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At the Sustainable Finance Frontier

Sustainability-Linked Bonds: Targets, Sustainability Profiles and Yield Spreads

Master’s Thesis in Accounting and Finance
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Abstract

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Key Words: Sustainability-Linked Bonds, Yield Spreads, Sustainability Performance Target, Corporate Social Responsibility, Efficient Market Hypothesis

Purpose: To investigate whether the ambitiousness of sustainability performance target and/or issuer sustainability profile have an influence on Sustainability-Linked Bond (SLB) yield spreads.

Methodology: The utilized econometric approach is OLS regressions on a cross-sectional data. The regressions use yield spreads as dependent variables, a self-constructed ambitiousness proxy, Average Annual Distance to Target (AADTT), and issuer ESG score as main explanatory variables. Further, we introduce gradual controls for Sustainability-Linked Bond, common bond, and issuer characteristics. Additionally, we control for sector, year, and region effects.

Theoretical perspectives: The theoretical perspective for this paper consists of Efficient Market Hypothesis, Signalling theory, and the theories under Corporate Social Responsibility umbrella i.e., Stakeholder, Legitimacy, and Institutional Theory. Moreover, theoretical reasoning based on SLB's structural features is adopted.

Empirical foundation: The initial global sample consists of 220 senior fixed coupon Sustainability-Linked Bonds issued in 2018-2022. In later specifications with further controls and subsamples this sample drops to 190, 177, 150, and ultimately 120 observations.

Conclusions: The study finds that more ambitious targets are associated with higher yield spreads of 2-3 bps per one percentage point increase in AADTT when the sustainability performance target is greenhouse gas emissions. Additionally, a one unit increase in ESG score is associated with a 1,031 bps decrease in yield spreads. The findings support the set hypotheses grounded on the theories above.

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Mikko Ala-Porkkunen
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Abbreviations

AADTT	Average Annual Distance to Target
bps	Basis points
CBI	Climate Bonds Initiative
CSR	Corporate Social Responsibility
DtT	Distance to target
EMH	Efficient Market Hypothesis
ESG	Environmental, Social, Governance
GHGE	Greenhouse Gas Emissions
ICMA	International Capital Markets Association
KPI	Key Performance Indicator
MLR	Multiple Linear Regression
OLS	Ordinary Least Squares
ROA	Return on Assets
SBTi	Science Based Target initiative
SLB(s)	Sustainability-Linked Bond(s)
SLBP	Sustainability-Linked Bond principles
SPO(s)	Second Party Opinion(s)
SPT(s)	Sustainability Performance Target(s)
TtT	Time to target
USD	U.S Dollars

1. Introduction

1.1. Background

As climate change has emerged as an urgent issue in the contemporary society, the development of sustainable finance instruments has followed closely suit. In the past decade, green bonds have been the most prominent sustainable finance instrument. Since the first green bond issuance in 2008, the market has developed swiftly, reaching a total amount issued of 478 mmUSD (billion USD) in 2022 (CBI, 2022). By earmarking the proceeds to the financing of sustainable and environmentally friendly projects (Flammer, 2021), green bonds can help facilitate the transition towards a greener economy.

In more recent years, a new sustainable finance instrument has emerged, that of Sustainability-Linked Bonds (SLBs). Sustainability-Linked Bonds can essentially be defined as bonds with structural contingencies on predefined Sustainability/ESG targets but without a use-of-proceeds clause. With few exceptions, these structural contingencies come in the form of coupon step-ups (hikes) of 25 bps. Despite the grouping under sustainable debt financing instruments, these two characteristics set SLBs apart from green bonds and convert to a fact that each instrument can cater different firms.

After its inception in 2018, the SLB market has been growing rapidly and saw 353 issues with a total amount issued of 139 mmUSD in 2022. Moreover, already at this stage, the average issue size of SLBs has surpassed the average issue size of green bonds, which together with issuances from large established companies such as Tesco, S&P, and Tele2, underline the importance and relevance of SLBs as a financial instrument.

1.2. Problem discussion

From a research perspective, the novelty of SLB market translates into scarce literature and large open fields for initial exploration. In the concurrent SLB literature Kölbel and Lambillon (2022) studied if SLBs trade at a lower yield than conventional bonds, and further if the coupon step-up has any impact on this, while Berrada, Engelhardt, Gibson and Krueger (2022) focused on the pricing and incentive mechanisms of SLBs. M. Liberadzki, Jaworski and K. Liberadzki (2021) then conducted a case study of SLBs, whereas Barbalau and Zeni (2022) focused on the coexistence of green and sustainability-linked debt instruments. This study appends the body of SLB literature, and further, knowledge by diving deeper into the catalyst of the coupon step-ups i.e., the Sustainability Performance Targets (SPTs) from an ambitiousness angle. Additionally, this study contributes to the mixed findings on the relationship between issuers' sustainability profiles and SLB yields.

The coupon adjustment is the most important and progressive mechanism of SLBs. Failure to achieve the predetermined SPT results in the issuer getting penalized in the form of a coupon step-up, which leads to a higher bond yield, and increasing cost of debt for the issuer. Consequently, we consider the studying of bond yields in relation to the coupon adjustment mechanism as intriguing and important. The paramount aspect of the coupon adjustment mechanism is the SPT since it dictates whether the penalty is invoked or not. Since the decision-making power is vested with the issuer, they can decide on the target ambitiousness. Holding all else equal, a more (less) ambitious target should ultimately translate into higher (lower) probability of the coupon adjustment being invoked. As information related to the SPTs is public, it would be reasonable to assume this to be also mirrored in SLB yield spreads, especially if the markets are efficient as theorized by Fama (1970).

Moreover, with SLBs alike with other sustainable debt instruments, the greenwashing worries are present and founded (Flammer, 2021; Talbot, 2017; Kölbel & Lambillon, 2022). In SLBs, these can manifest through both the target-setting and the issuers' credibility in reaching them. Essentially, extreme target values and certain target types as well as issuers with different sustainability profiles may influence the way (sustainable) investors perceive these SLBs, which should also be mirrored into their yield spreads. This relationship may further be strengthened from the generally documented inverse relationship between issuers sustainability profile and cost of debt (see e.g., Ge & Liu, 2015).

1.3. Purpose and research questions

The main purpose of this study is to investigate whether the ambitiousness of the predetermined sustainability performance targets (SPTs) affects the yield spreads of SLBs. Furthermore, the study also aims to investigate if the sustainability profile of the issuer affects the yield spreads of SLBs. Hence, we set to answer the following research questions:

Research question 1: *Does the ambitiousness of the SPTs affect the yield spread of SLBs at issue date?*
Research question 2: *Does the issuer sustainability profile affect the yield spread of SLBs at issue date?*

1.4. Findings

Using a global sample of 220 senior fixed coupon SLBs issued from 2019 to 2022, our results provide support for SPT ambitiousness having an impact on SLB yield spreads. The study found that a one percentage point increase in our self-constructed ambitiousness proxy, Average Annual Distance to Target (AADTT), is associated with a 2-3 bps increase in yield spreads when the target is greenhouse gas emissions. Our study also provides further support for a negative relationship between issuer sustainability profile and SLB yield spreads as we find that one unit increase in ESG score is associated with a 1,031 bps decrease in yield spreads. From a more granular perspective, our results indicate that it is the distance dimension of ambitiousness that drives the former relationship and the environmental dimension of ESG that drives the latter. Finally, we also find that greenhouse gas emissions targets experience lower yield spreads. We ground our findings on theories of efficient market hypothesis, environmental signalling, and corporate social responsibility.

1.5. Contribution

To the best of our knowledge, there exists no prior studies focusing on the relationship between the ambitiousness of sustainability performance targets and SLB yield spreads. Moreover, studying the impact of issuer sustainability profile on yield spreads also contributes to the limited, in this instance divided, pool of SLB literature. These avenues together with our larger up-to-date sample contribute to a better understanding of the developing SLB market.

From a more applied perspective, our findings can prove useful for firms considering SLB issuances. Based on our findings, issuers can make better-informed decisions when selecting the SPT-type and ambitiousness level, and further, when considering their sustainability profile's impact. In addition, our results can aid regulators in their efforts to improve guidelines and controls to decrease the greenwashing risk of SLBs. Finally, from a more academic perspective, our findings provide several venues for future research. These are outlined in the Conclusion section.

1.6. Outline

The rest of the paper is structured as follows. Section 2 provides a primer for thematic bonds and especially SLBs, then discusses the SLB market development and the aspect of greenwashing. Section 3 outlines the theoretical framework, while Section 4 covers the empirical literature. Section 5 then focuses on hypothesis development based on previous sections and Section 6 discusses the empirical methodology for the study. Finally, Sections 7 and 8 presents the empirical findings which then are discussed in Section 9. The last section, Section 10, concludes the paper.

2. Instruments, markets, and greenwashing

2.1. Traditional and green fixed income instruments

2.1.1. Fixed income instruments and bonds

Fixed income instruments are an integral part of the contemporary finance landscape. As described by Kila (2019), bonds, issued by both public and private entities, are the most common type of fixed income instrument. A bond represents a debt arrangement from the investor to the issuer where the issuer will repay the amount borrowed at the bond's maturity. In addition, the issuer pays an agreed amount of interest (fixed or floating) over the term of the bond to compensate the investor for borrowing money and facing the risk of losing it. From investor's perspective, this interest rate then refers to the yield of the bond, which has an inverse relationship with its price i.e., higher the yield, lower the price, and vice versa.

Kila (2019) also discusses the concept of "theme bonds" where bonds are issued to finance specific projects. In other words, the proceeds from theme bonds are earmarked to an investment in line with the bond theme. In the 19th and 20th century, theme bonds could be exemplified by war bonds and railway bonds where the proceeds were used to finance warfare and to develop the railway infrastructure (Kila, 2019). More recently, theme bonds related to sustainability have emerged and received a lot of attention from academics and practitioners alike. Today, the most prevalent theme bonds are green bonds.

2.1.2. Green Bonds

As noted by Flammer (2021), after being virtually inexistent prior to 2013, corporate green bonds have become increasingly popular in recent years. Green bonds can be defined as use-of-proceeds bonds where the raised proceeds are committed to finance climate friendly and environmental projects and investments. These projects and investments, often referred to as "green projects", can revolve around themes such as renewable energy, sustainable buildings, or resource conservation.

Green bonds are designed to help mitigate climate change. They offer companies a chance to signal their environmental commitment and provide investors a green investment opportunity (Bachelet et al. 2019). Furthermore, green bonds can attract investors who find utility in sustainable investing (Baker et al., 2018; Bachelet et al., 2019; Flammer, 2021), a notion that is conceptualized by Fama and French (2007) who argue that investors may have preferences for certain asset classes outside the rationale of classical asset pricing models. Hence, investors may accept lower yields in exchange for the perceived benefits of investing sustainable (Flammer, 2021).

2.2. Sustainability-Linked Bonds

2.2.1. General structure of SLBs

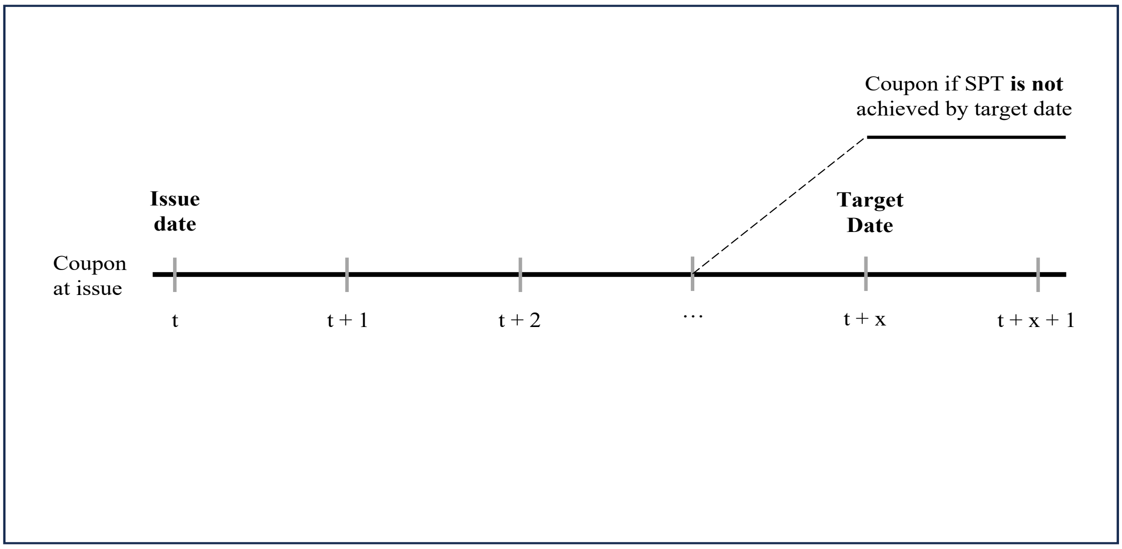
Following the emergence of green bonds, sustainable finance has become a major trend in debt markets. Recently, Sustainability-Linked Bonds (SLBs) have emerged as one structurally different alternative to green bonds with the aim of further enhancing the debt markets' role in encouraging companies to contribute to sustainability (ICMA, 2020). ICMA defines SLBs as a type of bond with financial and/or structural characteristics dependent on the issuer achieving certain predefined sustainability/ESG objectives. These objectives are measured using predefined Key Performance Indicators (KPIs) and evaluated against predefined Sustainability Performance Targets (SPTs). According to ICMA, SLBs facilitate sustainable development by explicitly committing issuers to future sustainable improvements within a predefined timeline.

Hence, SLBs can be defined as a contingent sustainable financing instrument, in which the structural characteristics of the bond can vary depending on the issuer achieving predetermined sustainability objectives. In comparison to green bonds, SLBs do not have a "use of proceeds" clause. Instead, SLBs provide the issuer with a clear financial incentive to reach their SPTs. This structure can impact the sustainability profile of issuers through two channels (Kölbel & Lambillon, 2022). First, by incentivising issuers to address their sustainability via a financial incentive if the issuer fails to reach the SPT, and second, by making issuers publicly commit to a sustainability target and hence being subject to reputational risk.

In comparison to green bonds, SLBs provide a more flexible way of raising funds while simultaneously signalling sustainable commitment. That is, the raised proceeds and the sustainability targets are at a company level rather than at a project/investment level, allowing a broader range of firms to participate in the sustainable debt market despite not being able to identify pure green projects (Swedbank, 2023). Insofar, the most common penalty structure in SLBs is a 25 bps coupon step-up, but higher or lower step-ups tied to one or many SPTs (e.g., 12,5 bps per SPT) exist too. Alternatively, reward-like coupon step-downs upon reaching the target exist but are still uncommon in practice.

