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Who benefits from the emission of Sustainability-linked bonds? A cross-industry analysis of the green premium.

Prof. Rosella Santella
RELATORE

Prof. Adalberto Pellegrino
CORRELATORE

Vincenzo Longo
CANDIDATO

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Chapter 1

1.1. Introduction

Within the ever-evolving landscape of global finance, the paradigm of sustainable finance emerges as a critical focal point, underscored by the growing recognition of human impact on both the environment and society. This multidisciplinary field endeavors to integrate financial principles with environmental and social objectives, emphasizing the imperative need for a transition towards financial practices that not only yield economic returns but also contribute to collective well-being and the health of our planet.

The escalating concern surrounding environmental challenges, such as climate change and biodiversity loss, coupled with an urgent call to address social inequalities, positions sustainable finance as an indispensable pillar in investment strategies and financial decision-making. Delving into an intricate exploration of sustainable finance instruments becomes imperative, as we stand at the cusp of a profound transformation in our approach to financial management.

Megatrends are defined as "deep and profound trends, global in scope and long-term in effect, touching everyone on the planet and shaping our world for many years to come." According to PwC's "Megatrends: Five global shifts reshaping the world we live in[1]" climate change stands among these transformative trends. It is increasingly exerting a pervasive influence on all aspects of our life. The extensive efforts needed to both mitigate and adapt to its impacts are anticipated to be profoundly disruptive, carrying the potential for substantial unintended consequences.

Not only do corporations and markets face substantial environmental pressures and the imperative to align with de-carbonization targets, but investors and stakeholders seem to be placing more emphasis on a company's conduct concerning the society and scrutinize its governance practices. This requires companies and financial markets to respond to these needs through increased engagement in Environmental, Social and Governance (ESG) issues and non-financial data disclosure.

[1] Megatrends. Five global shifts reshaping the world we live in. PwC, October 2022

As stated by ICMA[2], the role of the capital market can be a key role in orienting investors towards issuers that contribute to the sustainability needs we are experiencing. Capital markets participants tried to implement different financing instruments to address these needs or capitalize on trends that are currently pertinent in terms of raising funds and influencing the performance of both equity and bonds.

In a November 2022 report by the ISS on "The Role of the Debt Capital Market in Financing the Transition towards Net Zero[3]" the authors assert that capital markets play a pivotal role in supporting the Net Zero target. They posit that these markets can actively contribute to raising awareness regarding Environmental, Social, and Governance (ESG) issues. Over the recent years, numerous Net Zero Alliances have emerged, such as the Net Zero Asset Managers initiative, which oversees assets totaling 68 trillion USD under management, and the Net Zero Asset Owner Alliance, with AuM for 10.5 trillion USD.

On the contrary, in an article featured in the Financial Times on October 23, 2023, Aswath Damodaran offers a critique of ESG investing, suggesting that it is beyond redemption, "may it RIP[4]". Damodaran scrutinizes three prevalent arguments in favor of ESG:

- Value Creation Critique:

Damodaran underscores the absence of a universally acknowledged framework delineating how ESG practices contribute to enterprise value. He contends that while certain companies may derive value from the implementation of ESG practices, particularly those operating in niche markets, in many instances, ESG represents a cost that does not directly translate into increased revenues, thus diminishing overall enterprise value.

- Investor Returns Critique:

The article posits that incorporating ESG constraints in portfolio optimization leads to a diminished expected return. Damodaran questions the efficacy of ESG considerations from an investor perspective, suggesting that such constraints may not align with optimal portfolio outcomes.

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[2] Climate Transition Finance Handbook. June 2023. International Capital Market Association

[3] The Role of the Debt Capital Market in Financing the Transition towards Net Zero. November 2022, ISS insights.

[4] ESG is beyond redemption: may it RIP, Aswath Damodaran. Financial Times, 23/10/2023.

- Societal Impact Critique:

Damodaran asserts that the societal impact of ESG investing is inherently limited, and to illustrate this point, he offers an example related to fossil fuels. Publicly traded fossil fuel companies are divesting from new explorations and fossil fuel assets. He argues that this divestment has resulted in an investment void, subsequently filled by private equity firms. This, he contends, has perpetuated reliance on non-renewable energy sources, mirroring the energy landscape of previous decades.

These critiques collectively contribute to Damodaran's skepticism regarding the efficacy of ESG initiatives, raising important considerations for academic and practical discourse on the subject.

