potential greenium effect. A third goal is determining which factors cause differences in the spread between conventional and ESG bonds during issuance.

Our findings show no significant difference in spreads at issuance for ESG bonds vis-à-vis conventional bonds, all other factors being equal. In addition, we demonstrated that these results hold in both the pre-COVID-19 and COVID-19 periods. Our results also show that most of the pricing factors that explain

conventional bond spreads explain ESG bond spreads, also. However, credit ratings and country risk do not drive ESG bond spreads as they do for conventional bonds.

This work is structured as follows: Chapter 1 reviews the literature and outlines the research hypotheses. Chapter 2 details the data, econometric methodology and variables used in the tests. Chapter 3 discusses the results. Lastly, Chapter 4 offers conclusions and implications.

Chapter 1
Literature review

1. Corporate Social Responsibility, ESG, and the cost of capital

It is important to note that sustainable finance and socially responsible investing (SRI) are only a portion of the broader corporate social responsibility (CSR) concept (Park, 2018). ESG ratings are often used to assess the influence of corporate social responsibility on businesses. On the one hand, companies that take into account the effects of their actions on society and the environment can create positive change while still meeting their financial objectives. This is accomplished through the issuance of GSSS bonds, which stand for green, social, sustainability, and sustainability-linked bonds, also called by some authors "sustainable bonds" (Anyfantaki et al., 2022 and Mathew & Sivaprasad, 2022) or other "ESG bonds" (Perote et al., 2023). On the other hand, for investors, when deciding where to invest their money, it could be worth considering companies that prioritise CSR initiatives.

1.1The Impact of CSR on the Price of Bonds

Numerous studies have been carried out regarding the relationship between CSR and the price of the cost of capital. Initially, the focus was on the stock market perspective, trying to understand, like Cornell (2021), if companies with high ESG ratings are more likely to receive investment due to their lower equity costs, which could drive the development of environmentally sustainable technologies. This decrease in the cost of equity happens because these companies face fewer financial

penalties (such as legal costs, fines, and damages) from their business activities, and their operating performance tends to be more consistent (Menz, 2010). Furthermore, by reducing operational and financial risks, lenders should experience fewer claims, ultimately resulting in decreased risk premiums for the bonds (Menz, 2010).

1.1.1 What are green, social, and sustainability?

Green bonds

The market has grown incredibly after the European Investment Bank pioneered the launch of the inaugural green bond in 2007. A green bond is differentiated from a conventional bond by being "labelled", i.e., designated as "green" by the issuer or another entity, whereby a commitment is made to use the proceeds of green bonds (i.e., the principal) transparently and exclusively to finance or refinance "green" projects, assets or business activities with an environmental benefit (OECD, 2016). Examples of project categories eligible for green bond issuance include renewable energy, energy efficiency, clean transportation, green buildings, wastewater management and climate change adaption.

A turning point in this growth path was the Paris Agreement reached in 2015, which set the tone for a more active role in green financing instruments. OECD estimates indicate that around USD 6.3 trillion of infrastructure investment is needed each year in 2030 to meet development goals, increasing to USD 6.9 trillion a year to make this investment compatible with the goals of the Paris Agreement (OECD, 2018). With these goals, finance plays a crucial role in this climate change issue, and green bonds are a good start for financing green activities. More recently also, China has been contributing to the fast growth of the green market. China's recent efforts for environmental protection resulted in building a green financial system supporting environmentally responsible projects. This new policy led to the rapidly expanding of a new finance practice – green bond issuance in China (Wang et al., 2020). Another critical player contributing to this rising demand is the European Union through the

NGEU program. The high-volume green bond issuance of up to EUR 250 billion under this program will likely intensify green bond market growth by signalling sovereign and corporate issuers to enter the green bond market (Hinsche, 2021).

The popularity of green bonds has led to the development of other sustainable fixed-income instruments such as blue, transition, sustainable, and social bonds. However, the uptake of these products has been slower (Hand D. et al., 2022).

Unctad (2022) estimates that the value of sustainability-themed investment products in global financial markets will amount to $5.2 trillion in 2021, up 63 per cent from 2020. Despite these, there is a noticeable lack of research on the interaction between these types of bonds and other assets and their ability to encourage companies to prioritise environmental, social, and governance (ESG) issues. Moreover, only a few authors have studied sustainable bond performance (such as Mathew & Sivaprasad, 2022 and Anyfantaki et al., 2022). In particular, Anyfantaki et al. (2022) have shown that sustainable bonds outperform conventional bonds, positively affecting the stock market reaction upon issuance. Furthermore, ESG ratings are the main driving force behind their performance.

Social bonds

Social bonds are instruments that raise funds for projects that address or mitigate a specific social issue and seek to achieve positive social outcomes, such as improving food security and access to education, health care and financing, especially but not exclusively for target populations (UNCTAD, 2022).

Sustainability bonds

Sustainability bonds are bonds where the proceeds exclusively apply to finance or re-finance a combination of green and social projects. They offer a wider range of potential opportunities as examples of project categories eligible for sustainability bonds typically include those in the green and social bonds categories (OECD, 2022).

1.1.2 The drivers behind ESG bonds

Companies may issue ESG bonds instead of conventional ones for several reasons, and investors may choose to include pricier bonds in their portfolios. Many factors and motivations can influence these choices.

Non-financial aspects

Recent authors Dong et al. (2022), Lau et al. (2022), Kapraun et al. (2021), and Löffler et al. (2021) have shown that investors are placing a high value on ESG agenda and are willing to invest in non-financial aspects of investments. This trend is likely a direct result of the growing recognition of the importance of sustainable practices in the business world. This can explain shareholders' choices. If they prefer green bonds, they are willing to pay a premium for them, even if it means a lower return (Zhao et al., 2022).

From the issuer perspective, the study conducted by Cicchiello et al. (2022) in the European context found that besides financial aspects such as a company's current ratio and long-term debt, also non-financial aspects like the board size and an independent director can have a substantial impact on the probability of issuing green bonds. Furthermore, their findings revealed that organisations with a significant proportion of female members on their board and a long-term debt structure are more inclined towards green bonds.

Green bonds can also be issued as an ethical action with a measurable impact, creating ethical and sustainable value beyond economic and financial value. According to Paranque & Revelli (2019), this is possible.

All these findings suggest that many non-pecuniary reasons could motivate investors to purchase green bonds and companies to issue them.

Signalling effect

Another reason for ESG bonds' popularity is related to their ability to attract new investors and increase ownership. Tang & Zhan's (2020) study provides solid evidence in favour of the "investor attention" channel of green bond effects. By branding their bonds as green, companies can garner media attention and attract investors. This heightened visibility and share demand can result in a more extensive investor base. Furthermore, issuing sustainable or green bonds typically positively impacts liquidity and stock prices (Mathew & Sivaprasad, 2022; Flammer, 2021; Tang & Zhang, 2020).

Cost of capital argument

Companies can issue ESG bonds to reduce their cost of capital. This argument implies that ESG bond issuance can provide companies access to a more affordable funding source. The willingness of investors to pay a premium for ESG bonds means they accept lower yields than those of identical conventional bonds. When it exists regarding green bonds, this premium is commonly known as "the greenium". It is important to note that various studies have demonstrated a diverse spectrum of greenium values ranging from 0.7 to 80 basis points (Zaghini, 2023; Lichtenberger et al., 2022; Caramichael et al., 2022; Lau et al., 2022, 2021; Kapraun et al., 2021; Agliardi & Agliardi, 2021; Fatica et al., 2021; Hinsche, 2021; Hyun et al., 2020; Wang et al., 2020; Zerbib, 2019; Crifo et al., 2017). However, in many cases, this negative premium only appears in certain contexts. Kapraun et al. (2021) found evidence of a negative premium only for bonds issued by governments, local governments or supranational, on bonds denominated in EUR, and corporate bonds with an external certification on the primary market. These findings hold for the secondary market. Agliardi & Agliardi (2021) found that the size of the greenium is positively affected by more volatile asset prices, larger interest rates and corporate taxes, and, more importantly, they show that issuers' creditworthiness depends on the correlation of the green project with the core business of the firm. Zerbib (2019) showed that the sector and the rating are significant

drivers of the premium (as well as Hinsche 2021), finding that the negative premium is greater for financial and low-rated bonds. Caramichael et al. (2022) showed that, on average, U.S. dollar and euro-denominated green corporate bonds capture an 8 basis points greenium at issuance. However, their findings showed that the greenium emerged only in 2019, coinciding with the growth of the sustainable asset management industry following EU regulations.

Some authors document no significant difference in yields in general terms (Tang & Zhang, 2020; Hyun et al., 2020; Hachenberg & Schiereck, 2018), while others found no significant difference in yields for smaller corporate Green bonds or bonds issued in currencies other than EUR (Kapraun et al., 2021). Also, Fatica et al. (2021) did not find a premium for green bonds issued by financial issuers.

Other branches of the literature found higher yields for green bonds. For example, in the last two years of the Karpf & Mandel (2018) US municipal bonds study, the green premium turned positive as the relative credit quality of green bonds improved.

Hedging strategy and safe haven asset

Some researchers suggest that including ESG bonds in an investor's portfolio can provide benefits such as diversification and hedging. According to Chopra & Mehta (2022), Qi & Zhang (2022), and Dong et al. (2022), green bonds are a strong safe haven for high carbon-emitting sectors, energy asset return and stock markets with a high carbon footprint. For Chopra & Mehta (2022), green bonds effectively hedge against corporate bonds, treasury bonds, energy, and other commodities. Nevertheless, during periods of systemic risk, like the COVID-19 pandemic, green bonds act as a hedge and a strong safe haven across all stock sectors except financials. Lichtenberger et al. (2022) show that green bonds have lower volatilities and higher Sharpe ratios (in the paired and unpaired analyses), reflecting an improved wealth-accumulating characteristic of green bonds. Tiwari et al. (2023) found evidence that green bonds can be a good hedge against Islamic stocks, especially during market downturns. An additional diversification instrument could come from Islamic finance, which is

gaining momentum. Billah et al. (2023a) studied the connectedness among different types of assets, particularly sukuk and green bonds.

1.1.3 Challenges behind ESG bonds

As stated previously, the literature has outlined numerous rationales for why ESG bonds are appealing to both businesses and investors. However, that same literature also pointed out several challenges regarding the issue of sustainable bonds.

Greenwashing

As discussed, one of the driving factors for the existence of the green bond premium is the investor's preference for sustainable instruments, which is, however, based on their trust in the ESG credentials of the corresponding bond. Nevertheless, the lack of trust in the green label might be an additional source of uncertainty that may arise from the possibility of misuse of green funds and greenwashing, i.e., when projects of ambiguous environmental value are financed, which shakes market confidence in these financial instruments (Agliardi & Agliardi, 2021). Furthermore, we are in the presence of greenwashing behaviour when the "green" label is used as a catch-all for activities that are a 'bit green' but are not linked to a Paris-aligned transition pathway and therefore have minimal impact in moving the needle on reducing global emissions (Climate Change Initiative, 2020).