Furthermore, the SPTs can range from greenhouse gas emissions and energy efficiency to gender equality within workforce. These, however, should be set in good faith and be ambitious enough to represent a material improvement in the predefined KPIs according to ICMA's Sustainability-Linked Bond Principles (SLBP) (ICMA, 2022). Usually, the SPT threshold (target) date is set near the end of bond's maturity, but other more gradual structures are common too. Inspired by Kölbel and Lambillon (2022), Figure 1 illustrates a typical SLB structure.

Figure 1: Typical mechanism of a SLB



Naturally, combining KPIs and SPTs facilitates the need for verification and quantifiability of the ambitiousness of the issuing companies' sustainability goals. As a result, independent external actors can provide second party opinions (SPOs) and certificates before the issue to verify that the SLB is coherent with ICMA's SLBP. In order to adhere to these principles, the issuers should further disclose all relevant information and appoint an external party tasked with reviewing the terms of the SLBs.

2.2.2. Corporate SLB Example: Deere & Company Issue April 2022

To further illustrate the concept of SLBs, we provide a real-world example of a sustainability-linked bond. The exemplifying SLB was issued by John Deere Capital Corporation, a subsidiary of Deere & Company (NYSE:DE), on April 18th, 2022. Deere & Company, most famous for the John Deere brand, is a US based global manufacturer and distributor of both commercial and consumer parts and equipment for agricultural, construction and forestry industries. Before the issuance Deere & Company carried a Bloomberg composite credit rating of A and published a sustainability-linked bond framework for which S&P Global Ratings provided a SPO to confirm the alignment with ICMA's *Sustainability-Linked Bond Principles* (S&P, 2022).

The issued senior unsecured bond with 600 mUSD principal has a fixed coupon of 3,35%, maturity of 7 years, and is redeemable at maturity. The selected KPI for the bond was absolute Scope 1 and 2 greenhouse gas emissions (GHGE) from operations. The baseline value of 811000 metric tonnes of CO2 emissions was calculated in 2021, and the sustainability performance target was set to reduce this amount by 20% to 648800 metric tonnes by 2025, and by 50% to 405500 metric tonnes by 2030. Should Deere & Company fail to reach either of the pre-set targets before the SPT observation dates (year-end 2025 and year-end 2030), a 25 bps coupon step-up will be applied (John Deere, 2022).

2.2.3. Corporate SLB market development

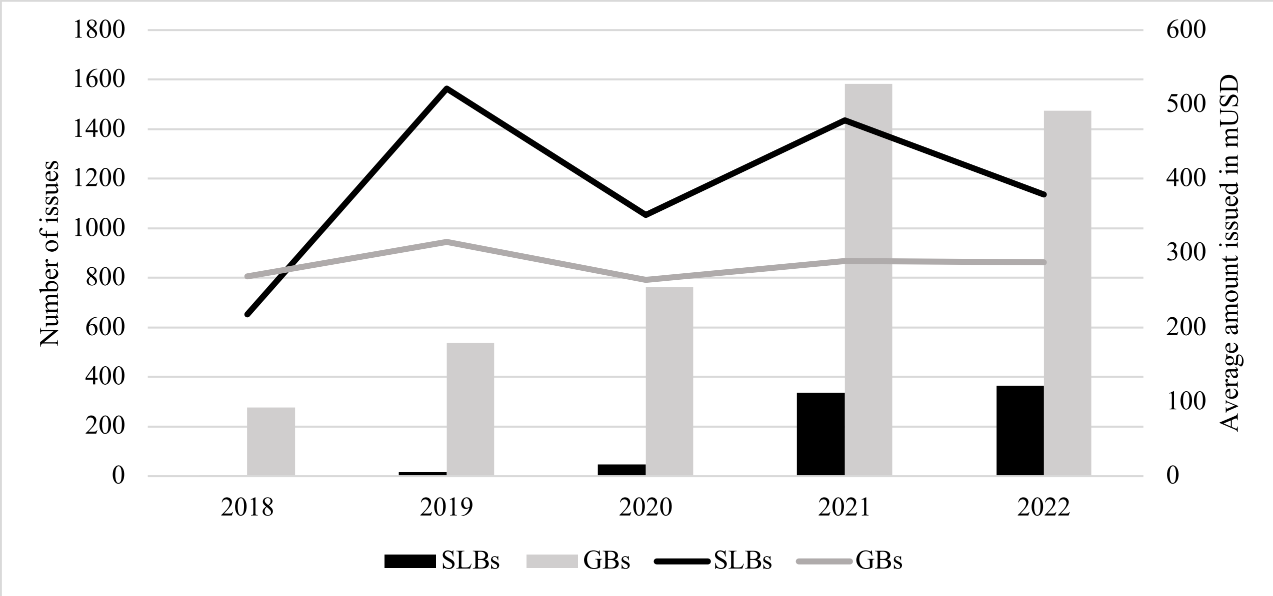
According to Bloomberg data, the first corporate SLB was issued in December 2018 by Beijing Infrastructure Investment Corporation Limited, a Chinese state-owned rail transportation company. After the first issue in 2018, the SLB market has been growing rapidly and saw 13 issues in 2019, 57 issues in 2020, and 336 issues in 2021. Moreover, despite the increasing macroeconomic and geopolitical risks in 2022 (Bloomberg, 2022), the SLB market remained resilient and saw 366 issues in 2022, underlining the importance of sustainability-linked bonds.

In comparison to the green bond market, the SLB market is still less developed, which is reflected in the number of new issues. However, already at this stage, the average issue size of SLBs has been significantly larger than the average issue size of green bonds every year par 2018. As can be seen in Figure 2, the average SLB issue size in mUSD was 478,45 in 2021 and 379,00 in 2022, while the comparative figures in mUSD for green bonds were 289,12 and respectively 287,51. This further supports the increasing role of SLBs in the future finance landscape.

Given their inherent nature, not restricted use-of-proceeds, but structural contingency on ESG targets, SLBs can cater to different firms and investors than green bonds. This notion is evident when we compare the BICS level one classifications (issuer sectors) for the abovementioned groups. Bloomberg data suggests that the more prominent sector half of SLB issuers consists of Industrials, Materials, Utilities, Consumer Staples and Consumer Discretionary, whereas a comparable half for green bonds consists of Financials, Utilities, Industrials, Governmental and Consumer Discretionary. Two inferences can be drawn: one, SLB issuers come from more carbon-intensive sectors, and two, SLBs are not yet as common amongst Governmental or Financial institutions.

Finally, in terms of geography, the issuer landscape for SLBs is similar yet even more skewed towards Europe in both number and value terms. European issues represent 494 (227,701 mmUSD) from a total of 766 (352,182 mmUSD) issues. Moreover, alike with green bond markets, Asia-Pacific region is the second most active region but, on average, has the smallest issue amounts, whereas Northern America is the least active region but, on average, has the largest issue sizes together with the Rest of the World. For more information on these dimensions, see Tables 12 and 13 at the end of the paper.

Figure 2: SLB and green bond number of issues and average amount issued; Source: Bloomberg



2.3. Greenwashing

With the emergence of green bonds, SLBs and alike, greenwashing – the practice of making unfounded claims about the sustainable commitment of a company – has become an increasing worry. In the case of green bonds, without harmonised legally binding requirements and public governance and enforcement, essentially any bond can be self-labelled as "green" (Flammer, 2021). This can be illustrated by the green bond issue where proceeds were used to finance clean coal power plants (Reuters, 2017). To combat this credibility threat for green bonds and sustainable finance overall (Talbot, 2017), a collection of actions against greenwashing has been undertaken. This collection consists of actions such as creating green bond standards and offering second party opinions and climate certifications to ensure alignment with them.

When it comes to SLBs, most of the abovementioned actions carry over. As exemplified in Deere & Company's SLB issue, ICMA has released *Sustainability-Linked Bond Principles* to which the issue was confirmed to be aligned with according to second party opinion, which most issues carry. As of today, there are no competing standards to ICMA's SLBP, for which the alignment is also voluntary leaving room for self-labelling. The absence of applicable CBI certifications does not help either. Moreover, while SPOs are encouraged by SLBP, they are not required for the alignment. The SPT assessment from an independent third party, however, is required at the target date (ICMA, 2020).

While SLBs have an enforcing mechanism to incentivise issuers to reach their sustainability performance target via financial rewards and/or penalties as well as increased external scrutiny, there still exists a possibility for greenwashing. Kölbel and Lambillon (2022) point out namely two channels for this, the selected SPT and the financial structure of the SLB. The former refers to a situation where the selected SPTs are not material, realistic or otherwise appropriate, while the latter refers to a large share of callable SLBs and, moreover, inadequate coupon step-ups. In the presence of SLB issuance premium similar to green bond “greenium” (see Section 4), as preliminary documented by Kölbel and Lambillon (2022), issuers may benefit from cost savings even if the coupon step-up will be applied after failing to reach set SPT(s).

3. Theoretical background

3.1. Efficient Market Hypothesis

The efficient market hypothesis (EMH) is derived from the concepts established by Fama (1970) in his work on efficient capital markets. The theory assumes that the prices of financial assets reflect all information available to the investors at the present time, indicating that the market is efficient. Consequently, investors cannot expect to earn abnormal returns consistently since all new information gets quickly incorporated into asset prices (Fama, 1970; Basu, 1977).

According to Fama, there are three levels of information efficiencies: the weak form, the semi-strong form, and the strong form. The weak form incorporates only historical prices, the semi-strong considers all information available to the public, and the strong form also includes information not known to the public, such as insider information. However, the EMH has been challenged and critiqued by economists who argue that human psychology, among other things, also play a part in determining asset prices (Malkiel 2003).

3.2. Information asymmetry and signalling

Information asymmetry refers to a situation where one party of a transaction is at a disadvantage because the other party is better informed. This leads to a situation where the party at a disadvantage cannot fully evaluate the quality of the good or service offered as described by Akerlof (1970) in his foundational article on adverse selection. Akerlof demonstrates information asymmetry with an example from used car market with both good and bad cars. In his example, the sellers have an information advantage since they know the true quality of the car, and thus can take advantage of the less informed buyers and sell bad cars at good car prices resulting to a pooling equilibrium.

Akerlof then suggests that good car sellers can escape this pooling equilibrium by mitigating the information asymmetry through warranties and third-party verifications, a concept established as signalling by Spence (1973). In his paper, Spence demonstrates this with a job market where candidates try to signal their ability by obtaining academic degrees and certifications. Despite the old heritage, problematic pooling equilibriums are well present in the modern day as well, as exemplified by companies with genuine sustainability agenda and companies with genuine greenwashing agenda.

3.3. Corporate Social Responsibility theories

While there is no universally accepted valid definition and understanding of corporate social responsibility (CSR) (see e.g., Griffin, 2000), one way to define it is the way companies consider environmental, social, and governance (ESG) factors in their business decisions and processes, and how good and credible the relationships with the various stakeholders of the firm are (Oikonomou, Brooks & Pavelin, 2014). For the rest of the paper, we will utilize this umbrella term for CSR which is grounded on the following three theories according to Maltais and Nykvist (2020).

In their work, Dowling and Pfeffer (1975) introduced the legitimacy theory which has later gained attention within various business research areas. Legitimacy theory suggests that companies must maintain a positive image and legitimacy in the eyes of their stakeholders, which can be best achieved by conforming to social, environmental and cultural norms and expectations, and ensuring that companies' actions align with the values of their stakeholders (Dowling & Pfeffer, 1975; Maltais & Nykvist, 2020).

In a similar vein, Meyer and Rowan (1977) later conceptualised the institutional theory which conjectures that the abovementioned social, environmental and cultural norms and expectations pressurise organizations to create symbolic formal structures such as hierarchies or standard procedures to gain legitimacy, instead of them being a product of pure utility maximization. Finally, Freeman (1984) then introduced the stakeholder theory. Particularly relevant in the context of environmental issues and sustainable development, stakeholder theory posits that companies should consider and balance the interests of all dependent and independent stakeholders, not just shareholders, in their strategic decision-making processes to optimise long-term value creation (Freeman, 1984; Freeman, Harrison, Wicks, Parmar & De Colle, 2010).

By integrating the abovementioned theories, the following comprehensive CSR theory could be constructed. Certain stakeholders may use companies' non-financial records such as sustainability reports and scores or formal structures to evaluate companies underlying corporate character, ethical standards, and further, legitimacy. As a result, a high CSR performer may be viewed more favourably and credibly by stakeholders, which may translate into competitive advantage through e.g., better reputation and lower capital constraints. (Jones, 1995; Cheng, Ioannou & Sefareim, 2014; Oikonomou et al., 2014).

4. Literature review

4.1. Efficient market hypothesis in a bond context

Using indices (MS International World Index, Salomon Brothers' World Index) as proxies, Lim, Gallo and Swanson (1998) found no long-term market inefficiencies between bond and stock markets. Similarly, using a sample of almost 9 million transactions with 8714 over-the-counter traded bonds, Ronen & Zhou (2008) found that bond prices adjust to new information before the equity market opens, underlining the notion of an efficient bond market. The integration and efficiency between the stock and bond markets is further documented by several other authors (Schiller & Beltratti, 1992; Bennet & Kelleher, 1988, Gallo, Lockwood & Swanson, 1997).

The literature, however, is not in complete harmony. For example, Peters (1989) found that investors' interpretation of events was not reflected immediately in the asset prices, suggesting bond market inefficiency. Similarly, by investigating high frequency returns on individual stocks and bonds, Downing, Underwood and Xing (2009) posited that despite bond market seeing improvements in transparency and reduction of transaction costs, it still remains less efficient than the stock market.

The efficiency of the bond market can further be investigated by studying the price adjustment process of bonds to credit rating reclassifications. While Katz (1974) found an average of 6-10 weeks lag in the price adjustment process in support of inefficiency, Weinstein (1976) later found no ex-post effect of a rating change announcement and argued that the bond market experiences a semi-strong form of efficiency. Due to the overall predictability of a rating change, the price change is a result of information leading up to the rating change, rather than the rating change itself. This is further supported by Wansley, Glascock and Clauretie (1992) who argues against the notion of lag in the adjustment period and concludes that bond markets, alike equity markets, are efficient.

4.2. Signalling and Green Bond literature

Given the already mature state of the green bond market, a body of literature has been established on several facets. Perhaps the most primitive research area within this body focuses on the motivation to issue green bonds. Flammer (2021) states that there are essentially three possible rationales: first, to credibly signal commitment towards the environment, second, to use them merely as a greenwashing tool, and third, to get access to cheaper financing in the presence of "greenium"[1]. Using a sample of 1189 corporate green bonds from 2013 to 2018, she later finds support for the first of these rationales.

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[1] Greenium, or green premium, refers to a situation where green bonds are issued at lower yields than common bonds. Insofar, the literature leans towards a presence of greenium but the debate is still ongoing (Cortellini & Panetta, 2020).