1.2. Role of the debt capital market

Specifically, the debt capital market assumes a central role in the realms of sustainable finance, socially responsible investing, and ESG considerations for several compelling reasons.

According to the policy insight titled "Mobilizing Global Debt Markets for a Just Transition" from the London School of Economics (LSE), the debt capital market emerges as a potent financial instrument for facilitating a just transition. Notably, bonds offer a distinct advantage by facilitating the involvement of a more extensive array of issuers in the transition process, including local and national governments, international organizations, and educational and health authorities. The report contends that bonds play a pivotal role in achieving a comprehensive "whole economy" transition. This is attributed to sustainable bonds, characterized by a targeted approach through the issuance of use-of-proceeds. Moreover, the debt market, being larger than the equity market, possesses a greater potential to positively influence the behaviors of firms and investors. Lastly, labeled debt instruments, such as green bonds or transition bonds, are highlighted for their significant signaling effects on financial markets, even when the issuer is not fully aligned with the Net Zero framework.

Despite the favorable outcomes observed within the sustainable debt market, the European Central Bank (ECB) issues a cautionary note, positing that these achievements are inherently transient. This temporality is attributed to the existing fragmentation in capital market structures and the absence of standardized practices, both of which have the potential to become constraints. Notably, a predominant risk confronting the sustainable debt market is identified as greenwashing, a phenomenon that has the capacity to impede subsequent advancements.

In the debt capital market, various instruments have been introduced, each seeking to address the financing requirements of companies by establishing a connection between financial performance and non-financial performance. Among these debt instruments (GSS+ Bonds), the most prevalent are[5]:

- Green bonds.

The most common type of sustainable debt. Green Bonds are any type of bond instrument in which proceeds will be used exclusively to finance or refinance, in whole or in part, new and/or existing eligible green projects.

- Social bonds.

The proceeds of social bonds will be used exclusively to finance eligible social projects.

- Sustainability bonds.

Their proceeds can finance both green and social projects.

- Sustainability-linked bonds.

The use-of-proceeds is for general purpose, but the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined Sustainability/ESG objectives.

- Transition bonds[6]

The proceeds are utilized to support a company's efforts in transitioning to a lower environmental footprint. This bond type does not require the classification of either the

[5] Definitions of green bond, social bond, sustainability bond and sustainability-linked bond are from their respective Principles, published by the International Capital Market Association. https://www.icmagroup.org/sustainable-finance/

[6] Sustainable finance primer series: Transition bonds, Institute for Sustainable Finance, Ryan Riordan, September 2019

project or the issuer as explicitly "green." Nevertheless, the issuer is obligated to allocate the proceeds exclusively to activities associated with climate transition.

Divergent perspectives characterize the discourse surrounding sustainable finance and GSS+ Bonds, with academic research yet unable to converge on a singular and universally shared response regarding various aspects. These encompass questions on the mechanisms by which sustainable activities may engender value and the potential presence of a premium associated with sustainable debt instruments.

1.3. Sustainability-linked Bonds

Sustainability-linked bonds are defined by ICMA[7] as “any type of bond instrument for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined Sustainability/ESG objectives”.
The two fundamental characteristics of these instruments are: the general purpose of the proceeds and the link between not reaching of a target Key Performance Indicators (KPIs) and a step-up in the coupon.

In their conceptualization, Sustainability-Linked Bonds (SLBs) are structured to potentially offer a reduced coupon to companies successfully achieving predetermined targets aligned with the objective of advancing towards Net Zero and fostering the transition to a sustainable economy. Conversely, companies unable to meet these stipulated targets at the time of issuance may face a penalty in the form of a higher coupon.

In contrast to green bonds, where the raised funds are earmarked for a specific project, the proceeds from this issuance are allocated for the general purposes of the company. The underlying concept of this instrument seeks to find a new compromise that transcends the constraints of the "use of proceeds" model inherent in green bonds. Ideally, it establishes a practical mechanism that contractually link Corporate ESG Performance and Corporate Financial Performance with the step-up coupon.

[7] Sustainability-Linked Bond Principles. June 2023. International Capital Market Association

The first Sustainability-linked bond was issued in September 2019 by Enel S.P.A.[8], an Italian company that operates as an integrated electricity and gas provider, a hard-to-abate industry.