Trust in the green label can emanate from different factors. For instance, the issuer and issuing country might be relevant for investors' trust in the green label. Kapraun et al. (2021) found that green bonds issued by more official entities (national governments, local governments, and supranational) might be viewed as more credible in terms of better implementation and more significant impact of the green project to be financed by the bond than bonds issued by corporations. However, Gao & Schmittmann (2022) emphasised that government interventions, such as green bond subsidies currently in place in Japan and Singapore, can help develop the green market but have a potential risk of increasing greenwashing. Further, the bond's green

credibility and the bond issue's sustainable reputation can significantly reduce the green-conventional yield differential in the secondary market, as reported by Kapraun et al. (2021). Countries with well-established environmental policy goals can lead investors to trust the green label more. So, rigorous screening procedures ex-ante and robust information disclosure requirements ex-post are necessary to increase greenwashing costs and ensure the integrity of green bonds, Gao & Schmittmann (2022). This could contribute to a reduction in greenwashing behaviour.

The lack of a harmonised framework

Not only Gao & Schmittmann (2022) and other researchers (Wulandari et al., 2018) have expressed concerns about the need for a set of robust, industry-adopted standards, but investors as well (Packer, 2017 and Climate Change Initiative, 2020).

Several studies refer not only to the importance of a universal guideline which allows investors to compare green bonds of different companies and countries easily but also to the impact of certification on the greenium (Zhao et al., 2022). The implications of the absence of robust standards are thereby exhibited through the greenium. For instance, some researchers only found greenium when the bonds are certified, with CBI certificates or external reviews (Fatica et al., 2021 and Hyun et al., 2020), or, in other cases, the greenium magnitude is intensified only in the presence of certification (Kapraun et al., 2021 and Wang et al., 2020). Certification plays a crucial role in guaranteeing that funds are used for green investment and that the resulting revenue is connected to it, bringing increased transparency to the market. Implementing these measures will enhance confidence in sustainable finance, ultimately affecting the cost of debt.

Because of these issues, several international organisations are working on mandatory rules for sharing sustainability data.

The EU is set a package of new rules through The Corporate Sustainability Reporting Directive (EU, 2022) that entered into force on 5 January 2023. According to the EU, the updated guidelines will guarantee that investors and stakeholders can

obtain the necessary information to evaluate potential investment risks relating to climate change and sustainability concerns. Moreover, the EU also believes that, in the long run, standardising information required for reporting will decrease company costs. Companies should apply the new rules for the first time in the 2024 financial year for reports published in 2025.

In 2021, the US Securities and Exchange Commission (SEC) proposed new regulations requiring companies to report different ESG factors. These factors include climate change, managing human capital, promoting board diversity, and governing cybersecurity risks.

In late 2021, the International Sustainability Standards Board (ISSB) was formed by The International Financial Reporting Standards Foundation (IFRS). The ISSB has the responsibility of developing mandatory corporate ESG disclosures and is currently working on the international applicability of the Sustainability Accounting Standards Board (SASB) standards.

Crisis periods

As previously stated, green bonds are a valuable tool for managing risk, particularly during times of crisis. The COVID-19 pandemic has greatly heightened the interest in sustainable financial instruments as they prove to be practical tools for promoting a "green recover", according to several authors. Perote et al. (2023) findings showed a significant and positive impact of a crisis related to the COVID-19 crisis on the returns of green bonds and ESG stock markets. Similarly, results were found by Billah et al. (2023a) regarding sukuk and green bond indices, which do not seem to be affected by fluctuations of global risk factors nor by risk transmitted from their peers, showing high levels of hedging effectiveness in a two-assets portfolio, exceeding 35 % in most cases. In contrast, Pham & Nguyen (2021) showed that green bonds do not provide significant diversification benefits for conventional bonds during bearish market conditions. However, combining green and conventional bonds can be advantageous during normal or bullish market movements.

Green bonds can play a significant role in responding to other extreme events like oil market shocks. For example, companies seem to release green bonds when the economy experiences crude oil shocks (Azhgaliyeva et al., 2022) as a strategic move to manage this market downturn effectively.

Central banks' support also has an important role in the growth of sustainable finance. However, Aloui et al. (2022) show that the green monetary intervention of the ECB could drive investors towards green markets only during non-crisis periods. It appears that the effectiveness of the green monetary policy could be diminished when facing times of crisis, as resulted during COVID-19 regarding stock markets. This highlights that different asset classes behave differently during extreme events.

1.1.4 ESG bonds in Europe

As the world changes, more companies and investors are turning to green bonds, a type of sustainable investment within the ESG investing category. As mentioned, this is a way to direct capital towards environmentally friendly options.

Currently, the EU has become a significant participant in the green bonds market thanks to various decisions that have boosted its growth and importance, as mentioned previously. For instance, Hinsche's (2021) research showed that a greenium of up to less than 4 basis points is expected for the NGEU bonds, with the potential to increase in the secondary market. Kapraun et al. (2021) found evidence that corporations traded at a considerable premium of up to 35 basis points, but only for EUR-denominated bonds.

Despite the European Commission's efforts to address ESG problems, they face challenges, as Hinsche (2021) and Maragopoulos (2016) noticed. These authors noted that both the EU taxonomy and EUGBS are very complex, and market participants are confronted with the need for more necessary data and a costly implementation process. With these new tools, the European Commission is increasing pressure on

companies to make decisions about which costs they will bear in order to prevent accusations of "greenwashing".

The European Central Bank (ECB) also contemplates taking a more active role in environmental policy within its ongoing strategic review. In particular, the ECB floated the idea of treating green bonds preferentially in its collateral framework, i.e., the conditions under which banks can pledge assets to obtain short-term funding from the Central Bank (Giovanardi et al., 2021). While the collateral framework can help to promote the use of green technologies, it has limited impact and can also have negative consequences. However, considering a setup in which fiscal policy can implement Pigouvian taxes on conventional production or subsidies on green production, Giovanardi et al. (2021) found there is still scope for active Central Bank policy.

1.1.5 ESG bonds in emerging markets

Africa's interest and appetite for developing renewable energies and sustainable economies are growing fast, as is the case for Asian Countries (India, Japan, South Korea, and especially China) (Paranque & Revelli, 2019). Issuers in emerging markets and developing economies (EMDEs) face unique challenges compared to those in developed economies. These include macroeconomic and policy instability, underdeveloped capital markets, limited access to quality information, and a need for more technical expertise (Amundi Asset Management, 2021). They are also challenged with balancing growth and sustainability. Due to their unstable economies, their economic progress often comes at the cost of considering climate impact(Amundi Asset Management, 2021). Despite being from emerging markets, several countries actively seek ways to address climate change, decarbonisation, and sustainability by participating in the green, social, sustainability, and sustainability-linked (GSSS) bond market. For instance, companies and financial institutions from EMDEs markets are encouraged to issue ethical products such as green and Islamic bonds to manage financial risks (Billah et al., 2023b). Thailand and Malaysia have a policy to provide

benefits to bond makers by paying for the costs with third-party inspections to attract more participants to the green bonds market (Zhao et al., 2022). Regarding the existence of a "greenium", Wang et al. (2020) found not only evidence of that in the major economy of EMDEs markets in China but also found that the economic magnitude of the Chinese green bond pricing premium is significantly larger than that of an international green bond. Furthermore, they highlighted that labelling green in China market could save about USD 100.6 million (CNY 703.8 million) per year for companies financing in debt.

1.1.6 Implications and hypotheses

1.1.6.1 Premium

Given the ambiguous nature of the literature surrounding the potential existence of a premium, it is crucial to consider the first hypothesis as follows:

Hypothesis 1. Corporate ESG bonds trade at a premium, i.e., at lower yields, than comparable conventional bonds.

1.1.6.2 Premium in the crisis period

The literature also showed mixed results regarding the behaviour of sustainable bonds during times of crisis. Navigating through a crisis period can be challenging, especially when it comes to financial matters. One area that is often affected is the premium rates we pay for various services. It is crucial to understand how the crisis impacts these rates and what steps we can take to manage them.

Some authors argue that in these times, sustainable bonds can act as a hedging instrument or a safe haven asset. Besides these arguments, not only the volume and number of ESG tranches have an expression in recent years, but also the pattern that they present is different (see Appendix A). Corporate green bonds started to be issued

in 2014, sustainability bonds in 2016, and social bonds in 2018. These different starting points can explain the different results regarding the existence of a premium. On the other hand, the years with the highest percentage of total value in corporate ESG bonds are from 2020 to 2022, the COVID-19 period. This supports our second hypothesis.

Hypothesis 2: Corporate ESG bonds trade at a premium, i.e., at lower yields, than comparable conventional bonds, during the COVID-19 pandemic.

1.1.6.3 Pricing

ESG bonds have the same characteristics as conventional bonds. However, they differ in two specific points. In ESG bonds, a commitment is made to use the proceeds transparently and exclusively to finance or refinance sustainable projects, assets or business activities. On the other hand, these types of bonds have higher costs related to certification procedures. Then it is essential to understand if the drivers behind the pricing of conventional bonds are the same as ESG bonds. This leads to the third and last hypothesis:

Hypothesis 3: Conventional and ESG bonds are affected by the same pricing factors.

Chapter 2
Data, methodology and variable definition

2.1 Sample selection

Information on bond issues was extracted from Dealogic DCM Analytics, a comprehensive source of data on primary bond markets across the globe. This data includes detailed information about bond issues at the tranche level. Bond tranches from non-financial companies between 2012 and 2022. Typically, qualitative information is accessible about various relevant bond features, in addition to the financial and other crucial aspects that help guide investors' decisions. For ESG bonds, there is also information available about the purpose of the project for which the funds are utilised. According to Dealogic DCM Analytics, now, all the bonds that were classified as green in the dataset were certified by external entities, and they meet Green Bond Principles. This is a relevant improvement because, as we explained earlier, many authors pointed out the absence of certification as a problem of lack of transparency and confidence to invest in sustainable instruments. Furthermore, as Fatica et al. (2021) have demonstrated, green bonds issued by financial and non-financial firms with external review have significantly lower average yields than self-labelled green bonds without review. It is important to note that the Dealogic DCM Analytics dataset, utilised in previous studies, may not have encompassed all certified ESG bonds as it happens now.

Upon conducting a thorough analysis of conventional bonds versus ESG bonds within the same country and sector, we became with the following sample: 30,368 bonds worth €13,192.72 billion, of which 29,168 worth €12,726.46 are conventional bonds and 1,200 worth €466,25 billion are ESG bonds of which 984 worth €379,23 billion are green bonds, 64 worth €22,99 billion are social bonds and 152 worth €64,04 billion are sustainability bonds.

Table 1: Industrial and geographic distribution by tranches.