Flammer's findings have gained a lot of support from complementing angles. In a questionnaire study focusing on what attracts investors and issuers to the green bond market, Maltais and Nykvist (2020) found that the investors value the possibility to invest in specific green and verified projects, whereas the issuers value the possibility to effortlessly communicate their sustainable contribution by issuing green bonds. Similarly, using a sample of 1105 green bonds from 2007-2019, Fatica and Panzica (2021) found that green bond issuers displayed a greater decrease in carbon intensity compared to conventional bond issuers with similar financial and environmental characteristics. The authors posit that this strongly supports green bonds' function as credible signals of environmental responsibility, especially when investors have imperfect information (Lyon & Maxwell, 2011).

Another strain of research then focuses on what prices (yields) green bonds are issued at, and further what issuer and issue characteristics influences these. In this area, Wang et al. (2019) and Xu et al. (2022) studied the factors influencing green bond risk premium (yield spread between green bond yield-to-maturity at issuance and risk-free interest rate) in the Chinese green bond market, and found that third-party verification, higher issue size, maturity, and credit rating lower the green bond risk premium. Later, with a Chinese sample of 456 bonds, Li et al. (2020) complemented the factors list by adding that higher CSR score helps issuers to reduce their cost of debt for green bonds.

Finally, from the cluster of financed green projects, Deng et al. (2020) found that the green bond yields in Chinese market were lower for issues with higher portion of proceeds invested in green projects. Complementary, focusing on the long-term green bond performance proxied by long-term yield-to-maturity, Russo et al. (2021) investigated the impact of the green project type using a global sample of 306 corporate green bonds in 2013-2016, concluding that the nature of the project financed by a green bond may influence its performance.

4.3. Corporate Social Responsibility literature in a bond context

When it comes to the direct relationship between CSR and bond yields, the literature is developing and unequivocal, yet leaning towards a negative relation. On one hand, within pure bond context, using a sample of 498 investment-grade Euro corporate bonds from July 2004 to August 2007, Menz (2010) finds a significant positive relationship between CSR performance and bond yield spreads. On the other hand, consistent with Oikonomou et al. (2014), and Cooper and Uzun (2015), using a sample of 4260 US primary market bond issues between 1992 and 2009, Ge and Liu (2015) found that higher CSR is associated with higher credit ratings, and when controlled for credit ratings, with lower bond yield spreads. The former relationship has been later separately supported by La Rosa et al. (2018) with a European sample, and the latter by Huang et al. (2018) with a Chinese sample.

However, the orientation towards a negative relationship seems to stem from the broader literature between CSR and cost of debt, including both accounting and market-based measures for cost of debt as well as different debt types. While Goss and Roberts (2011) and Magnanelli and Izzo (2017) find no support for such a relationship with US and global samples positing that CSR is not a first-order value driver in risk reducing, the vast majority of literature still supports the relationship (see e.g., Eliwa, Aboud and Saleh (2021), and Bhuiyan & Nguyen (2020)). Some authors suggest that it is the CSR driving the relationship, while others suggest that it is the CSR disclosure (Eliwa et al., 2021).

Based on the abovementioned studies, a negative relationship between CSR and cost of debt seems to be prevalent. This is theorised for with the following three arguments. One, as Heinkel et al. (2001) suggest and Cheng et al. (2014) document, investing based on firms' ethical standards crowds out investments for not socially responsible firms. Hence, better CSR performers should, ceteris paribus, have a relatively better access to finance, which should lower their cost of debt (Bhuiyan & Nguyen, 2020). Two, better CSR firms should have better stakeholder relationships and public reputation, which should lower the riskiness, and thus their cost of debt (Himme & Fischer, 2014). Three, CSR disclosure can contain value-relevant information which reduces the information asymmetries between contracting parties, and hence lower the cost of debt (Ge & Liu, 2015). To further support the general risk-reduction insurance-like notion of CSR, a negative relation between CSR and default risk has also been found by Sun and Chui (2014) and Boubaker, Cellier and Manita (2020).

4.4. Sustainability-Linked Bond literature

When it comes to SLBs, the novelty of the subject is reflected in the scarcity of academic research. In their paper, Berrada et al. (2022) introduces a theoretical framework to understand the incentive structure and pricing of SLBs. The authors then continue into empirical analysis using a global sample of 180 SLBs and conclude that approximately 25% of the issued SLBs are overpriced which leads to a positive stock market reaction and a negative short-term bond aftermarket performance. Finally, the authors conjecture a positive relationship between issuers ESG scores and overpricing.

Kölbel and Lambillon (2022) then study more closely the presence of sustainability premium equivalent to greenium using a global sample of 145 matched bond pairs from 2019 to first-half 2022. They document an average sustainability premium between 9 bps and 22 bps depending on the model specification. This was also later supported by Nordea in their remake of the study (Nordea, 2022). The premium was, however, found to be statistically significant only in 2021 with a value of 31 bps, and further dependent on if the issuers had previously issued SLBs or not. Interestingly, the authors did not find a relation between the premium and issuer sustainability profile.

Nevertheless, in the following cost-benefit analysis Kölbel and Lambillon showed that, on average, the savings from this premium (9 bps) exceed the maximum potential penalty that issuers need to pay if they fail to reach their SPTs, suggesting that SLB issuers can benefit from a "free lunch", and thus, use SLBs for greenwashing purposes. According to Kölbel and Lambillon, SLBs offer two potential greenwashing channels, the coupon step-up, and the ambitiousness of the SPTs. Ul Haq and Doumbia (2022) also discuss these and further emphasize on the callable feature present on many SLBs.

Finally, while some authors (see e.g., Liberadzki et al., 2021) focus on individual SLBs through a case study or commentary approach, Barbalau and Zeni (2021) focused on the co-existence and choice of issuing SLB versus a green bond. The authors develop a standard company financing model with asymmetric information for green investors and demonstrate that the co-existence of both non-contingent (green bonds) and contingent (SLBs) green securities is an equilibrium result when green outcomes are manipulable and firm types vary in their ability to manipulate. In the presence of asymmetric information, investors can use green bonds as a screening tool for the SLB issuers "greenness". Moreover, using a global sample of 661 green security issuers, the authors point out that contingent green securities are issued by more emission-intensive firms.

5. Hypothesis development

The key mechanism of SLBs is the possible change in coupon rate following the failure in achieving the predetermined sustainability performance target (SPT). Consequently, investors may assess the probability of the coupon step-up by assessing the ambitiousness level of the SPT based on its baseline and target value. The higher the ambitiousness, the higher the probability of a coupon step-up, and the higher the expected return of the SLB in question.

Given that the target relevant information is public, the EMH would posit that this probability of a coupon step-up, and the following higher coupon rate, should then already be priced into yield spreads if the SLB markets experience at least a semi-strong form of information efficiency. As SLB markets are a subgroup in the wider bond markets, this assumption seems reasonable based on the literature support for bond market efficiency (Lim et al., 1998; Schiller & Beltratti, 1992; Gallo et al., 1997; Ronen & Zhou, 2008). Thus, more ambitious targets should generally be associated with higher yields spreads using the dynamics documented by Weinstein (1976) with issuer credit rating changes i.e., that the rating (now coupon) change was already priced in before it actually occurred.

To expand the discussion further, we should also consider the implications of Spence's (1973) signalling theory. In this vein, an overly ambitious target could be a clear signal of greenwashing, which then could indicate that the associated SLB will either be called or face the coupon step-up, which both should increase its yield spread according to EMH. Further, considering the three main theories under the CSR umbrella, a more ambitious target with greenwashing signals may harm issuer's legitimacy and stakeholder relationships by deviating from common structures, not aligning with stakeholder needs, and increasing the general risk perception (Dowling & Pfeffer, 1975; Meyer & Rowan, 1977; Freeman, 1984; Himme & Fisher, 2014). Naturally, this, together with the extra resources and capital required to reach those more ambitious targets, should translate into higher yield spread as well. Finally, building on Heinkel et al. (2001) logic and Cheng et al. (2014) findings, SLBs with clear greenwashing worries may also be screened out from sustainable investment screens, which could lower the overall demand, and hence increase the yield spreads of these SLBs[2].

However, one could also argue for a negative or non-existent relationship between the ambitiousness of SPTs and SLB yield spreads. As mentioned, the literature on EMH is equivocal with authors such Katz (1974) or Downing et al. (2009) founding virtually no support for bond market efficiency.

[2] As the idea of investors finding utility outside economic gain may seem contradicting with EMH, we must clarify here. Heinkel et al. (2001) do not posit that sustainable investors forego their economic considerations but rather that they have additional considerations. This simply expands the list of factors considered according to EMH but does not refute it.

Moreover, if an overly ambitious target may function as a greenwashing signal, the same could be said about an overly unambitious target. In fact, ICMA's *Sustainability-Linked Bond Principles* state that the SPTs should be ambitious by nature. Hence, a better alignment with these standards as well as the act of setting real targets itself could equally be seen as stakeholder friendly, which should lower the issuer risk perception and the SLB yield spreads (Dowling & Pfeffer, 1975; Freeman, 1984). Finally, from a signalling perspective, ambitious targets could also be seen as a signal of issuer quality and positive future expectations in support of the opposite relationship with yield spreads.

Considering all, we find stronger ground for a positive relationship between target ambitiousness and SLB yield spreads. Thus, we set forth the following first hypothesis for our first research question:

$$H1 = \ SLBs\ with\ more\ ambitious\ SPTs\ experience\ higher\ yield\ spreads\ at\ issue\ date$$

Regarding our second research question, the theoretical as well as the empirical literature seem to lean towards a negative relationship between CSR and cost of debt (see e.g., Ge and Liu (2015); La Rosa et al. (2018)). The literature points out three reasons for this: better access to finance, lower information asymmetry, and lower risk profile due better stakeholder relationships and public reputation (Cheng et al., 2014; Ge & Liu, 2015; Bhuiyan & Nguyen, 2020). For SLBs, the SPT mechanism provides another channel to further enhance this relationship; the attempts of better CSR performers in reaching the set SPT(s) could be seen as more credible and more likely to be successful, which in turn should also be reflected on yield spreads similar to *H1*.

Naturally, lower cost of debt provides a source of competitive advantage for issuers with good CSR profiles (Bhuiyan & Nguyen, 2020). What is interesting, is then how can stakeholders evaluate issuers CSR profiles, or alternatively, how can issuers signal their quality. As suggested by Oikonomou et al. (2014) one way for stakeholders to do this, is to evaluate issuer's sustainability records and reports, as well as its formal structures (Meyer & Rowan, 1977). In the modern era, one such record is ESG scores. Alternatively, issuers can depict a self-inflicted signal of sustainability by, for example, a green bond issuance (Maltais & Nykvist, 2020; Barbalau & Zeni, 2021; Flammer, 2021). Regardless of how it is credibly communicated, a negative relationship between issuer's sustainability profile and SLB yield spreads is presumed, ceteris paribus.

In light of this, we develop the following second hypothesis for our second research question:

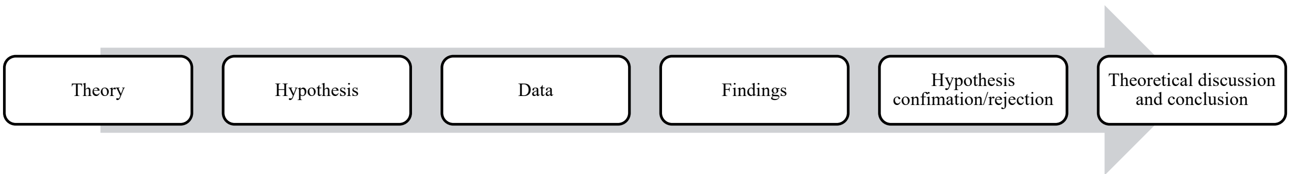
$$H2 = \ SLBs\ issued\ by\ firms\ with\ better\ sustainability\ profiles\ experience\ lower\ yield\ spreads\ at\ issue\ date$$

6. Methodology

6.1. Scientific approach

The research design for this study follows a deductive research approach outlined in Figure 3. Accordingly, the study follows a six-step process to test the hypotheses set above. Insofar, we have compiled and analysed the relevant theoretical and empirical literature for our study. In the next sections, we discuss the data collection process, describe the final sample for our study, and conduct a multivariate analysis to confirm/reject the set hypotheses regarding the impact of SPT ambitiousness and issuer's sustainability profile on SLB yield spreads. Finally, we will end the paper with a discussion and a conclusion.

Figure 3: Deductive Research Approach; Source: Bryman and Bell (2015, p.23)



6.2. Econometric design

6.2.1. Univariate analysis

Our sample description part will mainly focus on general SLB and issuer characteristics, while the summary statistics provides more insights on our sample distribution from the perspective of the variables later used in regression analysis. Further, we break the summary statistics down into two subgroups based on the ambitiousness of SPTs and conduct a mean-comparison test. Finally, we conduct a correlation analysis based on Pearson's correlation matrix. The purpose of the correlation analysis is to gain initial insights on the underlying relationships between the variables.

6.2.2. Multivariate analysis – OLS regression

As we are interested in the causal relationship between the ambitiousness of sustainability performance targets and yield spreads as well as the issuer's sustainability profile and yield spreads, we base our multivariate analysis on ordinary-least-squares (OLS) regressions[3]. In econometrics, OLS is commonly applied for hypothesis testing on pooled cross-sectional data (Li et al., 2020; Woolridge, 2016, p. 405). To ensure reliable results from an OLS regression, it is important to be coherent with the assumptions (conditions), which we will discuss more as the paper progresses.

[3] OLS is a statistical method widely used in econometrics to estimate a relationship between a dependent variable and independent variable(s). The name stems from the mechanism of the method, which minimizes the sum of the squared differences between the observed and predicted values of the dependent variable in a plane (Wooldridge, 2016, p.28).