The firm was no stranger to sustainable financing instruments. Since 2017 Enel issued three green bonds for a total amount of 3.5 billion of EUR.

According to their declarations at the time of the emission of the SLBs, they believed that general purpose financing products that linked the payments to the achievement of a target was the best way to foster the development of sustainable capital markets.

According to a report from S&P Global[9], published in September 2023, the emission of SLBs peaked in 2021, with a total emission of 96.2 billion USD. During 2022 this instrument reached a level of USD 75.77 billion in issuance, with a fall of 21%.

As for 2023, estimates predict an issue of 33 billion USD of SLBs, which will suffer a further collapse of the amount issued by 56%.

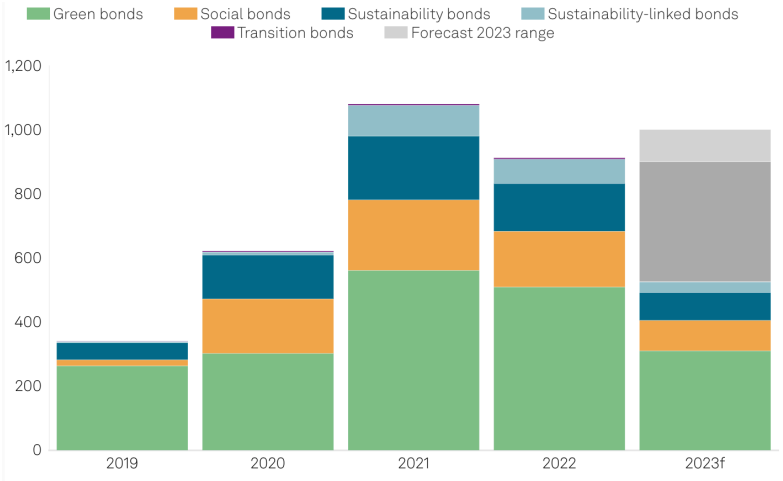

Figure 1 - GSS+ bonds issuance

Source: Environmental Finance Bond Database; S&P Global Ratings.

Since 2022, the new conditions in the macroeconomic environment, with a significant increase of interest rates due to high inflation, have generally reduced debt issuance, and this trend has also been noted in the issuance of sustainable debt instruments.

[8] Enel's General Purpose SDG Linked Bond, 04/09/2019
[9] Global Sustainable Bonds 2023 Issuance To Exceed $900 Billion, S&P Global, September 2023

In 2021, these instruments accounted for about 12% of total debt issuance. the following year, there was a reduction in emissions, consistent with the trend of the debt market, still standing at 13% of total emissions.
The forecasts for 2023 are optimistic and see the sustainable debt stand at about 14-16% of the debt issued in the year.

It is therefore noted that the sustainable debt market, mainly driven by the issuance of green bonds, follows the trends of the conventional debt market. However, this is not true of SLBs, which have shown a significant drop in emissions over the last two years. Their contribution to sustainable debt issuance has decreased from 9% in 2021 to an estimated 6% by 2023.

According to the report, ongoing uncertainties revolve around whether Sustainability-Linked Bonds (SLBs) effectively encourage issuers to establish ambitious sustainability objectives. These questions have endured for over a year, with stakeholders articulating reservations regarding whether the inherent structural and financial attributes associated with unmet targets provide adequate motivation for issuers to attain them.

In "Sustainability-Linked Bonds Have Long Road to Drive Impact" [10], from BloombergNEF, Maia Godemer posit that this instrument has the potential to unleash trillions of dollars in investment, guiding decarbonization in ways unparalleled by any other financial instrument.
This prospect becomes attainable upon overcoming challenges related to exit clauses, ineffectual terms and conditions, ambiguous timelines, and opaque targets. These elements are often strategically devised to safeguard issuers, particularly those facing substantial financial penalties amounting to hundreds of millions of dollars in interest rate consequences. According to the BNEF report, falling short of the specified target could indeed incur significant costs.