Panel A: Industrial distribution

Industrial category of issuer	Conventional bonds			Green bonds			Social bonds			Sustainability bonds		
	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value
Commercial and Industrial												
Agriculture, Forestry and Fishing	354	97 860	0,77	19	7 458	1,97	0	0	0,00	4	1 305	2,04
Communications	1 574	1 161 613	9,13	13	7 567	2,00	0	0	0,00	7	3 586	5,60
Construction/Heavy Engineering	3 970	1 335 229	10,49	78	39 789	10,49	0	0	0,00	4	941	1,47
Manufacturing												
Chemicals, Plastic and Rubber	881	355 809	2,80	17	9 055	2,39	0	0	0,00	3	124	0,19
Food and Beverages	1 374	742 467	5,83	13	5 553	1,46	2	446	1,94	3	748	1,17
Machinery and Equipment	2 367	1 560 210	12,26	33	16 912	4,46	3	586	2,55	17	15 868	24,78
Steel, Aluminium and other Metals	646	205 203	1,61	13	4 857	1,28	0	0	0,00	3	1 369	2,14
Other	815	384 615	3,02	4	2 017	0,53	0	0	0,00	7	3 348	5,23
Mining and Natural Resources	581	253 444	1,99	7	1 189	0,31	0	0	0,00	0	0	0,00
Oil and Gas	2 046	1 250 544	9,83	4	1 381	0,36	0	0	0,00	0	0	0,00
Real Estate	3 869	1 019 314	8,01	301	77 084	20,33	13	7 196	31,31	43	13 255	20,70
Retail Trade	771	396 747	3,12	5	2 114	0,56	0	0	0,00	4	1 599	2,50
Services	2 922	1 642 110	12,90	5	1 476	0,39	7	2 635	11,46	12	4 954	7,74
Utilities	4 200	1 400 711	11,01	373	173 642	45,79	2	763	3,32	36	14 931	23,32
Transportation	2 242	750 593	5,90	92	27 341	7,21	37	11 359	49,42	6	1 645	2,57
Public Administration/Government	7	5 380	0,04	0	0	0,00	0	0	0,00	1	291	0,45
Other (2)	549	164 614	1,29	7	1 799	0,47	0	0	0,00	2	71	0,11
Total	**29 168**	**12 726 464**	**100,00**	**984**	**379 233**	**100,00**	**64**	**22 985**	**100,00**	**152**	**64 035**	**100,00**

Panel B: Geographic distribution

Geographic location of issuer	Conventional bonds			Green bonds			Social bonds			Sustainability bonds		
	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value
Europe	**6 729**	**3 170 020**	**24,91**	**581**	**237 414**	**62,60**	**15**	**7 666**	**33,35**	**67**	**24 995**	**39,03**
European Union	4 256	2 189 107	17,20	475	213 774	56,37	13	7 006	30,48	30	12 634	19,73
United Kingdom	1 336	626 390	4,92	39	16 438	4,33	2	660	2,87	37	12 361	19,30
Eastern Europe	98	60 870	0,48	2	469	0,12	0	0	0,00	0	0	0,00
Northern Europe	679	90 657	0,71	62	5 642	1,49	0	0	0,00	0	0	0,00
Western Europe	360	202 996	1,60	3	1 091	0,29	0	0	0,00	0	0	0,00
America	**13 670**	**7 622 329**	**59,89**	**189**	**86 211**	**22,73**	**7**	**3 041**	**13,23**	**42**	**28 575**	**44,62**
United States	11 640	6 931 834	54,47	134	70 464	18,58	7	3 041	13,23	35	25 751	40,21
North America	1 407	460 359	3,62	41	9 945	2,62	0	0	0,00	1	340	0,53
Caribbean	8	2 562	0,02	0	0	0,00	0	0	0,00	0	0	0,00
Latin America	615	227 574	1,79	14	5 802	1,53	0	0	0,00	6	2 484	3,88
Asia	**8 271**	**1 785 564**	**14,03**	**206**	**54 581**	**14,39**	**42**	**12 278**	**53,42**	**34**	**8 081**	**12,62**
China	5 687	1 165 784	9,16	104	23 399	6,17	0	0	0,00	3	1 683	2,63
East Asia	1 916	392 973	3,09	93	27 727	7,31	42	12 278	53,42	31	6 398	9,99
South Asia	47	22 668	0,18	1	412	0,11	0	0	0,00	0	0	0,00
Southeast Asia	492	111 160	0,87	5	1 354	0,36	0	0	0,00	0	0	0,00
Western Asia	129	92 979	0,73	3	1 689	0,45	0	0	0,00	0	0	0,00
Australia/New Zealand	**448**	**135 868**	**1,07**	**5**	**952**	**0,25**	**0**	**0**	**0,00**	**9**	**2 384**	**3,72**
Africa	**50**	**12 683**	**0,10**	**3**	**75**	**0,02**	**0**	**0**	**0,00**	**0**	**0**	**0,00**
Total	**29 168**	**12 726 464**	**100,00**	**984**	**379 233**	**100,00**	**64**	**22 985**	**100,00**	**152**	**64 035**	**100,00**

Panel A describes the industrial distribution of tranches, whereas Panel B details the tranche allocation to issuers in a particular country. Data are for tranches with credit spread and tranche amount available during the 2012–2022 period.

Panel A of Table 1 presents the distribution of each type of bond across different industries. At the same time, Panel B organises the data per country where the issuer of each bond is located. In Panel A, it is shown that all 17 industries issue conventional bonds. However, only 16 industries issue green bonds (with the public administration or government industry being the only ones missing), and only 15 industries issue sustainability bonds (with the mining and natural resources industry and the oil and gas industry being the only ones missing). On the other hand, social bonds are only issued by a total of 6 industries (food and beverages, machinery and equipment, real estate, services, utilities, and transportation) which is a smaller number compared to the other types of bonds. The top industries with the largest shares of conventional bonds issued are services (12.90%), machinery and equipment (12.26%), utilities (11.01%), construction or heavy engineering (10.49%), and oil and gas (9.83%). These five industries account for over 50% of the total conventional bonds issued. ESG bonds reveal a more concentrated industrial pattern. The majority of green bonds (66%) come from utilities (45.79%) and real estate (20.33%). Conversely, social bonds are mainly issued by transportation (49.42%) and real estate (31.31%), accounting for 81%. Sustainability bonds are dominated by machinery and equipment (24.78%), utilities (23.32%), and real estate (20.70%), which make up 69% of the total issuance.

Panel B shows that the top geographic location for green bonds is the European Union (56.37%), the United States (18.58%), East Asia (7.31%), and China (6.17%). Their combined issuances make up 88.43% of all green bonds, which is in line with those mentioned by Flammer (2021). East Asia dominates social bonds, accounting for over half of all issuances at 53.4%, followed by European Union (30.48%) and the United States (13.23%). Meanwhile, the United States (40.21%), the European Union (19.73%) and the United Kingdom (19.30%) lead the pack for sustainability bonds, responsible for more than 79.3% of all issuances.

Table 2 presents a comprehensive breakdown of the top 10 firms and the countries they operate in for every bond type. When examining all types of issued bonds, we

only see each firm once, so there is no noticeable repetition pattern. Out of all the bond deals, the top 10 conventional bond issuers were only involved in 2%, which is lower than the 9.6% of green bond deals and 27% of sustainability bond deals. On the other hand, the top 10 social bond issuers were responsible for 78.13% of all deals.

Table 2: Top issuers distribution.

Top issuers					
Conventional bonds			**Green bonds**		
Firm	**By value of deals**	**By number of deals**	**Firm**	**By value of deals**	**By number of deals**
Apple Inc	0,85%	0,28%	TenneT Holding BV	4,84%	2,74%
China Railway Corp	0,73%	0,24%	ENGIE SA	2,72%	1,42%
Oracle Corp	0,71%	0,15%	Société du Grand Paris	2,18%	0,51%
Verizon Communications Inc	0,68%	0,22%	E.ON SE	2,12%	1,12%
T-Mobile USA Inc	0,65%	0,22%	Iberdrola Finanzas SAU	1,91%	0,91%
Comcast Corp	0,63%	0,23%	Volkswagen Internat. Fin.	1,45%	0,61%
Boeing Co	0,61%	0,21%	Orsted A/S	1,28%	0,81%
Amazon.com Inc	0,53%	0,14%	Energias de Portugal SA	1,19%	0,61%
IBM	0,51%	0,22%	Suez SA	1,13%	0,51%
CVS Health Corp	0,50%	0,11%	Electricite de France SA	1,08%	0,30%
Social bonds			**Sustainability bonds**		
Firm	**By value of deals**	**By number of deals**	**Firm**	**By value of deals**	**By number of deals**
East Nippon Expressway Co Ltd	31,32%	35,94%	Alphabet Inc	15,25%	3,95%
West Nippon Expressway Co	14,81%	10,94%	Housing New Zealand Ltd	3,51%	5,26%
Vonovia SE	10,44%	4,69%	Southern Water Services	3,43%	3,29%
SBB Treasury Oyj	9,35%	4,69%	Southern California Edison	2,80%	2,63%
Ford Foundation	7,70%	6,25%	Severn Trent Utilities Fin.	2,51%	2,63%
Icade Sante SAS	5,22%	3,13%	Koninklijke Philips NV	2,50%	1,97%
Oncor Electric Delivery Co	3,32%	3,13%	Comision Fed. Electricidad	2,39%	1,32%
Assura Financing plc	2,87%	3,13%	Cofinimmo SA/NV	2,34%	1,97%
Fujifilm Holdings Corp	2,55%	4,69%	Georgia Power Co	2,15%	1,32%
Royalty Pharma plc	2,21%	1,56%	Clarion Funding plc	2,05%	2,63%

Table 2 provides information on the biggest players and their relative importance. Data are for tranches with credit spread and tranche amount available during the 2012–2022 period.

2.2 Methodology and variables

To investigate the pricing implications of the ESG label, a standard equation for bond spreads is used, following Fatica et al. (2021). In this setup, the dependent variable is the credit spread in basis points (bsp). An OLS regression technique, adjusted for heteroskedasticity, is used. Due to time-varying risk premiums, cross-country differences and different purposes of ESG bonds, we estimate standard errors clustered by year, country and use of proceeds. Specifically, our econometric model is as follows:

$$\text{Credit spread}_{i,t} = \alpha_0 + \beta_1 \text{ ESG dummy}_{i,t} + \sum_{n=2}^{24} \beta_n \text{ Rating dummy}_{n,i,t} + \gamma \text{ Contractual characteristics}_{i,t} + \varphi \text{ Macroeconomic factors}_t + \varepsilon$$

The following section provides information about the utilised variables. Table 3 includes the definitions and sources for all variables and the expected impact of explanatory variables on credit spreads. Appendixes B and C provide a summary of descriptive statistics.

In Table 4, we conducted Wilcoxon z-tests and Fisher's exact tests to compare the variables of conventional bonds (CB) with three sub-samples of ESG bonds: green bond (GB), social bond (SB), and sustainability bond (SusB). This table reveals the main differences between conventional and ESG bonds, particularly the number of tranches and pricing. CB have more tranches, while the average credit spreads are higher for CB (207.9 bps) than for GB (173.2 bps), SusB (125.8 bps), and SB (62.5 bps). We also analysed the credit spread evolution of these bonds from 2012 through January 2020 (pre-COVID-19) and from February 2020 through 2022 (COVID-19 period) in Table 5. The results from both periods confirm the findings in Table 4. Specifically, between 2012 and 2022, it was observed that the average credit spread differences decreased as the rating decreased. However, in the pre-COVID-19 period, the average spread of GB was higher than CB, specifically for AA-, A-, BBB+, BBB, and BBB- ratings.

Table 3: Definition of variables, sources, and expected impact on credit spread.