In order to test for *H1* we set *Yield Spread* as the dependent variable and adopt *AADTT* (Average Annual Distance to Target) as the main explanatory variable for measuring SPT ambitiousness. We start from the simplest possible model controlling only for issuer credit rating, and then start adding more control variables gradually. These gradual controls can be grouped on to three distinct groups: SLB controls, bond controls, and issuer controls. Moreover, in later specifications we divide *AADTT* into time and distance dimensions to see which of them drives the potential relationship, and further interact it with a *GHGE* dummy variable. All regression variables will be discussed in more detail in the subchapters below. For *H1*, the regression model(s) can essentially be notated as follows:

$$Yield\ Spread_i = \alpha + \beta_1 AADTT + \beta_2 SLB\ controls + \beta_3 Bond\ controls + \beta_4 Issuer\ controls + \beta_5 Credit\ ratings + \mu_i \quad (1)$$

As for *H2*, the dependent variable *Yield Spread*, will remain the same, as will the majority of the other variables present in the model specified above. Since we are primarily interested in another relationship, the main explanatory, however, is different and the main explanatory variable from *H1* will be included in SLB controls. As a primary proxy for issuers sustainability profile, we use ESG score (*ESG*). This will later be changed to a green bond dummy variable *GB* (1 if the issuer has issued a green bond previously, 0 otherwise) for additional robustness and insights, and further broken down to its three components (E, S, G), to investigate which is the governing dimension in the relationship. Ultimately the regression model(s) for *H2* can be notated as follows:

$$Yield\ Spread_i = \alpha + \beta_1 ESG\ Score + \beta_2 SLB\ controls + \beta_3 Bond\ controls + \beta_4 Issuer\ controls + \beta_5 Credit\ ratings + \mu_i \quad (2)$$

6.2.3. Dependent variable

For our study, we use *Yield Spread* i.e., the yield difference between the SLB and the closest equivalent risk-free sovereign bond denoted in the same currency, as the dependent variable in line with Bachelet et al. (2019), Wang et al. (2019) and Li et al. (2020). To gain a better understanding of the dynamics behind bond yields, cash flows and prices that fundamentally drive the variation in *Yield Spreads*, we find it necessary to provide a primer on bond's price-to-yield relationship.

Bond's price-to-yield relationship follows an inverse pattern, that is, the lower the price, the higher the yield, and vice versa (Jorion, 2011). If we expand on this, from a theoretical valuation perspective, the present value (PV), or price, of a bond should equal the sum of its expected cash flows in time T discounted to present date by a factor of Y, as characterised in the formula below. These cash flows come in two ways, in the form of periodic coupon payments and in the form of principal payments, which, if not called, is paid at maturity. The discount rate Y in this expression then depicts the yield-to-maturity (YTM) and the unlevered IRR for investors (Jorion, 2011).

$$P = \sum_{t=1}^{T} \frac{C_t}{(1+Y)^t} + \frac{F}{(1+Y)^T} \quad (3)$$

While YTM is a commonly used proxy for comparing bonds, it has its flaws. First, the assumptions of holding the bond until maturity, and reinvesting the cash flows at the same risk-adjusted rate, are problematic (Caks, 1977; Jorion, 2011). Second, if one was to use YTM as a dependent variable, controlling for risk-free rate is mandatory as investors are interested specifically in the risk-adjusted returns. Third, in an era of negative interest rates YTM is theoretically subject to both positive and negative values which may distort the results. Using yield spreads solves these issues.

Finally, the above discussed price-to-yield relationship is not that fundamentally different for SLBs. However, the differing characteristic relates to the incentive mechanisms, i.e., coupon step-ups, of SLBs. According to EMH, investors are forward-looking, and all value relevant information is priced into asset prices. Based on this, an expected increase in SLBs' yields through a coupon step-up should be priced in and thus reflected in yield spreads. When controlled for other factors, an elevated yield spread should then imply that investors expect the issuer to fail to reach the SPT as it is the catalyst for coupon step-ups.

6.2.4. Main explanatory variables

Since there are no studies addressing the SPTs ambitiousness impact on SLBs yield spreads, we must construct our own explanatory variable. Refinitiv Eikon provides a good starting point for this as they have data on the calculated distance to target in percentages, and further on the baseline calculation date and the threshold date i.e., the target date. Moreover, both Bloomberg and Refinitiv contain security description notes, which we can use to verify these numbers and append missing values. Based on this, we begin to construct our main explanatory variable with the following two blocks:

$$DtT = Distance\ to\ target\ (\%) = \left|1 - \left(\frac{Treshold\ value}{Baseline\ value}\right)\right| \quad (4)$$

$$TtT = Time\ to\ target = \frac{Treshold\ date - \ Baseline\ date}{365} \quad (5)$$

Ceteris paribus, according to *H1* and Kölbel and Lambillon (2022), a greater distance (time) to target should be associated with a higher (lower) yield spread in the presence of financial penalties for the issuer. However, the relative comparison between SPT ambitiousness levels is difficult and should be done case-by-case as one SLB may have a 50% DtT with 5 years to reach it while another SLB may have a 10% DtT with 2 years to reach it. Hence, to tackle the abovementioned and to make the ambitiousness proxy more standardised, we employ Average Annual Distance to Target (*AADTT*) as the main explanatory variable with the following notation:

$$AADTT\ (\%) = \frac{Distance\ to\ target\ (\%)}{Years\ to\ target} = \frac{\left|1 - \left(\frac{Treshold\ value}{Baseline\ value}\right)\right|}{\frac{Treshold\ date - \ Baseline\ date}{365}} \quad (6)$$

As mentioned before, *H1* and *H2* are concerned about distinct relationships regarding yield spreads and hence should adopt different main explanatory variables. In the case of *H2*, the main explanatory variable will be the issuer's ESG score at issue. The ESG score, extracted from Refinitiv, is an often-used proxy for issuer sustainability profile, or quality, used by Berrada et al. (2022) in an SLB context. The ESG score is essentially a constituent of three separate scores – environmental (E) score, social (S) score, and governance (G) score – weighted distinctively across industry groups.

We expand the *H2* testing with these dimensions to see which, if any, of the dimensions drive the relationship. After this, we then proxy for issuer sustainability profile from another angle, that of issuer-initiated sustainability signals. As concluded by Maltais and Nykvist (2020) and Flammer (2021), one of the primary reasons for issuing green bonds is to signal environmental commitment to the public. Moreover, as SLB issuers are primarily from more carbon intensive sectors than green bond issuers, we believe that green bond issuers should be associated with lower SLB yield spreads. Based on this, we use green bond dummy variable (1 if the issuer has issued green bonds previously, 0 otherwise) as an alternative complementary proxy for issuers sustainability profiles.

6.2.5. Control variables

The first set of controls we add to augment our regression models relates to the SLB characteristics. In accordance with the prevalent SLB literature (Kölbel & Lambillon, 2022; Berrada et al., 2022), we control for differences in SPTs and incentive mechanisms via a *GHGE* dummy and a *StepUp* variable, potential greenwashing through call feature via an *isCallable* dummy, and certified target-setting via a *SBTi* (alignment with science-based targets initiative) dummy. We expect *GHGE* and *SBTi* to have negative coefficients due their environmental signalling value in accordance with CSR, and *isCallable* and *StepUp* to have a positive coefficients due premium redemption and higher penalties.

The second set of gradual controls then focuses on common different bond characteristics that may impact bond yield spreads. We control first for bond coupon rate, security, maturity, and issue size (Berrada et al., 2022; Kölbel & Lambillon, 2022; Li et al., 2020). For the first and third variables, we expect a negative relation, and for the second and fourth variables, we expect a positive relation. Later, we append this set of controls with *Bid-Ask Spread* variable to control for liquidity differences.

Finally, the last set of introduced controls focuses on issuer characteristics. Within this group, we control for issuer quality via *ROA*, profitability in relation to debt service costs via *InterestCoverage*, leverage via debt-to-assets ratio (*Debt to Assets)*, size via *Total Assets*, and company type via *isPrivate* dummy in accordance with (Li et al., 2020; Xu et al., 2022). From issuer controls, we expect *isPrivate* and *Debt to Assets* to have positive coefficients, and the rest to have negative coefficients.

Finally, we also apply controls for Sector, Year and Regional effects to capture the possible impact of these dimensions on SLB yield spreads. The data for control variables is extracted from Bloomberg, Refinitiv Eikon and CapitalIQ. All the variables discussed in Sections 6.2.3 – 6.2.5 can be found in Table 14.

6.2.6. Interaction terms for greenwashing channels

One SLB may not be comparable with another due to the variety of possible structural combinations with different SPTs, incentive mechanisms and callability features. To account for this, we introduce interaction terms for both greenwashing channels pointed by Kölbel and Lambillon (2022) and Doumbia and Ul Haq (2022), the SPT and the callable coupon step-up. Since the former channels concerns SPTs, and hence our main explanatory variable, we interact *AADTT* with *GHGE* as most SLBs in our sample have greenhouse gas emissions target(s). This interaction term then allows us to test *H1* with comparable SPTs instead of mixing e.g., GHGE SPTs with labor diversity SPTs. For the latter channel, we interact *StepUp* with *isCallable* in accordance with Kölbel and Lambillon (2022). With interaction terms, the *H1* regression model(s) notate(s) as:

$$\begin{aligned} Yield\ Spread_i = \ & \alpha + \beta_1 AADTT + \beta_2 GHGE + \beta_3 GHGE \times AADTT + \beta_4 StepUp + \\ & \beta_5 isCallable + \beta_6 isCallable \times StepUp + \beta_7 SLB\ controls + \\ & \beta_8 Bond\ controls + \beta_9 Issuer\ controls + \\ & \beta_{10} Credit\ ratings + \mu_i \end{aligned} \quad (8)$$

6.2.7. Statistical tests

We utilize the Breusch-Pagan and White tests to investigate the presence of heteroskedasticity in our main model. The presence of heteroskedasticity i.e., non-constant variance in the error terms violates the fifth MLR assumption and means that the OLS estimator is no longer best linear unbiased estimator (BLUE), and further that the usual standard errors, and hence the inferences of t-statistics (p-values) are no longer valid. In both Breusch-Pagan and White tests, a p-value below 0.050 indicates significant heteroskedasticity, which must be combatted by using either clustered or robust standard errors. In this paper, we conduct both tests after the first regression model. To gain more insights to possible multicollinearity issues, we also conduct a VIF-test.

6.3. Robustness

Besides introducing gradual controls, we achieve robustness in *H1* and *H2* by employing clustered standard errors. As the market description and later the sample description show, SLB issuances are skewed towards certain sectors. Moreover, as Kölbel and Lambillon (2022) note, some of the issuers have already issued several SLBs. Hence, we employ clustered standard errors, clustered by sector and firm, in later model specifications. As mentioned in 6.2.4, we further achieve robustness in *H2* by employing an alternative proxy for issuers' sustainability profile by introducing the green bond dummy variable. Additionally, we also conduct a brief subsample analysis in the end.

7. Data

7.1. Sample selection

The data collection process for this paper was done in the following way. In the first step, we extracted all corporate SLBs issued until December 31, 2022, from Bloomberg, which resulted in a total of 766 observations. In the second step, out of these 766 observations, we excluded the ones without ISIN codes, which reduced the sample size down to 478 observations. In the third step, using the ISIN codes as a bridge, we extracted the yield spreads at issue for the eligible sustainability-linked bonds from Refinitiv Eikon, which narrowed the SLB sample down to 314 observations. From this, we then excluded the SLBs where no data was available on SPTs or incentive mechanisms, which reduced the sample size down to 281. Finally, to standardize the sample, we further excluded SLBs without issuer credit ratings (less 48 SLBs), fixed coupon types (less 6 SLBs), and *Callable* or *At Maturity* maturity types (less 7 SLBs). The final sample amounts to 220 senior SLBs, as shown in Table 15.

7.2. Sample description

In Table 1, we show the region of the issuer. The majority (135) of the issues in our sample come from Europe, followed by Northern America (45) and Asia-Pacific (30). The remaining 10 issues then come from the Rest of the World. Evidently, the phenomenon of SLBs is more established in highly developed markets and is yet to gain a foothold in developing markets. Unsurprisingly, in support of this, the average issue sizes are largest in Northern America (0,78 mmUSD) and Europe (0,75 mmUSD), and smallest in Asia-Pacific (0,26 mmUSD) and Rest of the World (0,53 mmUSD).

Table 1: SLBs across regions.

	N	**mmUSD**
Europe	135	100,90
Northern America	45	34,95
Asia-Pacific	30	7,75
Rest of the World	10	5,26
Total	**220**	**148,86**

In Table 2, a sector breakdown is provided. In both number and value terms, the largest issuers of SLBs come from the Utilities, Materials, Industrials and Consumer Staples sectors. Consequently, it is noticeable that SLB issuers often are from capital and emission intensive sectors. This may suggest that issuers from these sectors are strongly concerned about the transition to sustainable economy and can impact it greatly but prior to SLBs with unrestricted use-of-proceeds, were lacking the sustainable instruments for it. SLBs have, however, also been issued by less carbon intensive sectors, such as Financials, Technology, and Health Care, the latter having the largest average issue size in the sample.

Table 2: SLBs across sectors.

	N	mmUSD
Communications	11	8,22
Consumer Discretionary	18	10,70
Consumer Staples	31	23,29
Energy	13	8,52
Financials	17	8,95
Government	1	0,30
Health Care	6	7,21
Industrials	32	18,07
Materials	36	19,65
Technology	8	4,94
Utilities	47	39,00
Total	**220**	**148,86**

Table 3 presents then a breakdown of the coupon adjustments for not achieving the predetermined SPT for our sample. As described in Section 2, the most common coupon step-up for failing to reach the SPT is 25 basis points, which also holds true for our sample through 98 observations. From the rest of the SLBs, 47 have a step-up above 25 bps while 59 observations have a step-up below 25 bps. 16 of the SLBs have other mechanisms such as carbon credit purchases. Finally, most issuers in our sample hold a BBB credit rating at issue followed by BB and A rated issuers. These ratings range from AA to CCC fairly symmetrically with few extreme values. Table 4 shows the ratings breakdown.

Table 3: SLBs per step-ups.

	N	mmUSD
Coupon Step-Up: >25 bps	47	32,01
Coupon Step-Up: 25 bps	98	72,30
Coupon Step-Up: <25 bps	59	40,28
Zero or other mechanism	16	4,27
Total	**220**	**148,86**

Table 4: Issuer credit ratings.

	N	mmUSD
AA	5	2,83
A	30	16,29
BBB	100	73,71
BB	57	38,84
B	24	13,91
CCC	4	3,28
Total	**220**	**148,86**

Overall, even though our sample is small, it appears to be very representative of the population when compared to Kölbel and Lambillon (2022) and Berrada et al. (2022) tabulations of SLB characteristics in terms of issuer region, sector and SLB mechanisms on the entire SLB universe identified in Bloomberg at their representative times. The same applies to a comparison with the SLB population shown in Section 2.2.3. Additionally, our paper also provides insights to issuer credit ratings. Similar to authors above, considering the coverage of Bloomberg's fixed income database, we assume the final sample to represent closely the developing SLB universe until December 31, 2022. Furthermore, compared to their sample sizes of 180 and 145 SLBs, we think our sample is as extensive as possible.

7.3. Univariate analysis

Table 5 provides the summary statistics for the variables included in the later regressions. As mentioned, the initial sample size amounts 220 observations with bond controls but drops to 190 observations with issuer controls, 177 observations with *Bid-Ask Spread*, and further to 150 observations with ESG scores. Our dependent variable, *Yield Spread*, is on average 232,08 bps. The distribution of *Yield Spread* appears to be fairly symmetric (slightly skewed to the right) with a median (206,10) close to the mean. The minimum and maximum values show a high degree of variability in yield spreads, which nonetheless is unsurprising considering the range of issuer credit ratings in our sample (AA to CCC). Lastly, the varied distribution seems to closely align with previous literature (see e.g., Li et al. (2020)), and provide a solid ground for hypothesis testing.