[10] Sustainability-Linked Bonds Have Long Road to Drive Impact, Bloomberg NEF, 19/07/2023;

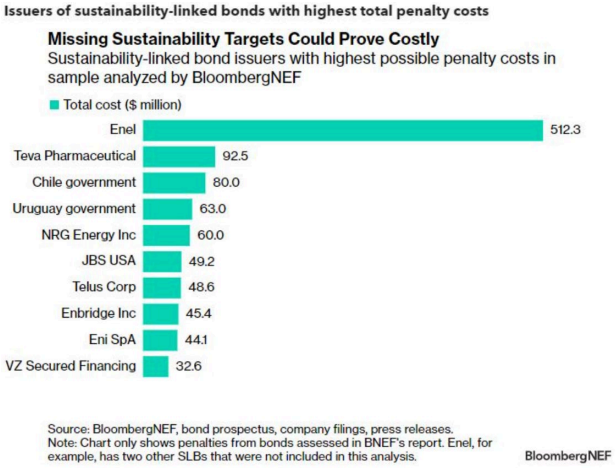

Figure 2 - Issuers with highest penalty costs

Source: Sustainability-Linked Bonds Have Long Road to Drive Impact, Bloomberg NEF

Vulturius et Al. 2022[11] argue that the efficacy of Sustainability-Linked Bonds (SLBs) is tied to a shared comprehension of qualifying economic activities and KPIs, the incorporation of science-based targets, the investors' capacity to mitigate the risk of greenwashing, and the bonds' effectiveness in incentivizing issuers.

In a November 2022 report from the World Economic Forum[12] on Sustainability-Linked Bonds (SLBs), it is posited that while these instruments have not undergone a revolutionary transformation of sustainable financing, they hold the potential to emerge and tip the scales toward a more sustainable debt market once specific challenges are addressed. These challenges include the clarification of the use of funds associated with sustainability-linked bonds, the establishment of credible and material KPIs, and the enhancement of transparency within predominantly private agreements between investors and issuers.

Because of their greater flexibility in the use of proceeds and in the definition of objectives, this instrument has raised many doubts.

[11] Vulturius et Al. (2022). Sustainability-linked bonds – their potential to promote issuers' transition to net-zero emissions and future research directions. Journal of Sustainable Finance and Investment.
[12] What are sustainability linked bonds and how can they support the net-zero transition?, World Economic Forum, 11/11/2022

In her analysis for the Financial Times, Kenza Bryan[13] raises four notable concerns regarding the efficacy of Sustainability-Linked Bonds (SLBs).

The first is a finding from *Ul Haq and Doumbia 2022*[14], economists affiliated with the World Bank Group, conducted research revealing that the average step-up in SLBs is approximately one-tenth of the overall coupon rates. This increase has demonstrated a tendency to stagnate as interest rates rise.

Moreover, their findings indicate that penalties associated with SLBs typically come into effect only a few years before the bond matures. Notably, the timing of these penalties appears to be inversely related to the higher coupon rates. They conclude that this instrument is prone to greenwashing.

The third concern was raised by The Financial Conduct Authority[15] in the United Kingdom, which has underscored an issue with SLBs, noting that the set targets can sometimes be deemed too weak to inspire confidence in their credibility.

Lastly, BloombergNEF reports that SLBs are more frequently "callable" compared to conventional bonds. This characteristic enables companies to retract SLBs by repaying the capital ahead of schedule.

Sustainability-linked bonds could serve as a tangible solution to the needs of firms and diverse stakeholders. However, its current proliferation is hindered by a set of unresolved questions, limiting its expansion and adoption.

The aim of this research is to study the phenomenon of Sustainability-linked bonds (SLBs) and try to understand if this instrument can be a tangible answer to the financing needs of the economic transition.

This study commences with an examination of Sustainability-Linked Bonds (SLBs) issued between 2019 and early 2024. The primary objective is to ascertain whether there exists a notable discount in the price at issuance for SLBs issued by companies demonstrating higher adherence to green standards. In essence, the inquiry aims to discern if this financial instrument effectively enables environmentally conscientious companies to incur a lower cost of debt. The overarching research questions guiding this study is

[13] A very bad product, destined to fail', Financial Times, 17/07/2023
[14] Ul Haq and Doumbia (2022). Structural Loopholes in Sustainability-Linked Bonds
[15] Non equity securities. Engagement Paper 4. Financial Conduct Authority. May 2023.

delineated as follows: To whom should the issuance of SLBs be directed for optimal financial outcomes? Is the cost of issuing Sustainability-Linked Bonds (SLBs) lower for companies with a strong commitment to environmental sustainability? In which industries is there a more pronounced economic incentive for the issuance of SLBs?