Variable name	Variable definition	Source	Expected impact on the spread			
			Conventional bonds	Green bonds	Social bonds	Sustainability bonds
Dependent variable:						
Credit spread	The yield spread at issue of all bonds (ESG and conventional)	DCM Analytics and Datastream				
Independent variables:						
Contractual characteristics						
ESG	It is a dummy variable that takes a value equal to "1" if a bond is classified as ESG and "0" otherwise.	DCM Analytics	NA	-	-	-
Green	It is a dummy variable that takes a value equal to "1" if a bond is classified as green and "0" otherwise.	DCM Analytics	NA	-	NA	NA
Social	It is a dummy variable that takes a value equal to "1" if a bond is classified as Social and "0" otherwise.	Authors'	NA	NA	-	NA
Sustainability	It is a dummy variable that takes a value equal to "1" if a bond is classified as Sustainability and "0" otherwise.	Authors'	NA	NA	NA	-
Rating	It is the bond rating is based on the S&P and Moody's ratings at the time of bond issuance. The rating is converted as follows: AAA = Aaa = 1, AA+=Aa1=2, and so on until CC=20. Code 0 = note rated.	DCM Analytics	+	+	+	+
Subordinated	It is a dummy variable that takes a value equal to "1" if the bond is subordinated and "0" if not.	Authors'	+	+	+	+
Maturity	It is the maturity of the bonds in years.	DCM Analytics	+	+	+	+

Variable name	Variable definition	Source	Expected impact on the spread			
			Conventional bonds	Green bonds	Social bonds	Sustainability bonds
Transaction size	It is the bond transaction size. Transaction size is converted into Euro millions when necessary.	DCM Analytics	-	-	-	-
Number of tranches	It is the number of tranches per transaction.	DCM Analytics	+	+	+	+
Currency risk	It is a dummy variable that takes a value equal to "1" for bonds denominated in a currency different from the currency in the deal's nationality and "0" otherwise.	Authors'	+	+	+	+
Callable	It is a dummy variable that takes a value equal to "1" if the bond is callable by the issuer, and "0" otherwise.	Authors'	+	+	+	+
Experienced green	It is a dummy variable equal to one if the issuer is not issuing a green bond for the first time, zero otherwise.	Authors'	NA	-	NA	NA
Use of proceeds – Purpose of a bond	It is a categorical variable capturing the purpose of the issuance, divided into 4 categories: "1"- corporate control category, including acquisition funding, leveraged and management buyouts, private placements, or spin-offs. "2" - capital structure category, which entails borrowing for refinancing, debt repayment, recapitalisation, dividend recapitalisation and restructuring. "3"- fixed asset-based proceeds are used for aircraft purchases, shipping, and general capital expenditures. "4" - general corporate purpose category, which includes	DCM Analytics	NA	NA	NA	NA

Variable name	Variable definition	Source	Expected impact on the spread			
			Conventional bonds	Green bonds	Social bonds	Sustainability bonds
	funding with general stated as its purpose, credit for working capital, public finance, and investments, as well as funding with an empty loan purpose code.					
Macroeconomic factors						
Volatility	It is the Chicago Board Options Exchange Volatility Index (VIX). VIX reflects market estimates of future volatility.	Datastream	+	+	+	+
Country risk	It is the S&P's country credit rating is at a close. Therefore, the rating is converted as AAA = 1, AA+=2, and so on until C = 21.	S&P Global Ratings	+	+	+	+
COVID-19	It is a dummy variable that takes a value equal to "1" if the bond was issued after the pandemic by COVID-19 came into force (from 1 February 2020 through to 31 December 2022) and "0" otherwise.	Authors'	NA	NA	NA	NA
Sector	It is a variable that indicates the firm's sector.	Authors'	NA	NA	NA	NA
Vigeo ESG Rating	It is a variable that indicates the country's ESG of the bond.	Datastream	-	-	-	-
Nonfinancial firms' characteristics						
Total assets	It is a variable that indicates the firm's total assets measured in Euro million.	Datastream	-	-	-	-
Total debt to total assets	It is a variable that indicates the total debt to total assets ratio.	Datastream	+	+	+	+

Variable name	Variable definition	Source	Expected impact on the spread			
			Conventional bonds	Green bonds	Social bonds	Sustainability bonds
Fixed assets to total assets	It is a variable which indicates the ratio of fixed assets to total assets. Fixed assets include property, plant and equipment.	Datastream	-	-	-	-
Market to book value	It is a variable that indicates the sum of the book value of liabilities and the market value of equity divided by the book value of assets.	Datastream	-	-	-	-
Return on assets	It is a variable that indicates the net income before preferred dividends minus the preferred dividend requirement, divided by total assets.	Datastream	-	-	-	-

Table 4: Univariate statistics – pricing features associated with bonds compared.

Variable of interest	CB	ESG			Variable of interest	CB	ESG		
		GB	SB	SusB			GB	SB	SusB
Univariate analysis - continuous variables									
Credit spread (bps)					**Transaction size (€ Million)**				
Number	29 168	984	64	152	Number	29 168	984	64	152
Mean	207,9	173,2	62,5	125,8	Mean	436,3	385	359	421
Median	155,0	134,3	25,0	99,0	Median	334,9	343	323	351
Rating [1-20 weak]					**Country risk [1-21 weak]**				
Number	29 168	984	64	152	Number	29 168	984	64	152
Mean	6,1	5,5	5,1	5,6	Mean	2,6	3,0	3,8	3,0
Median	7,0	7,0	5,0	6,0	Median	1	1	5	3
Vigeo ESG Rating					**Maturity (years)**				
Number	10 052	680	56	106	Number	29 168	984	64	152
Mean	77,6	79,5	74,2	76,8	Mean	9,5	9,1	9,3	12,0
Median	78,2	79,9	71,5	79,3	Median	7,0	7,0	7,0	10,0
Number of tranches					**Use of proceeds**				
Number	29 168	984	64	152	Number	29 168	984	64	152
Mean	2,0	1,5	2,2	1,8	Mean	3,3	3,8	3,8	3,8
Median	1	1	2	1	Median	4	4	4	4
Univariate analysis - dummy variables									
ESG					**Subordinated**				
Nr. of tranches	29 168	984	64	152	Nr. of tranches	29 168	984	64	152
Nr. of tranches with d=1	0	984	64	152	Nr. of tranches with d=1	96	19,68	0	0
% of total	0,0%	100%	100%	100%	% of total	0,3%	2%	0%	0%
Experienced green					**Callable**				
Nr. of tranches	29 168	984	64	152	Nr. of tranches	29 168	984	64	152
Nr. of tranches with d=1	0	846	0	0	Nr. of tranches with d=1	16 917	620	22	97
% of total	0,0%	86%	0%	0%	% of total	58%	63%	34%	64%
Currency risk					**COVID-19 period**				
Nr. of tranches	29 168	984	64	152	Nr. of tranches	29 168	984	64	152
Nr. of tranches with d=1	6 125	226	4	29	Nr. of tranches with d=1	9 042	699	61	126
% of total	21%	23%	6%	19%	% of total	31%	71%	95%	83%

This table reports summary statistics for a sample of ESG bonds – GB, SB, SusB –, and CB issued during the 2012–2022 period. Information on the characteristics of bond issuances was obtained from DCM Analytics and Datastream. We test for similar distributions in contractual characteristics using the Wilcoxon rank-sum test for continuous variables and the Fisher's exact test for discrete ones. The bond rating is based on the S&P and Moody's ratings at the time of bond issuance. The rating is converted as follows: AAA = Aaa = 1, AA+=Aa1=2, and so on until D = 22. For a definition of the variables, see Table 3.

2.2.1. Credit spread

Credit spread corresponds to the price for the risk associated with a bond tranche at the issuance date (Kapraun et al., 2021 and Fatica et al., 2021).

2.2.2 ESG, green, social and sustainability

The existence of a premium respecting green bonds, the greenium, has been recently studied and conducted to different conclusions. In order to investigate this issue, we utilised a dummy variable that takes a value equal to “1” if a bond is classified as green and "0" otherwise.

In this study, we are proposing three new approaches. The first is studying if ESG bonds have a premium regarding conventional bonds. We use a dummy variable equal to “1” if a bond is classified as ESG and "0" otherwise. The second one is studying if social bonds have a premium over conventional bonds. We use a dummy variable equal to “1” if a bond is classified as social and "0" otherwise. The third one is studying if sustainability bonds have a premium over conventional bonds. We use a dummy variable equal to “1” if a bond is classified as sustainability and "0" otherwise.

2.2.3. Credit rating

The credit ratings of bonds play a crucial role in determining their credit spreads. There is also evidence that this is also true for green bond premiums (Kapraun et al., 2021; Fatica et al., 2021; Zerbib, 2019). Hinsche (2021) found evidence that a negative green bond premium is greater for A or AAA-rated issuers. In this study, every tranche has been assigned at least one credit rating by either S&P or Moody's. These ratings are then converted in the following manner: AAA = Aaa = 1, AA+=Aa1=2, and so on until CC = 20 and code 0 for not rated bonds (similar to Kapraun et al., 2021 and Fatica et al., 2021). Rating scales are inverse scales concerning rating agencies, so we expect that spreads to increase as the rating scale increase due to the higher bond risk.

Table 5: Conventional bonds, green bonds, social bonds, and sustainability bonds mean and median credit spreads by rating.

2012-2022 Period

Credit rating	Conventional bonds			Green bonds			Social bonds			Sustainability bonds		
	Number	Credit spread		Number	Credit spread		Number	Credit spread		Number	Credit spread	
		Mean	Median		Mean	Median		Mean	Median		Mean	Median
AAA	242	122,8	95,0	4	87,1	75,0	0	0	0	0	0,0	0,0
AA+	30	75,7	69,0	1	42,5	42,5	0	0	0	6	57,0	58,0
AA	527	107,4	95,0	45	93,7	75,0	0	0	0	9	92,0	80,0
AA-	475	101,1	80,0	9	80,2	82,3	0	0	0	2	35,7	35,7
A+	1 320	102,7	88,0	23	77,1	65,0	4	33,3	16,5	12	54,8	61,1
A	1 826	130,4	100,0	39	113,0	107,3	1	27,0	27,0	7	94,9	95,0
A-	2 167	142,8	120,0	92	144,0	118,4	0	0	0	21	126,1	98,0
BBB+	3 443	145,5	130,0	176	143,5	123,0	8	141,1	165,0	18	134,5	122,5
BBB	3 259	182,3	156,8	105	164,6	151,8	0	0	0	19	148,5	131,7
BBB-	1 698	220,3	195,0	60	208,8	168,0	5	131,5	153,7	8	112,2	120,0

2012-01.2020 | Before COVID-19 period

Credit rating	Conventional bonds			Green bonds			Social bonds			Sustainability bonds		
	Number	Credit spread		Number	Credit spread		Number	Credit spread		Number	Credit spread	
		Mean	Median		Mean	Median		Mean	Median		Mean	Median
AAA	169	122,8	90,0	3	95,0	82,0	0	0	0	0	0	0
AA+	16	58,6	59,5	0	0	0	0	0	0	0	0	0
AA	306	101,2	92,8	7	75,6	75,0	0	0	0	3	85,5	75,0
AA-	249	98,5	72,0	1	123,4	123,4	0	0	0	0	0	0
A+	822	89,5	75,5	5	52,3	27,8	0	0	0	0	0	0
A	1 219	121,3	95,0	9	134,0	144,0	0	0	0	0	0	0
A-	1 390	128,7	110,0	29	148,9	129,7	0	0	0	3	96,1	98,0
BBB+	2 223	139,9	127,0	42	132,4	116,3	1	79,5	79,5	2	125,5	125,5
BBB	2 054	177,5	155,0	34	148,2	135,3	0	0	0	0	0	0
BBB-	1 027	220,1	195,0	13	299,7	240,0	0	0	0	2	115,0	115,0

02.2020-2022 I COVID-19 period												
Credit rating	Conventional bonds			Green bonds			Social bonds			Sustainability bonds		
	Number	Credit spread		Number	Credit spread		Number	Credit spread		Number	Credit spread	
		Mean	Median		Mean	Median		Mean	Median		Mean	Median
AAA	73	122,7	110,0	1	63,4	63,4	0	0	0	0	0	0
AA+	14	95,4	80,0	1	42,5	42,5	0	0	0	6	57	58
AA	221	115,9	102,0	38	97,2	74,5	0	0	0	6	95,3	80,0
AA-	226	104,1	90,0	8	74,8	78,4	0	0	0	2	35,7	35,7
A+	498	124,5	108,0	18	83,9	70,0	4	33,3	16,5	12	54,8	61,1
A	607	148,7	120,0	30	106,7	101,4	1	27,0	27,0	7	94,9	95,0
A-	777	168,0	142,6	63	141,8	112,0	0	0	0	18	131,1	105,0
BBB+	1 220	155,9	140,0	134	147,0	130,0	7	149,9	181,1	16	135,6	122,5
BBB	1 205	190,4	164,5	71	172,4	151,8	0	0	0	19	148,5	131,7
BBB-	671	220,6	198,0	47	183,6	160,0	5	131,5	153,7	6	111,2	120,0

This table displays number, mean and median credit spread for asset conventional bonds, EGS bonds, green bonds, social bonds and sustainability bonds, issues by initial S&P and/or Moody's credit ratings. Only investment-grade bonds were included.