Bringing the attention to our main explanatory variable, *AADTT*, we observe a mean value of 7,42%. The variability is fairly large with a standard deviation of 12,64%, which is further supported by the substantial range between the minimum and maximum values. Breaking down the *AADTT* into time dimension (*TtT*) and distance dimension (*DtT*), we observe that the *DtT* has more variability than the *TtT* based on the standard deviations in relation to the means of these variables. The average *TtT* is 7,7 years with the minimum value being 1 year and the maximum value being 23 years. Both the *TtT* and *DtT* appear to be somewhat skewed to the right with means greater than medians. The average *DtT* is 50,97% with the minimum value being 0% and the maximum value being 971%. Interestingly, *AADTT* and its dimensions also seems accurately synchronized with the average *AADTT* (7,42) multiplied by the average *TtT* (7,69) resulting in 57,06, which is close to the average *DtT* of 50,97.

The dummy variable *GHGE* shows that 78% (172) of the sample have SPTs with greenhouse gas emissions. Furthermore, it appears that 87% (191) of the SLBs are callable, 9% (20) are secured and 40% (88) are in accordance with science-based targets initiative. A high degree of callable SLBs inserts further scrutiny and support to greenwashing concerns through the first greenwashing channel discussed by Kölbel and Lambillon (2022). Finally, for the average (median) SLB, the coupon rate is 319,13 (305) bps, the maturity is 8,44 (7,5) years – and longer than the *TtT*, and the issue size is 676,63 (600) mUSD. All of the abovementioned common bond variables also show a substantial range between minimum and maximum values, implying that our sample is a not homogeneous and further meriting their inclusion as controls.

Moving on to the issuer controls (winsorized on the 1st and 99th percentile), we observe an average *ROA* of 4,32% with a standard deviation of 3,58 indicating that the issuing companies are of fairly good quality. Since even the minimum value is positive, it tells us that all issuers are profitable, which indicates that SLBs are more inclined to be issued by companies that are under less financial distress. This could be due the possible coupon step-up, which could induce further problems for companies that are already under financial distress. The abovementioned notion is evident in interest coverage ratio too with rightly skewed average (median) value of 10,77 (3,98). In size-terms, the average (median) issuing company has total assets of 54 480 (22 336) mUSD, while the difference between smallest and largest firm is 260 371 mUSD. The use of leverage is moderate-to-high in our sample, with average (median) *Debt to Assets* ratio of 51,31% (54,68%) and a standard deviation of 17,83 ushered by minimum (maximum) value(s) of 13,03% (87,24%). This implies that all issuers have other sources of debt, which is reasonable due the contingent nature of SLBs. Lastly, one-fourth (55) issues in our sample are from private companies.

Regarding *H2*, the average (median) ESG score in our sample is 75,31 (78,83) with values ranging from 16,71 to 93 with a standard deviation of 15,59. The constituents, E, S and G scores, behave in a similar manner with average values in the range of 70,98 to 78,69 and standard deviations of 15,74 to 19,63 laying the foundation for extreme values from 0 to 96,94. Finally, the mean value of 0,37 for the signalling-driven *GB* dummy implies that 70 SLBs are issued by firms that have issued green bonds previously.

Table 5: Summary Statistics

Variable	N	Mean	Median	SD	Min	p25	p75	Max
Yield Spread (bps)	220	232.08	206.10	155	9.66	111.05	324.95	855.13
AADTT	220	7.42	4.52	12.64	0	2.59	8.22	121.29
DtT (%)	220	50.97	33.60	94.34	0	19.78	55.62	971
TtT (years)	220	7.69	7.01	3.14	1	6	10.01	23.02
GHGE[2]	220	.78	1.00	.41	0	1	1	1
Coupon Step-Up (bps)	220	25.62	25.00	18.41	0	12.5	25	150
isCallable[2]	220	.87	1.00	.34	0	1	1	1
SBTi[2]	220	.4	0.00	.49	0	0	1	1
isSecured[2]	220	.09	0.00	.28	0	0	0	1
Coupon Rate (bps)	220	319.13	305.00	209.91	0	150	468.75	1175
Maturity (years)	220	8.44	7.45	3.99	3	6	10	30
Amount Issued (mUSD)	220	676.63	600.00	362.85	30.23	419.04	943.67	2161.04
isPrivate[2]	220	.25	0.00	.43	0	0	.5	1
ROA[1]	190	4.32	3.37	3.58	.06	2.31	5.15	20.57
Interest Coverage[1]	190	10.77	3.98	20.06	.13	2.43	9.47	132.29
Total Assets[1] (mUSD)	190	54479.71	22335.90	74473.09	783.82	9874.37	51492.8	261173.75
Debt to Assets[1] (%)	190	51.31	54.68	17.83	13.03	39.07	63.39	87.24
GB	177	.37	0.00	.48	0	0	1	1
Bid-Ask Spread	177	.6	.49	.32	0.01	.34	.97	2
ESG	150	75.31	78.83	15.59	16.71	69.85	85.37	93
E	150	74.3	77.31	19.63	0	63.6	90.69	96.94
S	150	78.69	82.32	15.74	13.81	70.72	91.82	96.4
G	150	70.98	77.90	18.56	12.5	64.09	83.58	96.88

Note: For variable explanation, see Table 14 in appendix

[1]*Wisorized on the* 1^{st} *and* 99^{th} *percentile*
[2]*Binary variable*

To achieve a more granular set of summary statistics, we further categorize our sample by our ambitiousness variable *AADTT* in Table 6. By comparing the two subgroups, it appears that more ambitious Sustainability Performance Targets are associated with higher yield spreads. In the group with less ambitious SPTs (*AADTT* < 7,42), the mean (median) yield spread is 211,08 (175,66), whereas in the group with more ambitious SPTs (*AADTT* > 7,42), the mean (median) yield spread is 289,38 (243,20). Consequently, this results to a difference of 78,30 (67,54) bps in support of *H1*. Finally, to test for significance in mean differences, we conduct a mean-comparison test which confirms a statistically significant difference in means (see Table 16).

By analysing the two dimensions of the *AADTT*, our sample behaves as expected. In less ambitious SLBs, the mean *DtT* is 31,47% while the mean *TtT* is 8,14 years. Compared to more ambitious SLBs, the mean *DtT* is 104,20% while the mean *TtT* is 6,45 years. On average, more ambitious SLBs have a longer distance from baseline to the threshold value, and a shorter time frame to achieve it on.

Further, it appears that GHGE SPTs are more common (82% vs 68%) in SLBs with less ambitious SPTs. More ambitious SLBs also seem to be callable to a higher extent than less ambitious SLBs (92% vs 85%). This may suggest that issuers use the call options to protect themselves from a more probable coupon step-up due more ambitious SPT(s) which could prove useful if the SLB was issued on greenwashing grounds. Based on the issuer characteristics, it seems also that larger, less profitable, and more levered companies are more likely to issue SLBs with more ambitious SPTs.

Finally, SLBs with more ambitious targets seems to be issued by companies with better ESG scores. The average ESG score in the sample group with less ambitious SPTs is 73,97 while the average ESG score in the sample group with more ambitious SPTs is 77,21. This is also consistent with average E, S, and G scores, as all of them are higher in the sample with more ambitious SPTs. However, given the miniscule difference and uneven observations, one should not draw any further conclusions here.

Table 6: Summary Statistics categorized by mean *AADTT*

AADTT < 7.42	N	Mean	Median	SD	Min	p25	p75	Max
Yield Spread (bps)	161	211.08	175.66	138.89	23.2	94.9	306.2	734.18
AADTT	161	3.62	3.35	1.72	0	2.48	4.71	7.14
DtT (%)	161	31.47	25.00	23.39	0	15	45	200
TtT (years)	161	8.14	7.01	3.25	1.67	6	10.01	23.02
GHGE[2]	161	.82	1.00	.39	0	1	1	1
Step-Up (bps)	161	25.22	25.00	19.8	0	12.5	25	150
isCallable[2]	161	.85	1.00	.36	0	1	1	1
SBTi[2]	161	.43	0.00	.5	0	0	1	1
isSecured[2]	161	.09	0.00	.28	0	0	0	1
Coupon Rate (bps)	161	296.66	285.00	193.78	0	100	450	750
Maturity (years)	161	8.56	8.00	3.97	3	7	10	30
Amount Issued (mUSD)	161	662.61	589.66	369.17	37.93	438.97	900	2161.04
isPrivate[2]	161	.22	0.00	.41	0	0	0	1
ROA[1]	139	4.67	3.68	3.86	.06	2.56	5.53	20.57
Interest Coverage[1]	139	12.31	4.97	20.53	.13	2.93	12.72	132.29
Total Assets[1] (mUSD)	139	48566.27	23289.80	64358.61	902.64	10936.43	51492.8	261173.75
Debt to Assets[1] (%)	139	48.91	49.88	18.11	13.03	35.07	61.51	87.24
GB[2]	126	.36	0.00	.48	0	0	1	1
Bid-Ask Spread	126	.61	0.49	.33	.13	.34	.98	2
ESG	110	73.97	78.05	16.04	16.71	69.85	83.71	93
E	110	73.24	77.32	20.38	0	63.17	90.08	96.94
S	110	76.86	78.40	16.18	13.81	70	90.05	96.4
G	110	70.26	77.58	19.17	12.5	59.27	83.26	96.88
AADTT > 7.42								
Yield Spread (bps)	59	289.38	243.20	181.49	9.66	146.07	413.9	855.13
AADTT	59	17.77	11.53	21.12	7.49	9.42	16.07	121.29
DtT (%)	59	104.2	66.00	167.81	20	50	89	971
TtT (years)	59	6.45	6.01	2.43	1	5.01	7.01	14.01
GHGE[2]	59	.68	1.00	.47	0	0	1	1
Step-Up (bps)	59	26.71	25.00	14	0	18.75	25	75
isCallable[2]	59	.92	1.00	.28	0	1	1	1
SBTi[2]	59	.34	0.00	.48	0	0	1	1
isSecured[2]	59	.08	0.00	.28	0	0	0	1
Coupon Rate (bps)	59	380.42	350.00	239.93	25	187.5	520	1175
Maturity (years)	59	8.11	7.00	4.06	3	5.5	10	30
Amount Issued (mUSD)	59	714.88	750.00	345.14	30.23	400	976.87	1738.74
isPrivate[2]	59	.34	0.00	.48	0	0	1	1
ROA[1]	51	3.37	3.16	2.46	.28	2.18	3.85	13.06
Interest Coverage[1]	51	6.56	3.33	18.22	.14	1.72	4.02	132.29
Total Assets[1] (mUSD)	51	70596.73	21641.19	95763.35	783.82	5911.31	64735.8	261173.75
Debt to Assets[1] (%)	51	57.86	59.27	15.37	23.41	45.49	68.73	87.24
GB[2]	51	.41	0.00	.5	0	0	1	1
Bid-Ask Spread	51	.56	0.49	.29	.01	.35	.79	1.18
ESG	40	79	81.73	13.8	43.85	72.4	92.06	93
E	40	77.21	76.50	17.34	40.81	63.6	94.95	96.25
S	40	83.72	86.24	13.39	40.5	77.38	96.01	96.4
G	40	72.96	81.58	16.85	23.49	65.41	83.58	94.81

Note: For variable explanation, see Table 14 in appendix

[1]*Wisorized on the 1st and 99th percentile*
[2]*Binary variable*

7.4. Correlation analysis

Table 7 then provides a correlation matrix showing pairwise correlations between each variable. The dependent variable, *Yield Spread*, has a significant correlation coefficient of 0,133 with our main independent variable *AADTT*, providing further indirect support for *H1*. The correlation coefficient between *TtT* and yield spreads is also negative and highly significant (-0,236) in line with *H1*. A more ambitious target would consist of a larger distance to target and a smaller time frame. The anticipated relationship can also be observed in the *DtT* although is it miniscule and insignificant. To sum up, the correlation with yield spreads behaves as hypothesized for the *AADTT* and its dimensions. Excluding *DtT* and *TtT*, *AADTT* shows no signs of high correlation or multicollinearity with the other variables.

Interestingly, it appears that *GHGE* is negatively correlated (-0,158) with *DtT* and positively correlated (0,193) with *TtT*. Further, the coefficients are highly significant, indicating that greenhouse gas emission SPTs tend to be less ambitious. Another interesting note is that the highly significant coefficient of 0,216 between *SBTi* and *Amount Issued* may imply that issuers want to certify themselves with science-based targets initiative for larger issues to benefit the maximum amount of dollars from a potential sustainability premium documented by Kölbel and Lambillon (2022).

Continuing with the bond variables, the coupon rate and yield spreads are highly correlated (0,841) with high significance. This is logical as coupon cash flows are a vital part of bond's price-to-yield relationship (see Section 6.2.3). Similarly, it appears that callable SLBs are positively correlated with yield spreads (0,300) with high significance, which also makes economic sense as investors will demand a higher yield due to the issuer's option to call the bond which results in fewer than expected coupon payments for the investor. Against our intuition, we, however, note a positive (0,395) and significant correlation between security (collateral) use and yield spreads. Generally, secured bonds should be deemed as less risky. This anomaly may be due simply a low share of secured (9%) SLBs.

The observed economic relation between *ROA*, *Interest Coverage* and yield spreads is as expected; higher profitability reduces risk, and, thus, should correlate negatively with yield spreads. However, from these, it is only the interest coverage which has a statistically significant correlation with yield spreads (-0,260). Similarly, the highly significant positive correlation coefficient between *Debt to Assets*, *Bid-Ask Spread* and yield spread is also economically reasonable due associated higher risk with higher leverage and lower liquidity. Lastly, the weakly significant correlation coefficient between yield spread and firm size is negative which is also reasonable as larger firms are often considered as less risky.

Finally, the total ESG score and the score for the different components of ESG are all negatively correlated to yield spreads with a high degree of statistical significance. Moreover, all coefficients are relatively high, the highest being the correlation between *E score* and yield spreads (-0,465). This, together with a significant negative correlation (-0,330) between green bond dummy *GB* and yield spreads, provide indirect support for *H2*. Interestingly, the correlation matrix also shows a highly significant positive correlation between issuer size (*Total Assets*) and issuer's sustainability profile (ESG 0,508; GB 0,380). From a logical standpoint, this relation may imply that larger companies have more money to invest in sustainability.

From an econometric perspective, most correlation coefficients between our variables can be perceived as moderate or low. Considering that *AADTT* and *DtT* as well as *ESG* and its components will never be used in a same regression model, the inferences with our main explanatory variables should be valid. Furthermore, STATA, the statistical program used throughout this paper, will automatically drop the variables with high collinearity further alleviating multicollinearity issues.