Chapter 2

2.1. Theoretical framework

The theoretical foundation of this research centers on the relationship between Corporate Social Performance (CSP) and Corporate Financial Performance (CFP). Sustainability-Linked Bonds (SLBs) are designed to establish a contractual nexus wherein CSP exerts direct influence on CFP.

Gillan et al. (2021)[16] provide an extensive literature review examining the relationship between CSP and CFP from various perspectives. According to their synthesis, diverse mechanisms have been proposed to elucidate how Environmental, Social, and Governance (ESG) considerations can contribute to the creation of value for firms. These mechanisms can be categorized as follows:

- Those that increase shareholders' wealth by enhancing cashflows or reducing the cost of capital and
- Those that increase shareholders' utility: shareholders' individual preferences can have an impact on how they value their stocks, therefore they might have a market-level impact on asset prices.

Conversely, an alternate viewpoint posits that firms with higher value or superior financial performance allocate resources to invest in ESG activities. In this scenario, the causality direction is perceived to be reversed.

Irrespective of the direction of causality, a positive correlation appears to exist between the financial and non-financial performance of a firm. This phenomenon should lead to a premium observed in the pricing of obligations tied to the non-financial performance of an enterprise, like Sustainability-Linked Bonds (SLBs). Additionally, a more pronounced premium is expected for bonds issued by companies demonstrating heightened commitment to sustainability and regular disclosure of non-financial information compared to their counterparts within the same sector.

[16] Gillan et Al. (2021). Firms and social responsibility: A review of ESG and CSR research in corporate finance. Journal of Corporate Finance.

2.2. Literature review

2.2.1. Tastes and asset pricing, and socially responsible investments

In recent years, numerous studies have explored the impact of Environmental, Social, and Governance (ESG) factors on investor preferences and how these preferences, in turn, influence asset pricing. *Fama and French (2007)*[17] conducted a study questioning the validity of two fundamental assumptions in classic asset pricing models: the assumption of complete agreement among investors and the assumption that investors base their asset holdings solely on anticipated payoffs. They demonstrated that misinformed investors or those with specific asset preferences can distort expected returns and prices.

Baker et al. (2018)[18] developed a model predicting that securities with positive environmental scores exhibit lower expected returns. On the other hand, *Pedersen et al. (2021)*[19] established a theoretical framework for ESG integration, which involves incorporating ESG characteristics into the portfolio construction process. Their findings indicate that the advantages of including ESG information include an increase in the potential maximum Sharpe Ratio. However, the costs associated with ESG preferences manifest in a lower Sharpe Ratio linked to the selection of a high-ESG portfolio.

2.2.2. Previous studies on green bonds

The first issuance of green bonds occurred in 2007, and since then, they have garnered a substantial share in the debt market. Due to their prominence, green bonds have been subject to more extensive research compared to Sustainability-Linked Bonds (SLBs). Presently, there remains a lack of consensus among researchers regarding the existence of a "greenium." This term refers to a premium that investors may be willing to pay for the acquisition of a green bond, resulting in a lower cost of funding for companies issuing such instruments.

The subsequent studies on green bonds have identified a premium.

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[17] Fama and French (2007). Disagreement, tastes, and asset prices. Journal of Financial Economics.
[18] Baker et Al. (2018). Financing the Response to Climate Change: The Pricing and Ownership of U.S. Green Bonds. NBER Working Paper.
[19] Pedersen et Al. (2021). Responsible investing: The ESG-efficient frontier. Journal of Financial Economics.

Baker et al. (2018)[20] concentrated on the yield at issuance (after-tax yield) of municipal bonds, specifically examining the green premium through regression analysis. Their findings revealed a green premium ranging from 5 to 7 basis points, indicating that green bonds are priced as if they hold a rating approximately half a notch higher on average. Notably, bonds certified by the Climate Bonds Initiative (CBI) command an even greater premium.

Zerbib (2019)[21] sought to discern the impact of pro-environmental preferences on bond prices, utilizing green bonds as a valuation instrument. The study evidenced a limited influence of investors' preferences on bond prices. Zerbib concluded that the reduced cost of debt for environmentally responsible companies is predominantly linked to lower financial risk, facilitated through intangible asset creation, and enhanced risk management, rather than stemming from non-pecuniary preferences of investors.