2.2.4. Contractual characteristics

Multiple studies have shown that various contractual elements, in addition to rating categories, provide insight into bond pricing (Fatica et al., 2021; Hinsche, 2021; Löffler et al., 2021; Kapraun et al., 2021; Hyun et al., 2020; Zerbib, 2019). These include maturity, deal size, number of tranches, currency risk, callable, experienced green and the use of proceeds, meaning the purpose of a bond.

Investors generally consider bonds with longer maturities riskier than those with shorter maturities. As a result, they often require higher premiums for long-term securities.

The issue size of a green bond can reduce the green bond premium, as reported by Hyun et al. (2020) and Kapraun et al. (2021). We anticipate that there will be a negative impact on spreads, with larger issues having lower spreads.

A subordinated bond is a bond that grants the buyer a lower priority claim on a company's assets compared to senior debt holders but is still higher than shareholders. Due to the increased risk, a higher yield is typically provided as compensation. In order to evaluate this, we utilise a subordinate dummy variable that is set to one for tranches that are considered subordinate. We hypothesise that subordinate bonds will have a favourable effect on credit spreads.

In terms of currency risk, we think the tranches more exposed to it will have higher spreads than those that are not. According to Kapraun et al. (2021), investors in green bonds issued by countries with relatively low sustainability reputations might trust and value the green label more when the issue is denominated in a major currency than when the bond is issued in a local currency. On the other hand, Fatica et al. (2021) consider that bonds denominated in local currency tend to have a tighter credit spread because they hold a lower exchange risk than bonds issued in foreign currencies. In this study, our sample of bonds was issued in more than 30 currencies. To assess the effect of the currency risk on the credit spread, we use a dummy variable that takes a

value equal to "1" for bonds denominated in a currency different from the currency in the deal's nationality and "0" otherwise.

Like Fatica et al. (2021), we also consider the impact on the credit spread of a callable dummy variable. A callable bond is a type of bond that gives the issuer the option to redeem it before its maturity date without any obligation to do so. This bond has an embedded call option that can be advantageous for the issuer if they predict that the interest rates will decrease. It enables them to redeem the bonds and issue new ones with lower coupon rates. However, investors should be aware that this presents a higher risk for them as they may miss out on future interest payments if the bonds are redeemed. This makes the bond riskier, resulting in a premium to compensate investors for the added risk. To assess the effect of the call option feature on the credit spread, we use a dummy variable that takes a value equal to "1" if the bond is callable by the issuer and "0" otherwise. We believe that callable bonds will positively impact credit spreads.

Fatica et al. (2021) believe that repeated debt issues on the green bond market can provide information benefits to investors. In his study, he found a greenium of 35 bps for non-financial corporations, which could be explained by considering that issuers placing more than one green bond can better signal their greenness over time. Following Fatica et al. (2021), we control first-time and repeated issuers' impact on credit spreads regarding green bonds. For that, we use the experienced green dummy variable equal to one if the issuer is not issuing a green bond for the first time and zero otherwise. We expect a negative effect on credit spread because sellers who have previously sold bonds can expect a higher premium rate than those new to the bond-selling process.

Also similar to Fatica et al. (2021), we control the purpose of the bond, and for that, we categorise the bond's purpose into 4 categories:

"1"- corporate control category, including acquisition funding, leveraged and management buyouts, private placements, or spin-offs.

"2" - capital structure category entails borrowing for refinancing, debt repayment, recapitalisation, dividend recapitalisation and restructuring.

"3"- fixed asset-based proceeds are used for aircraft purchases, shipping, and general capital expenditures.

"4" - general corporate purpose category, which includes funding with general stated as its purpose, credit for working capital, public finance, and investments, as well as funding with an empty loan purpose code.

2.2.5. Macroeconomic factors

We also analyse how macroeconomic factors affect credit spreads. We use the Chicago Board Options Exchange Volatility Index (VIX) to measure market volatility and predict future volatility. Based on our analysis, we anticipate that credit spreads will be positively impacted by market volatility (Löffler et al., 2021).

In order to effectively understand the risks of investing in various countries, we obtained S&P's country rating to control for country risk. Therefore, the rating is converted as AAA = 1, AA+=2, and so on until C = 21, as Marques & Pinto (2020). We expect a positive effect on credit spreads.

Anyfantaki et al. (2022), Mathew & Sivaprasad (2022), Kapraun et al. (2021), Hachenberg & Schiereck (2018), and Crifo et al. (2017) recognise the significance of ESG criteria as essential non-financial information. To assess if the ESG performance of the country where the bond has been issued impacts credit spreads, we use the same indicator as Crifo et al. (2017), the Vigeo sustainability country ratings. According to Crifo et al. (2017), government bond spreads have lower borrowing costs associated with high ESG ratings. However, the impact of ESG ratings on sovereign borrowing costs is about three times weaker than that of financial ratings (measured by S&P ratings) on sovereign borrowing costs. Additionally, Crifo et al. (2017) suggest that while extra-financial ratings play, from the standpoint of investors, an essential role in assessing risk, investors use them as a supplement to financial ratings. On the other hand, Mathew & Sivaprasad (2022) found that ESG ratings are the primary drivers of

the performance of sustainable bonds. Socially responsible investments matter most for firms' credit ratings, which results in an enhanced credit rating for the firms in long-term sustainability and thus reduces the probability of default. Consistent with these findings, we anticipate that Vigeo sustainability country ratings will negatively affect credit spreads.

Several authors referred that the company sector plays a role in green investment (Anyfantaki et al., 2022; Azhgaliyeva et al., 2022; Lau et al., 2022; Lichtenberger et al., 2022; Löffler et al., 2021; Agliardi & Agliardi, 2021; Hinsche, 2021; Packer, 2017). We use a sector dummy variable to control unobserved macroeconomic trends and possible industry-specific variations to determine if these implications apply to the broader sustainable market.

When studying the behaviour of green bonds during COVID-19, several authors found features of a safe haven (Dong et al., 2022). Qi & Zhang (2022) suggest that incorporating green bonds into their portfolios, aside from their environmental or climate benefits, appears to be an attractive diversification opportunity for investors in stock and energy assets return. On the other hand, according to authors like Aloui et al. (2022), investors who prioritise environmental, social, and governance (ESG) factors should consider the possibility of crises harming the dynamics of the green market. These authors not only highlighted the limitations of the Green Quantitative Easing by the ECB in crisis periods but also noticed that the green monetary intervention could drive investors towards green markets only during non-crisis periods. Zaghini (2023) has found out that the issuance of green bonds, regardless of whether they are eligible for ECB programs, had a reduction in the spread of about 20 basis points since the introduction of the ECB's pandemic emergency purchase program (PEPP). Additionally, green bonds that qualified for ECB programs had a further decrease in premium by 17 basis points. According to (Perote et al., 2023), sustainable market investors exhibit a similar reaction pattern to traditional market investors, but their sensitivity towards the daily COVID-19 news is significantly higher. This heightened sensitivity can result in exceedingly positive or negative

reactions, surpassing those of the average US stock market investor. Based on these conflicting research findings, we decided to examine the impact of this extreme event on credit spreads, and we include a dummy for the COVID-19 crisis, which takes a value equal to "1" if the bond was issued after pandemic COVID-19 came into force (from 1 February 2020 through to 31 December 2022) and "0" otherwise.

Finally, we utilise a year dummy variable to account for unobserved macroeconomic trends.

2.2.6. Issuing firms' characteristics

We examine the impact of firms' characteristics on credit spreads in line with other studies (Mathew & Sivaprasad, 2022; Kempa & Moslener, 2022; Cicchiello et al., 2022; Flammer, 2021; Tang & Zhang, 2020; Wang et al., 2020; Marques & Pinto, 2020; Wulandari et al., 2018). We include proxies for issuing firms' size (log total assets), financial leverage (total debt to total assets), asset tangibility (fixed assets to total assets), growth opportunities (market to book value) and profitability (return on assets). We expect a negative impact of total assets, fixed assets-to-total assets, ROA, and market-to-book variables, on credit spreads but a positive relationship between total debt-to-total assets ratio and credit spreads. We collect firm-specific accounting and market data from Datastream in the fiscal year ending before bond issuance.

Chapter 3
Results

3.1 Main results

Table 6 reports our baseline results with 4 models for the entire sample comprising all categories of bonds. Model [1] shows the impact of credit rating on credit spreads. According to the data, ESG bonds are being sold at a discount premium of 9.29 basis points (bps) over conventional bonds, as indicated by the negative coefficient of the ESG dummy. However, the effect is not statistically significant. This model may hide some heterogeneity, so we introduced more contractual variables in the model [2]. According to model [2], the premium has decreased to 5.93 bps compared to the previous model, but it is still not considered statistically significant. Model [3] includes model [2] and some macroeconomic factors revealing that, in this case, ESG bonds are being sold at a discount premium of 12.57 bps over conventional bonds, higher than model [1] and [2]. However, the coefficient remains not statistically significant. The last model [4], which is an addition to our previous model [3], with the "use of proceeds-fixed effects", the "industry-fixed effects", and the "year-fixed effects". According to Model 4, ESG bonds are being sold at a small positive premium of 2.16 bps compared to conventional bonds, which contradicts the results of the models [1], [2], [3]. Nevertheless, in this model, the effect is also not statistically significant.

According to these results, we reject H1. This is because sustainable bonds do not trade at a premium compared to conventional bonds. These findings are similar to Kapraun et al. (2021), who argue that investors have a weak preference for green bonds or low trust in the purpose of these bonds.

Table 6: Regression analyses of the determinants of credit spreads.