Table 7: Pearson's Correlation Matrix

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
(1) Yield Spread	1.000																						
(2) AADTT	0.133**	1.000																					
(3) DtT (%)	0.021	0.932***	1.000																				
(4)TtT (years)	-0.236***	-0.141**	0.088	1.000																			
(5) GHGE	-0.087	-0.241***	-0.158**	0.193***	1.000																		
(6) Coupon Step-Up	-0.006	0.006	0.005	0.089	0.072	1.000																	
(7) isCallable	0.300***	0.057	0.039	-0.119*	0.087	0.227***	1.000																
(8) SBTi	-0.029	-0.117*	-0.082	0.049	0.032	0.084	0.212***	1.000															
(9) isSecured	0.395***	-0.012	-0.034	-0.166**	0.123*	-0.070	0.120*	-0.023	1.000														
(10) Coupon Rate	0.841***	0.116*	0.020	-0.142**	-0.112*	0.034	0.226***	-0.008	0.287***	1.000													
(11) Maturity	-0.095	-0.118*	-0.041	0.269***	0.132**	-0.037	0.094	-0.071	-0.131*	-0.009	1.000												
(12) Amount Issued	0.001	0.056	0.079	-0.009	0.141**	0.124*	0.349***	0.216***	-0.028	-0.026	0.045	1.000											
(13) ROA	-0.092	-0.095	-0.059	0.055	-0.110	-0.049	0.183**	-0.014	-0.124*	0.022	-0.050	0.137*	1.000										
(14) Interest Coverage	-0.260***	-0.067	-0.046	0.010	-0.107	-0.133*	-0.146**	0.106	-0.102	-0.211***	-0.109	-0.065	0.450***	1.000									
(15) Debt to Assets (%)	0.353***	0.060	0.110	0.035	0.105	0.009	0.279***	0.022	0.152**	0.284***	-0.029	0.246***	-0.086	-0.426***	1.000								
(16) Total assets	-0.164**	-0.021	-0.016	-0.026	0.027	0.004	-0.107	0.064	0.015	-0.123*	0.005	0.231***	-0.193***	-0.160**	0.165**	1.000							
(17) isPrivate	0.468***	-0.021	-0.034	-0.195***	-0.051	-0.137**	0.070	0.037	0.383***	0.359***	0.037	-0.188***	-0.312***	-0.175**	0.083	0.014	1.000						
(18) Bid-Ask Spread	0.497***	-0.084	-0.081	-0.022	-0.033	-0.129*	0.085	-0.177**	0.228***	0.450***	0.144**	-0.177**	0.180**	-0.051	0.160**	-0.168**	0.276***	1.000					
(19) GB	-0.330***	-0.068	-0.039	0.105	0.037	-0.052	-0.113*	0.122*	-0.121*	-0.213***	0.100	0.111*	-0.203***	-0.075	0.063	0.380***	-0.221***	-0.241***	1.000				
(20) ESG	-0.397***	0.080	0.089	0.083	0.100	-0.043	-0.067	0.084	-0.243***	-0.235***	0.037	0.311***	-0.061	-0.001	0.017	0.508***	-0.303***	-0.404***	0.301***	1.000			
(21) E-score	-0.465***	0.098	0.118	0.096	0.128*	-0.076	-0.061	0.086	-0.227***	-0.232***	0.128*	0.289***	-0.084	-0.018	0.062	0.503***	-0.263***	-0.385***	0.367***	0.877***	1.000		
(22) S-score	-0.329***	0.093	0.098	0.051	0.029	-0.044	-0.038	0.116	-0.249***	-0.225***	0.000	0.258***	-0.134*	0.004	-0.002	0.484***	-0.199**	-0.397***	0.310***	0.904***	0.704***	1.000	
(23) G-score	-0.231***	0.011	0.016	0.100	0.103	0.025	-0.048	0.009	-0.129*	-0.154*	-0.046	0.245***	0.084	0.019	-0.024	0.315***	-0.307***	-0.258***	0.083	0.800***	0.561***	0.591***	1.000

Note: For variable explanation, see Table 14 in appendix

**** p<0.01, ** p<0.05, * p<0.1*

8. Empirical Results

In the first set of regression models, Models 1-5 shown in Table 8, we focus on establishing and investigating the potential relationship between the ambitiousness of SPTs and SLB yield spreads. Model 1 is the simplest model only containing the main explanatory variable for ambitiousness (*AADTT)*, and controls for issuer credit ratings and sectors. The estimations in Model 1 imply that there exists a positive statistically significant relationship between *AADTT* and yield spreads with a coefficient of 1,075 indicating that one percentage point increase in *AADTT* results to 1,075 bps increase in yield spread. Moreover, the credit rating controls perform as expected (lower the rating, higher the yield spread) and are all highly significant or significant par rating group A. The substantial coefficient difference (87,304 vs 248,118) between BBB and BB groups also mirrors well the anticipated economic effect of belonging to investment/junk-grade.

As mentioned earlier, for our results to be reliable, they must be coherent with MLR assumptions. Hence, we test model A for heteroskedasticity using both Breusch-Pagan and White tests. Based on the results shown in Table 17 (p-values of 0 for both tests), we can reject the null hypothesis of constant variance with confidence and conclude that our models suffer from heteroskedasticity. To combat this, we employ robust and clustered standard errors throughout the following models.

In Model 2, we introduce our first set of control variables based on SLB characteristics. This reduces the *AADTT* coefficient to 0,836 and the coefficient also loses its statistical significance. As for the introduced controls, the greenhouse gas target dummy variable (*GHGE*) is significant and affects yield spreads negatively (-35,898). Further, the callability feature of SLBs (*isCallable)* results in a 39,824 bps increase in yield spreads, ceteris paribus. The coefficient is significant with its anticipated economic impact. The coefficient for *SBTi* is negative (-0,257) and not significant.

In Model 3, we further specify our model by including two interaction terms for the two greenwashing channels mentioned in section 6.2.6. As theorized, one SPT may not be comparable with another and the often-present callability feature may signal greenwashing exertion. With the added controls, *AADTT*, remains statistically insignificant with a coefficient of 0,318, whereas the interaction term between *GHGE* and the *AADTT* (*GHGExAADTT*) has a coefficient of 4,610 and is highly significant. This implies that if the SPT is set to GHGE, the target ambitiousness as measured by *AADTT* will result in a 4,928 bps increase in yield spread for every one percentage point increase in *AADTT*. Further, the *GHGE* coefficient changes drastically to -66,537 and is now highly significant. The other greenwashing interaction term, *isCallablexStepUp,* however, remains statistically insignificant.

To further augment our models, we include all bond controls in Model 4, and further, all issuer specific controls in Model 5. In Model 4 (5), the coefficient for *GHGExAADTT* changes to 2,140 (2,715) but remains statistically significant. The coefficient for *GHGE* also decreases to -31,823 (-26,314) while remaining significant. Moreover, from the newly added control variable *Coupon Rate* is highly significant and has a positive relationship with yield spread as estimated; an increase of 1 bps in coupon rate is associated with a 0,344 (0,325) bps increase in yield spread. Additionally, *isPrivate* dummy is economically and statistically significance with a coefficient of 37,136 indicating sensibly that private companies pay more for SLBs, whereas *isCallable* holds its former relation.

Based on models 1-5, it seems that the ambitiousness of SPTs does impact SLB yield spreads in accordance with *H1*. To verify the robustness of our results, we do, however, continue specifying our models by first including year and region controls in line with Kölbel and Lambillon (2022), and then using clustered standard errors with sector and issuer clusters to ensure that our results are not caused by secondary issues or sector skewness. Models 6-8 in Table 9 function as these robustness checks and indicate that the results are robust. The interaction term *GHGExAADTT* remains statistically significant with an estimated coefficient of 2,035 throughout these specifications.

Model 9 in Table 9 then continues from this by investigating which dimension, time or distance, drives the ambitiousness relationship. Despite our initial insights on the correlation statistics and the predicted signs for both variables, the results indicate that it is the distance dimension that governs the relationship with economically and statistically significant coefficient of 0,393 for its relative interaction term with *GHGE*. Finally, to combat omitted variable bias, we augment our model by including control variables for bond liquidity and issuers' sustainability profile in Model 10. In this last specification for *H1*, both *GHGE* and its interaction term with our ambitiousness variable remain highly statistically significant with respective coefficients of -45,587 and 3,032. Moreover, while the liquidity proxy *Bid-Ask Spread* fails to reach any significance, the ESG score does show significance for its coefficient of -0,976. The final adjusted R-squared for Model 10 amounts to 0,883.

Before moving on to *H2*, we assess our multicollinearity status with a VIF test for Model 10, which contains all control variables as well as the main explanatory variables from *H1* and *H2*. The results from VIF-test in Table 18 at the end of the paper indicate no signs of problematic multicollinearity in violation of MLR assumptions, especially for the main explanatory variables. While interpretation of VIF scores alone is problematic (Wooldridge, 2016, p.86), we believe that the low VIF scores alongside low pairwise correlations and careful variable selection allay the multicollinearity worries.

In Models 11-14 in Table 10, we begin estimating the relationship between issuers' sustainability profile and yield spreads first without GHGE dummy, and later with GHGE dummy. Given the earlier findings, we found it necessary to control for both the target type, and the target ambitiousness. Due simplicity, we do, however, drop the interactions terms for these. Our sustainability profile proxy *ESG* remains statistically significant in both models with coefficients of -1,091 and -1,031. Further, the latter coefficient remains weakly significant throughout the robustness checks using clustered robust errors with sector (Model 13) and issuer (Model 14) clusters. This indicates that a one-unit increase (decrease) in ESG score is associated with a 1,031 decrease (increase) in yield spread.

Model 15 then broadens the analysis by breaking the ESG score down to its three pillars: E, S, and G. Unsurprisingly, we find that it is the environmental profile (*E-score*) that drives the relationship between issuers' sustainability profile (*ESG)* and yield spreads with a statistically and economically significant coefficient of -0,809. Finally, in Table 11 we continue with our analysis by changing our main explanatory to green bond dummy (*GB*). Using *GB* as a proxy complements the use of *ESG* as it takes its prominent angle from the signalling theory. Despite its hypothesized negative coefficient of -16,753, *GB*, however, remains statistically insignificant in both Models 16 and 17.

To conclude our study, the last set of regressions, Models 18-20 presented in Table 11, then employ our all three main explanatory variables *ESG*, *GB*, and *AADTT* together. We do this first for the full sample, and then for a subsample of observations where the set sustainability performance target is greenhouse gas emissions to gain additional insights. While *ESG* and *GB* are both used as proxies for issuers' sustainability profiles, we believe that including them both on a model is appropriate as they measure it from complementing angles, and further do not have high pairwise correlation.

In Model 18, we find strong statistical significance for the ambitiousness interaction term with a coefficient of 3,020, statistical significance for our primary sustainability profile proxy (*ESG*) with a coefficient of -0,896, and further weak statistical significance for our secondary complementary sustainability profile proxy *(GB)* with a coefficient of -22,038. The subsample analysis in Models 19-20 then continues from here by first using robust standard errors, and then clustered standard errors with firm clusters as a robustness check. With a statistically significant coefficient of 2,232 for *AADTT*, and negative but statistically insignificant coefficients of -27,763 and -0,513 for *GB* and *ESG*, the results imply that the ambitiousness of the targets does impact the yield spreads of SLBs with GHGE-targets, but the issuer's sustainability profile does not. The last model ends with an adjusted R-squared of 0,890.

Overall, our results provide strong support for confirming *H1* (SLBs with more ambitious SPTs experience higher yield spreads at issue date) and moderate support for confirming *H2* (SLBs issued by firms with better sustainability profiles experience lower yield spreads at issue date). For the remaining variables, we find that greenhouse gas emission targets are associated with a negative relationship with yield spreads, whereas coupon rate is associated with a positive relationship with yield spreads. Further, we also find that bonds issued by private companies and bonds that have callability features, experience higher yield spreads.

Table 8: Regression results for Model 1 to 5

VARIABLES	1 Yield Spread	2 Yield Spread	3 Yield Spread	4 Yield Spread	5 Yield Spread
AADTT	1.075**	0.836	0.318	0.306	0.260
	(0.458)	(0.579)	(0.363)	(0.209)	(0.196)
GHGE		-35.898**	-66.537***	-31.823***	-26.314**
		(15.581)	(17.991)	(11.888)	(12.573)
GHGExAADTT			4.610***	2.140**	2.715***
			(1.341)	(1.062)	(0.929)
StepUp		39.389	144.157	-13.904	67.630
		(33.400)	(94.247)	(71.982)	(67.637)
isCallable		39.824**	63.178***	32.796*	47.506***
		(18.343)	(17.083)	(17.568)	(17.921)
isCallablexStepUp			-104.023	34.512	-65.422
			(98.179)	(74.405)	(66.621)
SBTi		-0.257	-4.876	-2.649	-10.376
		(11.640)	(11.239)	(8.028)	(8.667)
isSecured				41.580	15.812
				(26.393)	(29.684)
Coupon Rate				0.344***	0.325***
				(0.031)	(0.031)
Maturity				0.049	0.402
				(1.051)	(1.228)
Amount Issued (log)				-5.593	-2.460
				(6.076)	(6.990)
ROA					-1.541
					(1.295)
Interest Coverage					0.411*
					(0.211)
Debt to Assets					-0.118
					(0.256)
Total Assets (log)					-1.183
					(4.421)
isPrivate					37.136**
					(17.646)
AA	-	-	-	-	-
A	12.473	-1.597	2.991	1.235	18.392
	(40.837)	(26.225)	(29.797)	(20.807)	(17.444)
BBB	87.304**	69.182***	66.232**	41.396**	54.492***
	(37.958)	(25.278)	(29.661)	(18.203)	(16.018)
BB	248.118***	223.657***	219.537***	133.076***	155.230***
	(38.634)	(27.413)	(32.614)	(23.287)	(23.133)
B	385.493***	361.411***	355.666***	201.543***	232.386***
	(41.722)	(37.787)	(41.229)	(27.616)	(29.916)
CCC	636.156***	624.085***	610.541***	407.912***	471.132***
	(56.608)	(41.724)	(44.982)	(34.675)	(30.005)
Constant	120.573***	122.669***	71.445*	178,891	71.063
	(50.562)	(41.617)	(40.636)	(114.083)	(127.945)
Observations	220	220	220	220	190
Standard errors	Standard	Robust	Robust	Robust	Robust
Sector controls	Yes	Yes	Yes	Yes	Yes
Year controls	No	No	No	No	No
Region controls	No	No	No	No	No
Adjusted R-squared	0.724	0.735	0.748	0.876	0.878

Note: For variable explanation, see Table 14 in appendix

Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 9: Regression results for Model 6 to 10

VARIABLES	6 Yield Spread	7 Yield Spread	8 Yield Spread	9 Yield Spread	10 Yield Spread
AADTT	0.233	0.233	0.233		-0.093
	(0.223)	(0.266)	(0.288)		(0.145)
ESG					-0.976**
					(0.419)
DtT				0.006	
				(0.022)	
TtT				-0.564	
				(3.144)	
GHGE	-25.964*	-25.964	-25.964*	-28.711	-45.587***
	(13.595)	(16.205)	(14.959)	(27.717)	(13.424)
GHGExAADTT	2.035**	2.035**	2.035***		3.032***
	(0.993)	(0.739)	(0.746)		(0.914)
GHGExDtT				0.393***	
				(0.150)	
GHGExTtT				-0.549	
				(3.426)	
StepUp	-3.112	-3.112	-3.112	-6.879	135.291
	(89.111)	(77.115)	(86.107)	(85.390)	(88.534)
isCallable	20.637	20.637	20.637	23.962	87.841***
	(23.011)	(21.415)	(30.830)	(21.972)	(26.506)
isCallablexStepUp	12.510	12.510	12.510	16.310	-158.280*
	(91.024)	(82.711)	(89.377)	(87.440)	(87.071)
SBTi	-13.838	-13.838	-13.838*	-14.546*	-3.468
	(8.723)	(11.001)	(8.169)	(8.762)	(8.723)
isSecured	18.914	18.914	18.914	19.855	67.823**
	(28.820)	(42.118)	(31.672)	(29.039)	(29.833)
Coupon Rate	0.373***	0.373***	0.373***	0.371***	0.323***
	(0.036)	(0.033)	(0.030)	(0.035)	(0.036)
Maturity	-0.006	-0.006	-0.006	-0.279	1.779
	(1.220)	(1.723)	(1.825)	(1.348)	(1.237)
Amount Issued (log)	4.587	4.587	4.587	3.733	1.774
	(7.849)	(11.375)	(8.672)	(8.085)	(8.656)
Bid-Ask Spread					13.499
					(17.586)
ROA	-0.210	-0.210	-0.210	-0.452	1.060
	(1.379)	(1.844)	(1.924)	(1.333)	(1.608)
Interest Coverage	0.231	0.231	0.231	0.227	-0.298
	(0.217)	(0.216)	(0.258)	(0.218)	(0.292)
Debt to Assets	-0.230	-0.230	-0.230	-0.290	-0.019
	(0.272)	(0.454)	(0.307)	(0.271)	(0.371)
Total Assets (log)	-4.727	-4.727	-4.727	-4.064	8.564*
	(4.473)	(5.766)	(5.362)	(4.547)	(4.735)
isPrivate	42.321**	42.321*	42.321**	38.748**	64.775**
	(16.938)	(23.194)	(18.416)	(17.628)	(27.455)
AA	-	-	-	-	-
A	25.177	25.177	25.177	21.185	-41.953*
	(20.713)	(30.306)	(23.598)	(21.908)	(25.098)
BBB	54.788***	54.788*	54.788**	51.908**	-21.611
	(19.464)	(29.670)	(22.726)	(20.274)	(33.985)
BB	150.102***	150.102***	150.102***	148.228***	79.984**
	(26.824)	(46.530)	(31.214)	(27.238)	(38.678)
B	210.904***	210.904***	210.904***	210.058***	113.221**
	(31.435)	(27.175)	(35.126)	(31.205)	(49.372)
CCC	443.165***	443.165***	443.165***	446.428***	346.488***
	(31.358)	(32.825)	(34.458)	(30.804)	(54.215)
Constant	82.836	82.836	82.836	95.348	-164.206
	(133.385)	(165.289)	(144.873)	(140.788)	(170.209)
Observations	190	190	190	190	150
Standard errors	Robust	Cluster (sector)	Cluster (firm)	Robust	Robust
Sector controls	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes
Region controls	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.885	0.885	0.885	0.885	0.883

Note: For variable explanation, see Table 14 in appendix

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 10: Regression results for Model 11 to 15

VARIABLES	11 **Yield Spread**	12 **Yield Spread**	13 **Yield Spread**	14 **Yield Spread**	15 **Yield Spread**
AADTT	0.272	0.136	0.136	0.136	0.205
	(0.200)	(0.224)	(0.221)	(0.288)	(0.220)
ESG	-1.091**	-1.031**	-1.031*	-1.031*	
	(0.421)	(0.426)	(0.553)	(0.546)	
E-score					-0.809**
					(0.376)
S-score					-0.372
					(0.442)
G-score					0.157
					(0.326)
GHGE		-20.812*	-20.812	-20.812	-19.362*
		(11.269)	(12.987)	(13.762)	(10.791)
StepUp	-28.787	-26.618	-26.618	-26.618	-27.871
	(21.749)	(21.970)	(20.964)	(23.082)	(21.968)
isCallable	33.011*	39.542**	39.542**	39.542**	40.789**
	(17.340)	(17.014)	(16.635)	(19.295)	(16.465)
SBTi	-3.056	-3.519	-3.519	-3.519	-2.812
	(8.937)	(8.984)	(8.519)	(6.885)	(8.928)
isSecured	46.322	58.525*	58.525**	58.525*	53.361*
	(28.574)	(30.296)	(23.075)	(30.292)	(29.697)
Coupon Rate	0.365***	0.357***	0.357***	0.357***	0.351***
	(0.032)	(0.032)	(0.039)	(0.031)	(0.032)
Maturity	1.091	1.108	1.108	1.108	1.402
	(1.285)	(1.305)	(0.880)	(0.953)	(1.335)
Amount Issued (log)	2.475	2.171	2.171	2.171	3.794
	(8.897)	(8.935)	(14.909)	(10.439)	(9.161)
Bid-Ask Spread	9.030	10.107	10.107	10.107	10.638
	(19.491)	(19.020)	(36.701)	(26.603)	(19.450)
ROA	1.438	1.126	1.126	1.126	0.489
	(1.778)	(1.725)	(1.817)	(2.005)	(1.726)
Interest Coverage	-0.261	-0.280	-0.280	-0.280	-0.180
	(0.345)	(0.317)	(0.437)	(0.399)	(0.307)
Debt to Assets	-0.121	-0.045	-0.045	-0.045	-0.011
	(0.359)	(0.375)	(0.636)	(0.429)	(0.380)
Total Assets (log)	5.714	7.600	7.600	7.600	8.037*
	(4.754)	(4.806)	(6.338)	(5.502)	(4.791)
isPrivate	78.931***	73.614***	73.614*	73.614***	77.552***
	(25.548)	(26.022)	(33.885)	(27.821)	(27.154)
AA	-	-	-	-	-
A	-20.539	-29.772	-29.772	-29.772	-20.085
	(26.947)	(26.150)	(35.111)	(30.369)	(25.327)
BBB	1.172	-7.203	-7.203	-7.203	5.076
	(38.370)	(36.065)	(60.520)	(45.780)	(33.697)
BB	94.933**	89.862**	89.862	89.862*	99.570**
	(43.039)	(41.306)	(76.541)	(52.159)	(38.981)
B	125.058**	114.677**	114.677	114.677*	124.033**
	(52.289)	(52.032)	(87.944)	(64.638)	(49.773)
CCC	333.527***	331.246***	331.246***	331.246***	338.095***
	(54.024)	(53.567)	(90.621)	(63.121)	(53.002)
Constant	-119.476	-121.413	-121.413	-121.413	-174.375
	(143.448)	(145.384)	(240.315)	(194.988)	(152.454)
Observations	150	150	150	150	150
Standard errors	Robust	Robust	Clustered (sector)	Clustered (firm)	Robust
Sector controls	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes
Region controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.871	0.873	0.873	0.873	0.875

Note: For variable explanation, see Table 14 in appendix

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 11: Regression results for Model 16 to 20

VARIABLES	16 Yield Spread	17 Yield Spread	18 Yield Spread	19 Yield Spread	20 Yield Spread
AADTT	0.433	0.433	-0.187	2.232*	2.232***
	(0.277)	(0.361)	(0.150)	(1.167)	(0.783)
GB	-12.863	-12.863	-22.038*	-27.763*	-27.763
	(10.556)	(12.819)	(12.329)	(14.218)	(16.876)
ESG			-0.896**	-0.513	-0.513
			(0.412)	(0.480)	(0.551)
GHGE			-47.931***		
			(13.214)		
GHGExAADTT			3.020***		
			(1.004)		
StepUp	-3.168	-3.168	-32.367	-31.415	-31.415
	(19.112)	(21.297)	(19.579)	(24.236)	(23.425)
isCallable	27.363	27.363	61.172***	67.528**	67.528***
	(17.822)	(22.446)	(17.439)	(25.639)	(24.439)
SBTi	-9.801	-9.801	-3.322	-4.409	-4.409
	(8.971)	(8.838)	(8.552)	(9.908)	(7.702)
isSecured	6.234	6.234	62.978**	93.128*	93.128*
	(28.242)	(33.081)	(30.134)	(53.942)	(49.665)
Coupon Rate	0.404***	0.404***	0.337***	0.368***	0.368***
	(0.034)	(0.028)	(0.037)	(0.037)	(0.026)
Maturity	-1.288	-1.288	1.314	0.607	0.607
	(1.452)	(2.168)	(1.212)	(1.307)	(1.094)
Amount Issued (log)	7.784	7.784	-1.837	4.897	4.897
	(8.683)	(10.149)	(8.644)	(9.963)	(10.320)
Bid-Ask Spread	17.601	17.601	20.042	32.472	32.472
	(18.623)	(24.442)	(17.808)	(26.144)	(36.825)
ROA	-0.831	-0.831	0.380	-2.711	-2.711
	(1.687)	(2.076)	(1.612)	(2.799)	(3.261)
Interest Coverage	0.222	0.222	-0.358	-0.073	-0.073
	(0.288)	(0.346)	(0.281)	(0.945)	(1.063)
Debt to Assets	-0.247	-0.247	0.006	0.585	0.585
	(0.321)	(0.384)	(0.348)	(0.726)	(0.781)
Total Assets (log)	-5.322	-5.322	9.122*	4.421	4.421
	(4.614)	(5.195)	(4.744)	(7.241)	(8.633)
isPrivate	45.160***	45.160**	63.009**	65.017*	65.017*
	(16.321)	(18.940)	(25.800)	(34.809)	(36.330)
AA	-	-	-	-	-
A	55.285**	55.285**	-37.806	-25.069	-25.069
	(24.752)	(27.312)	(25.088)	(92.788)	(99.232)
BBB	80.014***	80.014***	-28.618	-16.054	-16.054
	(23.679)	(27.020)	(32.667)	(95.186)	(104.749)
BB	160.955***	160.955***	61.778*	65.110	65.110
	(30.631)	(37.290)	(37.021)	(102.164)	(118.031)
B	220.698***	220.698***	90.398*	30.049	30.049
	(35.360)	(43.506)	(48.684)	(97.544)	(116.855)
CCC	433.070***	433.070***	315.868***	288.106**	288.106**
	(32.859)	(38.148)	(57.228)	(113.028)	(130.853)
Constant	-114.113	-114.113	-27.476	-170.775	-170.775
	(134.186)	(168.296)	(144.243)	(230.741)	(255.580)
Observations	177	177	150	120	120
Standard errors	Robust	Clustered (firm)	Robust	Robust	Clustered (firm)
Sector controls	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes
Region controls	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.869	0.869	0.884	0.890	0.890

Note: For variable explanation, see Table 14 in appendix

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

9. Analysis and Limitations

9.1. Analysis and Discussion

Based on the regression results in the previous section, we find support that the ambitiousness of sustainability performance targets (SPTs), measured by *AADTT*, influences SLB yield spreads at issue when the set SPT is greenhouse gas emissions. This is evident in the interaction term *GHGExAADTT*, which remains statistically significant or strongly significant throughout the model specifications with a minimum (maximum) coefficient of 2,035 (4,610). Further, despite the initial contrary correlation statistics, our granular analysis indicates it is the distance, not the time, dimension that drives the relation. Overall, the findings suggest that we can confirm the *H1* with confidence – more ambitious SPTs are associated with higher yield spreads when the target is greenhouse gas emissions.

Since Model 10 contains variables from both hypotheses and all controls, we believe it is the most accurate estimation for the relationship; in Model 10, the coefficient for *AADTT* is economically and statistically insignificant -0,093, for *GHGE* is economically and statistically significant -45,587, and for *GHGExAADTT* is economically and statistically significant 3,032. This implies that a one percentage point change in *AADTT* is associated with a 2,939 bps increase in yield spread for GHGE-targets. The subsample results in Model 20 indicate a similar, albeit a more conservative, relationship with a coefficient of 2,232. Using this as a straightforward way to illustrate the result in practice, the associated yield spread difference between bottom-quartile and top-quartile *AADTT* is then -12,6 bps corresponding to extra savings, or costs, of 0,85 mUSD on debt for the issuer with average issue size.

We believe that our results indicate that the SLB market is at least partly efficient in accordance with the efficient market hypothesis and bond market efficiency literature (Gallo et al., 1997; Ronen & Zhou, 2008). Further, we find that the notion of SLBs incorporating predictions about the likelihood of a coupon step into their yields similar to how bond markets anticipate credit rating changes before they are announced (Weinstein, 1976; Wansley et al., 1992) resonates well with our hypothesis and results. Moreover, as we control for issuer characteristics, the positive relationship may indicate that the stakeholders are discontent with the high self-inflicted resource and capital needs of deviating ambitious targets (Dowling & Pfeffer, 1975; Meyer & Rowan, 1977; Freeman, 1984).

On the contrary, we do not find support that SLBs with less ambitious targets are less coherent with ICMA's *Sustainability-Linked Bond Principles* and thus have higher greenwashing concerns, and ultimately, yield spreads. We find this interesting as the greenwashing concerns are soundly founded. On the other hand, this may simply imply that within sustainable asset classes, investors prioritize financial gains above the "extra" sustainability gains, and that the current standards need to be revised. Perhaps this relation is subject to change after the release of competing or updated principles. Further, the hypothesized better capacity of financially strong firms to prioritize sustainability and thus set more ambitious SPTs also fails to manifest in our results. Indeed, the correlation matrix seems to suggest the opposite with negative correlation coefficients between *AADTT* and profitability proxies.

A potential explanation for why this relationship is only demonstrated in SLBs with greenhouse gas SPTs may lie in the simple fact that GHGE-targets are more comparable with one another, as supported by the subsample analysis. Comparing SLBs with SPTs such as holding/receiving a climate certificate or increasing workforce diversity by X% with GHGE makes little sense. Moreover, GHGE as targets may be more quantifiable and understandable for investors, which provides a solid foundation for assessing the likelihood on whether the set SPT and the associated coupon step-up will materialise or not. Thus, the pricing in the SLB market is likely more efficient with GHGE-targets.