Dependent variable: Credit spread (bps)	[1] All types of bonds	[2] All types of bonds	[3] All types of bonds	[4] All types of bonds	[4a] All types of bonds Pre-COVID-19	[4b] All types of bonds COVID-19
Independent variables:						
Intercept	81.37 ***	288.47 **	285.85 ***	311.49 ***	442.93 ***	44.43
	(3.18)	(116.67)	(95.01)	(96.06)	(86.74)	(146.94)
ESG dummy	-9.29	-5.93	-12,57	2.16	36.64 **	-1.83
	(9.52)	(12.06)	(11,62)	(9.35)	(15.06)	(9,65)
AA+	15.13	21.90	3.75	-4.01	-2.24	-18.82
	(13.01)	(13.59)	(6.39)	(9.11)	(8.73)	(19.98)
AA	11.17 *	15.63 *	0.36	4.53	9.86	0.33
	(6.48)	(9.37)	(8.01)	(9.24)	(12.52)	(12.67)
AA-	3.00	1.65	-9.37	-1.87	-2.12	-12.50
	(7.13)	(10.91)	(7.73)	(6.88)	(10.28)	(9.23)
A+	15.75 **	14.31	-0.97	13.58 *	10.05	14.95 *
	(7.34)	(12.68)	(7.21)	(7.22)	(10.84)	(7.86)
A	35.68 ***	32.24 **	17.46 **	25.68 ***	19.50 *	30.64 ***
	(8.72)	(15.00)	(8.58)	(8.33)	(10.87)	(10.87)
A-	44.75 ***	41.63 ***	28.44 ***	41.14 ***	36.14 ***	43.24 ***
	(7.34)	(13.38)	(9.08)	(8.83)	(11.58)	(11.60)
BBB+	75.71 ***	67.34 ***	53.69 ***	65.64 ***	64.89 ***	60.20 ***
	(7.03)	(13.51)	(9.58)	(9.36)	(12.25)	(12.97)
BBB	104.02 ***	92.10 ***	79.03 ***	88.18 ***	80.52 ***	92.79 ***
	(9.79)	(17.13)	(12.21)	(11.47)	(13.09)	(16.70)
BBB-	146.25 ***	135.90 ***	125.54 ***	136.17 ***	134.77 ***	135.38 ***
	(9.95)	(17.90)	(14.77)	(14.76)	(15.89)	(26.47)
BB+	248.42 ***	237.18 ***	231.62 ***	241.89 ***	218.89 ***	278.72 ***
	(18.82)	(26.97)	(24.15)	(25.05)	(22.64)	(41.02)
BB	280.30 ***	265.75 ***	260.65 ***	275.38 ***	257.04 ***	304.77 ***
	(17.21)	(24.62)	(22.42)	(22.15)	(21.23)	(41.77)

Dependent variable:	[1]		[2]		[3]		[4]		[4a]		[4b]	
Credit spread (bps)	All types of bonds		All types of bonds		All types of bonds		All types of bonds		All types of bonds Pre-COVID-19		All types of bonds COVID-19	
BB-	330.46	***	312.03	***	310.13	***	325.93	***	310.70	***	357.00	***
	(13.59)		(21.54)		(19.40)		(20.11)		(20.46)		(29.60)	
B+	393.14	***	375.47	***	371.58	***	388.24	***	379.01	***	400.03	***
	(13.05)		19.57		(17.98)		(18.28)		(22.08)		(26.64)	
B	476.94	***	455.93	***	452.57	***	467.68	***	453.79	***	493.29	***
	(18.12)		(24.52)		(23.51)		(22.65)		(25.06)		(39.40)	
B-	506.92	***	486. 16	***	485.71	***	498.11	***	490.51	***	511.62	***
	(20.98)		(25.51)		(25.04)		(22.53)		(29.58)		(21.75)	
CCC+	599.31	***	576.31	***	574.98	***	589.14	***	599.31	***	544.93	***
	(24.87)		(29.45)		(28.30)		(24.72)		(26.73)		(49.76)	
CCC	671.75	***	653.18	***	653.11	***	673.53	***	696.66	***	612.65	***
	(37.64)		(37.45)		(38.08)		(29.65)		(39.17)		(31.61)	
CCC-	856.05	***	844.10	***	842.75	***	876.14	***	839.22	***	918.52	***
	(74.38)		(74.53)		(71.53)		(80.08)		(116.22)		(20.42)	
Not rated	103.93	***	130.01	***	114.72	***	128.44	***	118.93	***	140.09	***
	(11.02)		(16.41)		(11.56)		(11.86)		(14.31)		(19.06)	
Subordinated			33.65		35.13		51.18	***	62.43	**	37.74	
			(21.39)		(22.08)		(18.96)		(25.61)		(23.08)	
Log maturity			4.23		5.22		6.42	**	5.83		9.69	***
			(3.81)		(3.87)		(3.17)		(4.43)		(3.66)	
Log transaction size			-13.61	**	-15.79	***	-16.23	***	-21.07	***	-7.07	
			(6.16)		(5.16)		(4.78)		(5.13)		(5.50)	
Number of tranches			-0.22		-0.75		-0.03		0.52		-2.75	
			(4.18)		(3.97		(4.03)		(5.19)		(1.84)	
Currency risk			37.98	***	40.13	***	32.32	***	36.90	***	28.08	***
			(9.08)		(5.66)		(4.85)		(5.50)		(6.52)	
Callable			68.07	***	65.10	***	71.87	***	69.41	***	78.15	***
			(9.23)		(9.32)		(8.76)		(9.34)		(17.30)	
Experienced Green			-11.54		-12.88		-14.02		-49.14	***	-4.35	

Dependent variable:	[1]	[2]	[3]	[4]	[4a]	[4b]
Credit spread (bps)	All types of bonds	All types of bonds	All types of bonds	All types of bonds	All types of bonds Pre-COVID-19	All types of bonds COVID-19
		(8.89)	(8.84)	(9.04)	(17.21)	(8.88)
Volatility			2.68 ***	2.91 ***	1.53 **	3.07 ***
			(0.72)	(0.76)	(0.60)	(0.84)
Country risk			2.27	3.52 ***	5.37 ***	-1.55
			(1.56)	(1.37)	(1.54)	(1.60)
Use of proceeds fixed effects	No	No	No	Yes	Yes	Yes
Industry fixed effects	No	No	No	Yes	Yes	Yes
Year fixed effects	No	No	No	Yes	Yes	Yes
Number of observations	30 368	30 368	30 368	30 368	20 534	9 834
Adjusted R^2	0.51	0.54	0.56	0.59	0.61	0.58

This table presents the results of an OLS regression analysis of the determinants of bond credit spreads for: (i) a sample of 30,368 bonds - model [1], model [2], model [3]; (ii) a sample of 30,368 bonds in model [4] -, of which 20,534 bonds in pre-COVID-19 period - model [4a] - and 9,834 bonds in COVID-19 period - model [4b]. For a definition of the variables, see Table 3. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors. Due to time-varying risk premia and cross-country differences, we estimate standard errors clustered by year and country.

Table 7: Regression analyses of the determinants of credit spreads by type of bond.

Dependent variable:	[7]		[8]		[9]		[10]		[11]
Credit spread (bps)	Conventional bonds		ESG bonds		Green bonds		Social Bonds		Sustainability bonds
Independent variables:									
Intercept	1087.27	***	1072.68	***	1123.21	***	-354.80	**	658.80
	(96.49)		(144.53)		(147.28)		(154.44)		(511.36)
Rating	18.71	***	3.25		3.68		-3.93	**	0.18
	(2.15)		(2.22)		(2.27)		(1.74)		(7.56)
Subordinated	90.78	***	122.24	***	115.70	***			
	(17.57)		(20.23)		(31.64)				
Log maturity	-11.22	***	-25.50	***	-22.48	***	-12.21		-31.97
	(4.24)		(7.79)		(8.58)		(14.38)		(21.76)
Log transaction size	-49.77	***	-40.14	***	-43.40	***	19.92	*	-16.79
	(5.08)		(6.85)		(7.18)		(10.48)		(17.80)
Number of tranches	-10.89	***	-14.71	***	-10.42	**	12.86	**	-25.38
	(4.22)		(4.91)		(5.01)		(4.73)		(17.10)
Currency risk	0.54		29.00	***	18.73	*	59.39	***	-19.22
	(6.47)		(9.82)		(10.55)		(18.00)		(40.50)
Callable	57.70	***	131.81	***	134.58	***	44.17		70.69
	(14.59)		(21.19)		(20.82)		(31.97)		(58.70)
Experienced Green			-17.01	*	-68.46	***			
			(9.88)		(12.52)				
Volatility	2.49	***	2.81	***	2.91	***	0.33		0.69
	(0.70)		(0.56)		(0.66)		(0.45)		(1.43)
Country risk	6.07	***	3.33		4.28	**	37.94	***	0.29
	(1.44)		(2.05)		(2.13)		(10.75)		(4.50)
Use of proceeds fixed effects	Yes		Yes		Yes		Yes		Yes
Industry fixed effects	Yes		Yes		Yes		Yes		Yes
Year fixed effects	Yes		Yes		Yes		Yes		Yes
Number of observations	29 168		1 200		984		64		152

Dependent variable: Credit spread (bps)	[7] Conventional bonds	[8] ESG bonds	[9] Green bonds	[10] Social Bonds	[11] Sustainability bonds
Adjusted R^2	0.38	0.37	0.41	0.90	0.10

This table presents the results of an OLS regression analysis of the determinants of bond credit spreads for: (i) a sample of 29, 168 conventional bonds – model [7]; (ii) a sample of 1,200 EGS bonds– model [8]; (iii) a sample of 984 green bonds– model [9]; (iv) a sample of 64 social bonds – model [10]; and (v) a sample of 152 sustainability bonds – model [11]. For a definition of the variables, see Table 3. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors. Due to time varying risk premia and cross-country differences, we estimate standard errors clustered by year and country.

To understand the role of ESG bonds during times of crisis, we split our sample into two sub-periods. The first sub-period corresponds to a period before the beginning of the COVID-19 pandemic, from 2012 to the end of January 2020. The second sub-period corresponds to the pandemic from 1 February 2020 to the end of 2022.

Then we run our model [4] in both sub-periods, and the results are in Table 6. Model [4a] presents the results of the first sub-period before the pandemic. Surprisingly, the results contradicted the previous findings. They show that ESG bonds are being sold at a higher premium of 36.64 basis points (bps) over conventional bonds, as indicated by the positive coefficient of the ESG dummy. This outcome is in line with the findings of the model [4], both present a positive coefficient, however, contrary to model [4], in this model [4a], not only is this effect statistically significant at 5%, but it also presents a larger size of the premium. A positive premium is in accordance with the findings of Karpf & Mandel (2018) for the last two years of their observations, explained by the relative credit quality of green bonds improvement.

Model [4b] shows the results related to the pandemic period. They reveal that ESG bonds are being sold at a discount premium of 1.83 basis points (bps) over conventional bonds, as indicated by the negative coefficient of the ESG dummy. Nonetheless, the effect is not statistically significant, meaning the premium is nonexistent. This outcome is in line whit the previous findings of the models [1], [2], [3], so we reject H2. During crises such as the COVID-19 pandemic, ESG bonds are traded with the same premium as conventional bonds.

One possible explanation for this mismatch of results between the two sub-periods could be that ESG bond issues were minor from 2014 to 2019 and nonexistent from 2012 to 2013, which also was highlighted by Anyfantaki et al. (2022) and Flammer (2021). This could be related to the fact that the conventional bond market is more mature, while the ESG bond market is younger. This can be seen in Appendix A, during this sub-period, ESG bonds were dominated by the issue of green bonds, although the percentage of total value represents only 22.96%, considering the total

period from 2012 to 2022. When we look at the periods from 2020 to 2022, which correspond to the pandemic period, we can see that it was in those periods when the ESG bond market was more bustling. In these latest years, green bonds have a percentage of the total value of 77,04%, social bonds achieved a 97,24% percentage of the total value, and sustainability bonds reached 89,96% of the percentage of the total value. These percentages demonstrate the relevance of those three years and could explain these discrepancies.