Given the above-described nature, an overly ambitious SPT in the form of GHGE may also be a clear greenwashing signal to investors. This may, ceteris paribus, indicate that the SLB will either be called or face the coupon step-up – both of which should be reflected positively on yield spreads based on EMH. Furthermore, investors with sustainable investment criteria may screen out SLBs with overly ambitious targets due greenwashing worries (Heinkel et al., 2001) which may result in lower demand, and thus, lower price and higher yield for these SLBs. Additionally, an overly ambitious target may also harm the legitimacy of the issuer, resulting to higher yield spreads due higher risk perception amongst stakeholders (Dowling & Pfeffer, 1975; Freeman, 1984; Himme & Fisher, 2014)

Across our models, we also find evidence that setting GHGE as the SPT lowers the yield spreads substantially. Indeed, with an average *AADTT*, the associated total impact on yield spreads is -24 bps, which further implies that the *AADTT* must be 15,52, or roughly double the average, to offset the impact. This finding coincides well with the project-cluster green bond literature where greener projects are associated with lower yields and better bond performance (Deng et al., 2020; Russo et al., 2021). Utilizing the signalling theory and literature, setting GHGE SPTs may signal credibly issuers' commitment towards sustainability in a similar way as issuing green bonds does (Flammer, 2021; Fatica & Panzica, 2021). Moreover, while overly ambitious GHGE target may be screened out from sustainable investment screens, it is reasonable to assume that normal GHGE targets would instead be screened in, considering the ambiguousness of some other targets in current SLB space.

Inferences could be drawn from CSR as well. GHGE-targets may simply better align with stakeholder interests, and further convey legitimacy and coherence with prevalent SLB structures (Dowling & Pfeffer, 1975; Meyer & Rowan, 1977; Freeman, 1984). Alternatively, from an economic perspective, upcoming emission decreases may signal better future efficiency, and hence, margins, considering the high share of carbon-intensive issuers.

When it comes to *H2*, we find moderate support that issuers' sustainability profile impacts SLB yield spreads. With our primary proxy for sustainability profile, the ESG score, the associated relationship is statistically significant with a coefficient of -1,031, whereas with our complementary secondary proxy, the green bond dummy, we find no real significance despite the estimated negative coefficient. Moreover, our later specifications indicate that the environmental dimension drives this relationship, and that the relationship is more robust for all types of SLBs, not just the GHGE-SLBs. To illustrate the economic impact of the ESG score further, the associated yield spread difference between the highest (93,00) and lowest (16,71) ESG performing issuers amounts to 78,7 bps.

Compared to the prevalent SLB literature, our results are much in line with Berrada et al. (2022) but opposed to Kölbel and Lambillon (2022) who used sustainability index inclusions as proxy for sustainability profiles. In general, we conjecture motivations for this relationship between issuers' sustainability profile and SLB yield spreads from instrument-specific and traditional perspectives. From an instrument-specific perspective, we advocate that our results may further support the fact that investors assess the likelihood of achieving the set SPT(s) and avoiding the associated coupon step-ups as discussed in *H1*. Building on EMH and CSR, investors may deem the attempts of better CSR performers (proxied by ESG score) in reaching the set SPT(s) as more credible and likely to be successful. This, in turn, should decrease the likelihood of coupon step-ups and expected returns for investors, which then should be reflected on the yield spreads.

From a more traditional perspective, we note that our results are much in harmony with the literature on the relationship between CSR and cost of debt. The main arguments that issuers with better CSR are associated with better stakeholder relationships (Freeman, 1984), higher legitimacy (Dowling & Pfeffer, 1975) and better access to finance (Bhuiyan & Nguyen, 2020), which in turn lowers their general riskiness and ultimately yield spreads, resonates well with the SLB space as well – especially in the presence of greenwashing concerns and the reputational risks associated to them. If investors have asymmetric information about issuers sustainability profiles, an ESG score is likely to reduce that asymmetry, and further govern the quality assessment making them as an appropriate proxy with estimated and confirmed positive relationship.

Moreover, given the greenwashing worries, our results resonate also well with Heinkel et al. (2001) suggestions that investors who find utility in sustainable investing may screen out instruments that are subject to these worries. SLB issuers with better sustainability profiles (lower greenwashing concerns) should then, in theory, be included in "sustainable investment screens", which may result in higher demand, better access to finance and ultimately lower yields using Cheng et al. (2014) logic.

In regard to our other findings on SLB yield spreads based on our control variables, we find that the issuer credit ratings and coupon rates seem to explain the majority of yield spread variability. This, we interpret based on highly significant positive coefficients throughout the model specifications for both controls, high adjusted R-squared with only credit rating controls, coupon cash flows being integral part of bonds' price-to-yield relationship, and the fact that these two variables incorporate information from the majority of the other controls. Further, we find that private issuers generally experience noticeably higher yield spreads of 37,136 to 78,931 bps likely due higher information asymmetry and lower liquidity. Similarly, callable SLBs also have higher yield spreads, as expected. For the other controls, we find no robust statistical and/or economic significance.

Finally, by pulling together the findings, our results have several implications, especially for issuers. First, it seems that by setting GHGE as SPT(s) issuers can lower their cost of debt due reduced asymmetry, environmental signalling, and better more credible stakeholder relations. Setting the target thresholds, however, should be done within reasonable limits as more ambitious targets are generally associated with higher yield spreads. With higher coupon step-ups, this relationship is likely to strengthen. Similarly, setting too immaterial targets may spark greenwashing worries.

Moreover, while SLBs differ fundamentally from green bonds due unrestricted use-of-proceeds, cater different firms, and are issued by more carbon intensive firms, it still seems that better sustainability profile issuers benefit at issue, likely due higher sustainable credibility. This, possibly and hopefully, is subject to change as SLBs can financially incentivise all firms to commit to sustainability. On the other hand, for regulators, our results indicate that the current greenwashing mechanism seems to work in the opposite direction to what ICMA wanted in their principles. This may call for a release of updated or competing principles, perhaps with legally binding threshold requirements and active governance.

9.2. Limitations

Despite our efforts in maximizing our sample size, it is still small in absolute terms, which is the major limitation of this study. A small sample size may affect the findings from OLS regressions and result to imprecise estimates of coefficients. A small sample is also more prone to random variation which may lead to unreliable inferences and difficulties in generalizing the results to the larger population. Moreover, the novelty of the SLB market and thus the availability of data further limits our study. Ideally, for additional robustness, we would have liked to also use an alternative proxy for target-ambitiousness and sustainability index inclusions as an alternative proxy for sustainability profile. Unfortunately, this was not possible due data limitations (unavailability and outdatedness). Further, on the data realm, using three different databases may also expose us to data provider specific differences, although we did ensure the comparability across all variables. Moreover, the developing nature of SLBs is also mirrored in Bloomberg; for our study period, Bloomberg search resulted in 754 SLBs the first time, and 766 SLBs the second time. Finally, given the social science nature and the little-researched area of SLBs, our results may always be influenced by factors not captured by our models (omitted variable bias). All this is important to keep in mind when interpreting our results.

10. Conclusion

Sustainability-linked bonds (SLBs) represent the newest sustainable financing frontier in the fight against the climate change. Using a global sample of 220 SLBs issued in 2019-2022, this paper set to answer two research questions: *does the ambitiousness of the Sustainability Performance Targets (SPTs) affect the yield spreads of SLBs at issue date*, and, *does the issuer sustainability profile affect the yield spreads of SLBs at issue date?* This was achieved by employing OLS regressions with SLB yield spread as a dependent variable, and a self-constructed ambitiousness proxy, Average Annual Distance to Target (AADTT), and ESG scores as the main explanatory variables.

The study found that a one percentage point increase in our ambitiousness proxy is associated with a 2-3 bps increase in yield spreads when the sustainability performance target is greenhouse gas emissions. In addition, the study found that a one unit increase in issuer ESG score is associated with a 1,031 bps decrease in yield spreads. Moreover, the former relation is mainly driven by the distance dimension, whereas the latter relation is mainly driven by the environmental score. In addition, we find that greenhouse gas emissions targets experience notably lower yield spreads. The results are premised on theories of efficient market hypothesis, signalling, and corporate social responsibility.

In relation to previous studies, this paper contributes to the scarce but growing body of SLB literature by focusing on the under-explored relationship between the ambitiousness of SPTs and SLB yields, and by contributing to the unequivocal findings on the relationship between issuers' sustainability profile and SLB yields with a larger sample. Additionally, the study provides several implications for issuers to consider when structuring an SLB issue, especially from the target type and ambitiousness perspective.

Given the novelty of the SLB space, this paper provides several future research avenues too, most of which will become more compelling as time passes. First, as most SLBs have second party opinions which assess the target ambitiousness, future research could use them as an alternative ambitiousness proxy. Second, as most of the SLBs in our sample start to near the target date, it would be interesting to see which of these bonds get called, and under which conditions. Third, given the so-far dominance of environmental-type SLBs, future research could focus on other ESG profile SLBs. Finally, diving deeper into the SPT territory and investigating the current state of target setting, measuring and comparability across industry groups could be rewarding. In short, the possibilities are plentiful.

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Tables

Table 12: SLB and GB universe 2018 to 2022 by region

	SLBs		GBs	
By region	**N**	**mmUSD**	**N**	**mmUSD**
Europe	494	227,70	2498	646,97
North America	49	36,83	318	164,63
Asia-Pacific	152	30,84	1426	272,84
Rest of world	72	29,81	390	216,53
Total	**767**	**325,18**	**4632**	**1300,96**

Note: N denotes number of issues and mmUSD denotes total amount issued in USD billions

Table 13: SLB and GB universe 2018 to 2022 by sector

	SLBs		GBs	
By sector	**N**	**mmUSD**	**N**	**mmUSD**
Communications	27	13,78	40	27,40
Consumer Discretionary	91	31,71	244	71,87
Consumer Staples	95	42,48	51	15,85
Energy	37	14,39	194	30,63
Financials	74	23,95	2446	557,79
Government	2	0,60	299	191,86
Health Care	22	11,41	15	4,79
Industrials	144	49,47	303	54,07
Materials	131	55,99	128	41,12
Technology	27	9,76	56	21,14
Utilities	117	71,65	856	284,47
Total	**767**	**325,18**	**4632**	**1300,96**

Note: N denotes number of issues and mmUSD denotes total amount issued in USD billions

Table 14: Variable description

Variable (unit or type)	Explanation	Data source
Yield Spread (bps)	Yield difference between the SLB and the closest equivalent risk-free sovereign bond denoted in the same currency	(b)
AADTT (%)	DtT/TtT	(a) (b)
DtT (%)	| 1 – (Threshold value / Baseline value) |	(a) (b)
TtT (years)	(Threshold date - Baseline date) / 365	(a) (b)
Green Bond (binary)	1 if the issuer has issued green bonds before SLBs, 0 otherwise	(a) (b)
ESG Score (numerical)	ESG Score of the issuer at issue	(b)
E,S,G Scores (numerical)	Environmental, Social and Governance scores of the issuer at issue	(b)
GHGE (binary)	1 if the Sustainability Performance Target is GHGE, 0 otherwise	(a) (b)
Step-Up (bps)	Coupon step-up associated with the SLB in case of failure to reach the Sustainability Performance Target	(a) (b)
isCallable (binary)	1 if the SLB is Callable, 0 otherwise	(a)
SBTi (binary)	1 if the SPTs are set according to science-based targets initiative, 0 otherwise	(b)
isSecured (binary)	1 if the SLB is Secured, 0 otherwise	(a) (b)
Coupon Rate (bps)	Interest rate of the SLB in basis points	(a)
Maturity (years)	Maturity of the SLB in years	(a)
Amount Issued (mUSD)[1]	Total amount issued in million USD	(a)
Bid-Ask Spread (bps)	(Ask Price – Bid Price) / ((Ask Price + Bid Price) / 2)	(b)
ROA (%)	EBIT x 0.625 / Average Total Assets	(a) (b) (c)
Interest Coverage (numerical)	EBIT / Interest expenses	(a) (b) (c)
Debt to Assets (%)	Total Assets / Total Debt	(a) (b) (c)
Total Assets (mUSD)[1]	Total Assets in million USD	(a) (b) (c)
isPrivate (dummy)	1 if the issuer is a private company, 0 otherwise	(a) (b) (c)
Credit ratings (categorical)	Issuer credit rating in S&P rating scale	(a) (b) (c)

Data source: (a) Bloomberg terminal; (b) Refinitiv Eikon; (c) CapitalIQ
[1] Variable is used with a natural logarithmic term in regressions

Table 15: Data sample selection process

Step 1: Extracting corporate SLB universe until 31.12.2022
Using *Bloomberg Terminal*
Result: 766 observations
Step 2: Excluding SLBs without ISIN code
Using *Excel*
Result: 478 observations
Step 3: Obtaining yield spreads using ISIN codes
Using *Refinitiv Eikon*
Result: 314 observations
Step 4: Cleaning and standardising the data
No data on SPT or incentive mechanism - 33 observations excluded
No credit rating for issuer - 48 observations excluded
No fixed coupons - 6 observations excluded
Maturity type other than Callable or At maturity - 7 observations excluded
Result: 220 observations
Final sample
220 observations

Table 16: Mean-comparison test for *Yield Spread* categorized by *AADTT*

	AADTT < 7.42	AADTT > 7.42	Mean1	Mean2	dif	St Err	t value	p value
Yield Spread	161	59	211.080	289.382	-78.302	23.041	-3.4	.001

Table 17: Model 1 Heteroskedasticity Test

Test	H_0	P-value	Decision	Heteroskedasticity
Breusch-Pagan test	Constant variance	0	Reject	Yes
White test	Homoskedasticity	0	Reject	Yes

Table 18: Variance Inflation Factor (VIF) test

Variable	VIF	1/VIF
CallablexStepUp	60,45	0,02
StepUp	55,84	0,02
isCallable	6,76	0,15
Interest Coverage	4,58	0,22
Total Assets (log)	3,81	0,26
ROA	3,6	0,28
Bid-Ask Spread	3,05	0,33
Amount Issued (log)	2,89	0,35
Debt to Assets	2,88	0,35
Coupon Rate	2,86	0,35
ESG	2,78	0,36
GHGE	2,62	0,38
GHGExAADTT	2,3	0,43
isSecured	2,08	0,48
isPrivate	2,04	0,49
Maturity	1,5	0,67
AADTT	1,47	0,68
SBTi	1,46	0,68
Sector controls	Yes	Yes
Year controls	Yes	Yes
Region controls	Yes	Yes
Credit ratings	Yes	Yes
Mean VIFs		
With all variables	11,62	.
Without categorical control variables	9,05	.