As referred previously, some authors advocate several factors behind credit rating to explain the pricing of conventional bonds. Therefore, it is essential to understand if those drivers extend to the pricing of ESG bonds. Table 7 reports this analysis and presents for each type of bonds which variables explain their price. We used the same variables of the model [4] and ran that model for each category of the bonds. Model [7] describes the results for conventional bonds, and model [8] illustrates the results for ESG bonds. Credit ratings are essential to explain conventional bonds' price, but not for ESG bonds. Regarding the subordinated bond feature, both models demonstrate that this aspect is relevant to the pricing of conventional or ESG bonds. Nevertheless, the ESG bond coefficient is higher than the conventional bond coefficient by 35%, meaning that the impact on price concerning variation in this variable is more significant for ESG bonds. The contractual characteristics of maturity, transaction size, the number of tranches and volatility are drivers that contribute to the pricing of both categories of bonds and with the same dimension regarding the impact on the price. The currency risk feature is only relevant to explaining the price of ESG bonds but not for conventional bonds. One argument supporting this result could be, as Kapraun et al. (2021) reported, that green bonds issued by countries with low sustainability reputations might be more trustworthy if the issue is denominated in a major currency than when the bond is issued in local currency. On the contrary, the country's risk characteristics are critical to explaining the price of conventional bonds but irrelevant to the ESG bonds price. In respect of callable features, Table 7 reports that they contribute to the pricing of either conventional or ESG bonds. Although, the effect on

the price is different. The ESG bonds coefficient is greater than the conventional bonds coefficient by almost 130%, meaning that the impact on price concerning variation in this variable is more significant for ESG bonds. Taking everything into consideration, we reject H3. However, some factors related to conventional bond pricing are the same as ESG bonds, and others are different.

In models [9], [10], [11], it can be seen in more detail what are the drivers for pricing each ESG bond category. The first immediate discovery is that none of these listed features explains the price of sustainability bonds. The second discovery is that green bonds are driven by almost the same factors as those mentioned earlier for ESG bonds. The third discovery is that social bonds share certain factors with conventional and green bonds, but sometimes the direction of the relationship is opposite. We will examine each driver in greater detail in the following.

Regarding green bonds, the credit rating does not affect their price. However, for social bonds, it is an important factor. The negative coefficient means that social bonds with higher ratings have more risk (we remind that 1 = AAA and 20 = CC) and, therefore, a lower spread, resulting in a higher price. This behaviour is the inverse of what happens with conventional bonds and is contrary to what would be expected. Conventional bonds present a positive coefficient meaning that in bonds with higher ratings, which are riskier, the spread of the conventional bond increase to compensate for the most considerable risk. In respect of bond features like maturity, volatility and callable, the findings show that just like in conventional bonds, these factors are important to explain the price in green bonds too. However, for social bonds, they are unnecessary. Concerning the subordinated feature, it only shows values for green bonds, and it is important to explain its price as it happens with conventional bonds. Experienced green features also present data for green bonds, which is relevant to explain the credit spread. Similar to the findings of the Fatica et al. (2021) study, this coefficient indicates a negative correlation. In other words, companies that have issued multiple green bonds can reduce their credit spread. Concerning the transaction size of bonds, this driver is relevant for green bonds but less relevant for social bonds since

it is only statistical significance at the 10% level. However, the significant differences are regarding the sign and the dimension of coefficients. While the relation is negative for green bonds by 43.40 bsp, for the social bonds, the sign is positive by 19.92 bsp. The study by Fatica et al. (2021) also shows these divergences of signs in this coefficient. The same divergence is found regarding the number of tranches drivers. It is statistical significance at the 5% level for both green and social bonds but shows a negative relationship for green bonds and a positive one for social bonds. This mix of results is present in Marques & Pinto's (2020) findings. The currency risk driver positively correlates with green and social bonds. The statistical significance for green bonds is at the 10% level by 18.73 bsp, while for social bonds, it is at the 1% level by 53.39 bsp. This suggests that currency risk plays a significant role in explaining the credit spread on social bonds and has a more significant impact when compared to green bonds. Finally, regarding the country risk, as expected, the country risk driver positively correlates with green and social bonds. The statistical significance for green bonds is at the 5% level by 4,28 bsp, while for social bonds, it is at the 1% level by 37,94 bsp. This suggests that country risk plays a significant role in explaining the credit spread on social bonds and has a more significant impact when compared to green bonds.

3.2 Additional sensitivity tests

To examine further if sustainable bonds are trading at a premium regarding conventional bonds, we introduce a new macroeconomic variable and a set of firm characteristics.

Table 8 reports the results of these models with additional variables that reduce our sample.

The model [5] includes an additional macroeconomic variable, the Vigeo ESG rating. Similarly to the evidence in Table 4, we do not find an effect for the ESG label when considering Vigeo ESG Rating. The coefficient is negative at 6.38 but not statistically significant. In Model [6], we extend our baseline specification by adding several firm characteristics variables, which capture relevant features such as credit

risk and profitability. In particular, we include the following variables: the natural logarithm total assets (€ million), debt to total assets, fixed assets to total assets, market to book value and return on assets. Again, the results do not show any effect of the ESG label, although the coefficient is negative at 3.88 bps, it is not statistically significant.

These results maintain the conclusion achieved with the results presented in Table 6, and we still reject H1. With more explanatory variables, our results show that sustainable bonds do not trade at a premium compared to conventional bonds.

Then we ran model [6] in our sample split into sub-periods, and the results are shown in Table 8. Model [6a] shows the results concerning the sub-period before the beginning of the COVID-19 pandemic. They indicate that ESG bonds are being sold at a higher premium of 2.41 basis points (bps) over conventional bonds, as indicated by the positive coefficient of the ESG dummy. However, contrary to the results of the model [4a], this effect is minor and not statistically significant. With more variables to explain the behaviour of the credit spread, the results are in accordance with the results found in the model [4]. When we look at the findings during the COVID-19 period model [6b], the coefficient of the ESG dummy is below 1 bsp and positive, a different result from the model [4b]. Nevertheless, the conclusion is the same, the coefficient is not statistically significant. These findings validate our conclusion of rejecting H2. ESG bonds do not trade at a premium regarding conventional bonds during the COVID-19 pandemic.

Table 8: Regression analyses of the determinants of credit spreads with additional variables.

Dependent variable: Credit spread (bps)	[5] All types of bonds		[6] All types of bonds		[6a] All types of bonds Pre-COVID-19		[6b] All types of bonds COVID-19	
Independent variables:								
Intercept	17.86		-273.19	***	-155.67		-385.20	*
	(82.62)				(104.87)		(192.65)	
ESG dummy	-6.38		-3.88		2.41		0.55	
	(9.83)		(19.34)		(24.59)		(29.13)	
AA+	-68.33	***						
	(19.86)							
AA	-9.82		127.43	***	148.80	***		
	(18.65)		(24.96)		(27.55)			
AA-	-19.38		116.30	***	100.74	***	24.39	
	(18.03)		(23.87)		(27.56)		(15.40)	
A+	-4.91		125.69	***	127.81	***	-2.81	
	(16.53)		(23.46)		(24.57)		(16.41)	
A	-0.34		125.65	***	128.54	***	5.26	
	(15.43)		(23.20)		(23.85)		(17.23)	
A-	13.03		128.49	***	130.35	***	18.05	
	(16.35)		(22.35)		(23.57)		(18.61)	
BBB+	34.82	**	148.27	***	140.04	***	45.25	***
	(16.95)		(21.32)		(22.46)		(16.82)	
BBB	51.89	***	174.42	***	166.70	***	70.27	***
	(18.38)		(23.47)		(25.00)		(22.71)	
BBB-	93.10	***	211.81	***	217.39	***	80.80	***
	(19.84)		(22.22)		(24.18)		(24.65)	
BB+	174.23	***	287.18	***	272.84	***	181.20	***
	(21.20)		(25.15)		(27.22)		(35.93)	
BB	244.11	***	360.13	***	347.31	***	267.57	***
	(24.02)		(24.94)		(27.81)		(31.77)	
BB-	298.62	***	413.77	***	420.02	***	257.20	***
	(24.89)		(28.70)		(31.74)		(42.03)	
B+	386.83	***	495.40	***	505.60	***	318.54	***
	(23.60)		(33.52)		(35.62)		(73.16)	
B	443.76	***	513.61	***	498.88	***	425.83	***
	(26.09)		(35.38)		(42.66)		(33.81)	
B-	479.64	***	538.58	***	520.40	***	417.18	***
	(29.06)		(38.70)		(39.29)		(70.05)	
CCC+	597.53	***	596.80	***	566.26	***	523.72	***
	(45.11)		(52.89)		(54.73)		(119.63)	
CCC	753.77	***	1048.03	***	1037.91	***		
	(62.39)		(31.45)		(34.80)			
CCC-								
Not rated	95.31	***	265.18	***	257.46	***	151.07	***
	(19.86)		(25.22)		(27.55)		(28.06)	
Subordinated	81.81	***	76.26	***	88.33	***	60.26	
	(20.11)		(22.80)		(25.18)		(48.14)	

Dependent variable:	[5]		[6]		[6a]		[6b]	
Credit spread (bps)	All types of bonds		All types of bonds		All types of bonds Pre-COVID-19		All types of bonds COVID-19	
Log maturity	2.61		17.78	***	16.16	***	18.96	***
	(3.35)		(3.79)		(4.69)		(5.84)	
Log transaction size	-15.26	***	7.33	*	3.33		14.83	
	(3.32)		(4.29)		(4.44)		(9.10)	
Number of tranches	-8.72	***	-2.34		-2.80		2.19	
	(1.90)		(2.37)		(3.09)		(4.48)	
Currency risk	14.15	***	-3.62		-9.41	*	5.91	
	(4.57)		(4.61)		5.29		(8.43)	
Callable	89.80	***	32.80	***	36.39	***	29.32	**
	(10.54)		8.80		(10.31)		(11.67)	
Experienced Green	-23.19	**	-7.10		-20.50		2.92	
	(11.12)		(22.86)		(34.95)		(32.85)	
Volatility	2.79	***	2.81	***	0.33		3.16	***
	(0.35)		(0.27)		(0.67)		(0.43)	
Country risk	4.68	***	3.30	**	4.63	***	0.26	
	(1.68)		(1.41)		(1.74)		(1.44)	
Vigeo rating	4.60	***	1.39	**	1.70	**	0.66	
	(0.81)		(0.60)		(0.70)		(0.83)	
Log Total assets			-15.11	***	-14.69	***	-19.52	***
			(2.73)		(3.29)		(5.27)	
Total debt to total assets			52.19	***	39.89	*	103.96	***
			(20.00)		(20.61)		(33.07)	
Fixed assets to total assets			124.48		107.05		142.33	
			(102.16)		(146.61)		(121.29)	
Market to book value			-0.74		-0.97		-0.46	
			(0.52)		(0.61)		(0.57)	
Return on assets			-1.11	**	-0.91	**	-3.05	***
			(0.46)		(0.45)		(1.02)	
Use of proceeds fixed effects	Yes		Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Number of observations	10 894		3 491		2 352		1 139	
Adjusted R^2	0.60		0.64		0.66		0.62	

This table presents the results of an OLS regression analysis of the determinants of bond credit spreads, with additional variables regarding Table 5, such as Vigeo rating and several firms' characteristics for: (i) a sample of 10,894 bonds - model [5]; (ii) a sample of 3,491 bonds in model [6] -, of which 20,352 bonds in pre-COVID-19 period - model [6a] - and 1,139 bonds in COVID-19 period - model [6b]. For a definition of the variables, see Table 3. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors. Due to time-varying risk premia and cross-country differences, we estimate standard errors clustered by year and country.

Chapter 4
Conclusion

Currently, ESG bonds are gaining relevance and are considered an important financial instrument to fund environmental, social and sustainability investments. If a company needs financial support to undertake an ESG project, it can opt for either conventional or ESG bonds, as the latter is not mandatory. From the supply perspective, some authors advocate that by issuing ESG bonds, the firm is making a signal to the market – the signalling effect. Other authors are in accordance with the cost of capital argument that firms can lower their borrowing costs by reducing ESG bond spreads. From the demand perspective, evidence shows that investors value sustainability and are willing to pay for non-monetary attributes of investments. This controversy surrounds the motivations behind ESG bond literature. However, it fails to provide an objective answer to the question: "What is the purpose of firms issuing this type of instrument, and why should investors consider buying it?" Most researchers try to answer this question by studying a subtype of ESG bonds, the green bonds. Our study contributes to the literature covering the study of all the subtypes of corporate ESG bonds: green, social and sustainability. Based on Mathew & Sivaprasad's (2022) recommendation, we researched the yield differences between sustainable and conventional corporate bonds.

We found no significant difference in spreads at issuance for ESG bonds vis-à-vis comparable conventional bonds, all other factors being equal. Our findings are in line with those of other authors regarding green bonds, such as Kapraun et al. (2021), and Zerbib (2019) and broadly agree with Lau et al. (2022), which conclude that the world is unwilling to pay to save the Earth.

Based on our findings, we must assert that the cost of capital argument is not valid. The fact is that there is no discernible difference in pricing between ESG and

conventional bonds. Thus, it is clear that ESG bonds do not provide a cheaper source of debt financing.

A potential explanation for the lack of a premium is that the ESG market is still relatively new and experiencing significant growth, as noted by several researchers, particularly by Anyfantaki et al. (2022). Additionally, there is a recognised need for greater transparency and uniform standards for determining the eligibility of ESG projects, obtaining external certification, and improving reporting. However, the recent regulations in the EU, set to take effect in 2024, have been introduced alongside proposals from the SEC and SASB standards in the US. These initiatives may lead to investors accepting a lower spread in support of a more sustainable world in the future.

A second finding is that there were no discernible variances in credit spread between conventional and ESG bonds in both the pre-COVID-19 and COVID-19 periods. Our research findings differ from Zaghini's (2023) and Caramichael et al. (2022) results, which showed a premium during the COVID-19 crisis. Instead, our findings align with those of Perote et al. (2023). It is essential to acknowledge that our study encompasses a more extensive analysis period than the cited researchers. This is due to the inclusion of data from the COVID-19 period spanning from February 2020 to December 2022. This adds a revitalising aspect to the overall literature.

Our third and last finding was that most of the factors related to conventional bond pricing are the same as ESG bonds. However, credit ratings and country risk do not drive ESG bonds as they do for conventional bonds. We have not found any evidence to support the Mathew & Sivaprasad (2022) study that suggests ESG ratings are the main contributing factor to the success of sustainable bonds. ESG bond drivers include subordination level, maturity, transaction size, number of tranches, currency risk, callable, and market volatility.

Two key objectives could be further explored through additional research. Scholars could investigate the robustness of these results using different methodological techniques, such as matching the sample of green bonds with conventional bonds with

similar characteristics, both in terms of issuer structure (rating, sector), issuance volume, bond seniority and time to maturity. It would also be beneficial to conduct further research on the corporate ESG bond market in the future as it becomes more mature, namely after the EU's new regulations come into effect and for social and sustainability bonds.

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Appendixes

Appendix A. Distribution of tranches by year.

Year	Conventional bonds			Green bonds			Social bonds			Sustainability bonds		
	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value	Number of tranches	Total value [€ Million]	Percent of total value
2012	2 322	892 920	7,02	0	0	0,00	0	0	0,00	0	0	0,00
2013	1 943	713 103	5,60	0	0	0,00	0	0	0,00	0	0	0,00
2014	524	184 904	1,45	4	542	0,14	0	0	0,00	0	0	0,00
2015	3 121	1 183 931	9,30	18	6 766	1,78	0	0	0,00	0	0	0,00
2016	3 004	1 246 961	9,80	20	7 317	1,93	0	0	0,00	1	76	0,12
2017	3 285	1 240 703	9,75	48	19 550	5,16	0	0	0,00	2	166	0,26
2018	2 870	1 047 697	8,23	60	17 470	4,61	1	300	1,31	1	171	0,27
2019	2 897	1 232 673	9,69	118	35 426	9,34	1	335	1,46	19	6 017	9,40
2020	5 584	3 080 529	24,21	221	82 225	21,68	19	8 624	37,52	35	19 816	30,95
2021	2 291	1 187 997	9,33	261	112 037	29,54	11	3 838	16,70	51	22 324	34,86
2022	1 327	715 046	5,62	234	97 900	25,82	32	9 888	43,02	43	15 466	24,15
Total	**29 168**	**12 726 464**	**100,00**	**984**	**379 233**	**100,00**	**64**	**22 985**	**100,00**	**152**	**64 035**	**100,00**

This table presents the distribution of the full sample of tranches by year. Data are for tranches reported in DCM Analytics with amount available, issued by and nonfinancial firms during the 2012–2022 period.

Appendix B. Descriptive statistics for all types of bonds regarding continuous variables.

Panel A: Continuous variables												
Variable of interest	**Conventional bonds**						**Green bonds**					
	Number	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**	**Number**	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**
Contractual characteristics												
Rating	29168	6,09	7,00	4,82	0	19	984	5,51	7	4,14	0	17
Maturity (Years)	29168	9,47	7,00	8,40	0	100	984	9,05	7	8,76	1	62
Transaction size (€ Million)	29168	436,32	334,85	448,31	0,00	10128,91	984	385,4	342,88	317,82	4,94	2161,23
Number of tranches	29168	1,96	1,00	1,61	1	20	984	1,48	1	0,86	1	9
Use of proceeds – Purpose of a bond	29168	3,25	4,00	1,05	1	4	984	3,75	4	0,65	1	4
Macroeconomic factors												
Volatility	29168	19,29	16,22	9,58	9,14	82,69	984	21,91	20,55	8,82	9,14	72
Country risk	29168	2,63	1	2,42	0	21	984	2,95	1	2,75	1	20
Sector	29168	9,2	10	9,2	1	17	984	11,17	11	3,96	1	17
Vigeo ESG Rating	10052	77,58	78,18	5,34	68,71	86,96	680	79,54	79,9	5,85	68,71	86,96
Firms' characteristics												
Total assets (€ Million)	9984	68,99	27,18	110,35	0,00	741,67	345	49,38	17,28	81,37	0,00	483,628
Debt to total assets	9968	0,42	0,4	0,24	0,00	5,3	345	0,44	0,39	0,4	0,00	5,3
Fixed assets to total assets	9936	0,04	0,3	0,3	0,00	0,39	339	0,06	0,05	0,05	0,00	0,24
Market to book	9984	4,49	2,32	76,56	-1793,07	305,49	345	2,15	1,6	8,06	-86,98	42,05
Return on assets	9652	4,22	4,28	13,28	-898,82	51,14	335	4,17	3,78	4,3	-10,82	28,68
Variable of interest	**Social bonds**						**Sustainability bonds**					
	Number	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**	**Number**	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**
Contractual characteristics												
Rating	64	5,08	5	2,54	0	10	152	5,61	6	3,17	0	12
Maturity (Years)	64	9,25	7	9,2	2	49	152	11,99	10	9,33	2	40
Transaction size (€ Million)	64	359,14	323,44	215,93	42,11	850	152	421,28	350,51	348,18	7,34	2122,42
Number of tranches	64	2,2	2	0,99	1	4	152	1,79	1	1,31	1	8

Panel A: Continuous variables												
Use of proceeds – Purpose of a bond	64	3,77	4	0,61	2	4	152	3,84	4	0,56	1	4
Macroeconomic factors												
Volatility	29168	24,02	23,38	5,47	12,05	38,15	152	22,4	21,28	7,86	9,43	63,95
Country risk	29168	3,8	5	1,73	1	5	152	2,99	3	2,08	1	10
Sector	29168	13,2	15	2,74	5	15	152	10,24	11	4,07	1	17
Vigeo ESG Rating	10052	74,19	71,46	4,91	71,46	86,5	106	76,81	79,27	5,19	68,71	86,5
Firms' characteristics												
Total assets (€ Million)	9984	19,43	11,96	19,91	4,33	41,99	36	106,94	72,09	92,31	3,12	262,51
Debt to total assets	9968	0,4	0,41	0,16	0,23	0,55	36	0,29	0,3	0,16	0,05	0,55
Fixed assets to total assets	9936	0,05	0,02	0,05	0,02	0,12	33	0,05	0,05	0,03	0,0138738	0,1249708
Market to book	9984	2,96	2,66	1,22	1,91	4,3	36	5,71	1,72	15,76	0	94,91
Return on assets	9652	6,97	7,92	2,31	4,34	8,65	36	6,48	4,43	5,18	0,83	18,63

This table presents the descriptive statistics for continuous variables of conventional and ESG type of bonds samples issued during the 2012–2022 period worldwide.

Information on the characteristics of bond issuances was obtained from DCM Analytics and Datastream. For a definition of the variables, see Table 3.

Appendix C. Descriptive statistics for all types of bonds regarding dummy variables.

Panel B: Dummy variables						
Variable of interest	**Conventional bonds**			**Green bonds**		
	Number	**% of total**	**Std. Dev.**	**Number**	**% of total**	**Std. Dev.**
ESG dummy	29168	0%	0,00	984	100%	0,00
Green	29168	0%	0,00	984	100%	0,00
Social	29168	0%	0,00	984	0%	0,00
Sustainability	29168	0%	0,00	984	0%	0,00
Subordinated	29168	0%	0,06	984	2%	0,13
Currency risk	29168	21%	0,41	984	23%	0,42
Callable	29168	58%	0,49	984	63%	0,48
Experienced green	29168	0%	0,00	984	86%	0,34
COVID-19	29168	31%	0,46	984	71%	0,45
Variable of interest	**Social bonds**			**Sustainability bonds**		
	Number	**% of total**	**Std. Dev.**	**Number**	**% of total**	**Std. Dev.**
ESG dummy	64	100%	0,00	152	100%	0,00
Green	0	0%	0,00	0	0%	0,00
Social	64	100%	0,00	152	0%	0,00
Sustainability	64	0%	0,00	152	100%	0,00
Subordinated	64	0%	0,00	152	0%	0,00
Currency risk	64	6%	0,24	152	19%	0,39
Callable	64	34%	0,48	152	64%	0,48
Experienced green	64	0%	0,00	152	0%	0,00
COVID-19	64	95%	0,21	152	83%	0,38

This table presents the descriptive statistics for dummy variables of conventional and ESG type of bonds samples issued during the 2012–2022 period worldwide. Information on the characteristics of bond issuances was obtained from DCM Analytics and Datastream. For a definition of the variables, see Table 3.