In a study focused on the Chinese market, *Zhang et al. (2021)*[22] investigated the relationship between green investment and corporate cost of capital. By pairing green and conventional bonds, they identified a green premium of 24.9 basis points. Employing the implied cost of capital and the abnormal revenue model, they explored three channels through which green bonds can impact the cost of capital: enhancing stock liquidity, reducing information asymmetry, and diminishing perceived firm risk. The study concluded that effective environmental risk management generates value for the firm.

The primary studies demonstrating the absence of a premium paid for green bonds are as follows.

Karpf and Mandel (2017)[23] employed the Oaxaca Blinder decomposition to analyze the price spread between green and brown bonds. Their findings indicated that brown bonds (conventional bonds) are traded at higher prices than green bonds, but this disparity could

[20] Baker et Al. (2018). Financing the Response to Climate Change: The Pricing and Ownership of U.S. Green Bonds. NBER Working Paper.
[21] Zerbib (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. Journal of Banking & Finance.
[22] Zhang et Al., (2021). Green bond issuance and cost of capital. Pacific-Basin Finance Journal.
[23] Karpf and Mandel (2017). Does it pay to be green? A Comparative Study of the Yield Term Structure of Green and Brown Bonds in the US Municipal Bonds Market.

not be solely attributed to the greenness of the bond; rather, it was influenced by fundamental characteristics. The study also hinted at a form of discrimination against green bonds in the municipal security market, where they were expected to be traded with a lower average return, but the opposite was observed.

Larcker and Watts (2020)[24] conducted a comparison of green and non-green municipal bonds in the United States and found no significant differences in pricing. Notably, they observed that borrowing costs for green bonds were approximately 10% higher than those for traditional bonds. The study proposed alternative explanations, including the lack of green demand, differences in liquidity, and potential greenwashing. Green bonds exhibited minimal distinctions in institutional ownership.

Flammer (2021)[25] investigated the motivations behind firms issuing green bonds, testing three hypotheses: signaling, greenwashing, and a lower cost of capital. The study revealed that stock markets responded positively to green bond issuance. Subsequently, companies demonstrated improvements in their environmental performance and experienced an increase in ownership by long-term and green investors. The results aligned with the signaling argument, indicating that green bond issuance served as a positive signal for firms.

2.2.3. Previous studies on sustainability linked bond

Sustainability-Linked Bonds (SLBs) represent a relatively recent financial instrument, especially when compared to the more established green bonds. Due to their novelty, there is currently no consistent and extensive body of literature that delves deeply into the mechanics, dynamics, and implications of this financial instrument. As SLBs continue to gain traction in the financial markets, it is expected that researchers and scholars will contribute to the growing body of literature, providing more in-depth analyses and insights into the intricacies of SLBs, their impact on financial markets, and their role in promoting sustainability.

The following are the most relevant research on this instrument.

[24] Larcker and Watts (2020). Where's the greenium?. Journal of Accounting and Economics.
[25] Flammer (2021). Corporate green bonds. Journal of Financial Economics.

Kolbel and Lambillon (2023)[26] identified a premium at issuance of -9 basis points (bsp) for Sustainability-Linked Bonds (SLBs) compared to their benchmark bonds. Additionally, they estimated that the benefit derived from the lower cost of debt is, on average, higher than the potential maximum penalty, suggesting a favorable outcome for the issuer. The study considered industry fixed effects in its analysis.

Berrada, Engelhardt, Gibson, and Krüger (2022)[27] developed a theoretical model to analyze the incentive structure of SLBs and the optimal conditions for their issuance. Introducing a mispricing measure for SLBs, they demonstrated that the issuance of overpriced SLBs results in an increase in stock prices, consistent with a transfer of wealth from bondholders to stakeholders.

Barbalau and Zeni (2021)[28] developed a model that explores the financing of green projects, considering the involvement of investors with preferences for environmentally sustainable initiatives within the context of corporate financing with information asymmetry. In this framework, companies aim to fund projects with uncertain outcomes, known only to the firm and subject to manipulation. Two types of green debt contracts are considered: non-contingent contracts like green bonds, specifying funded projects without committing to green outcomes, and contingent contracts like sustainability-linked bonds, allowing flexibility in fund usage but tying outcomes to specific contingencies. The model suggests that both types of contracts coexist as an equilibrium when green outcomes can be manipulated, and firms differ in their ability to manipulate. Empirical evidence supports the predictions that low-type firms, aiming to profit from manipulation, tend to issue contingent debt, while non-contingent debt serves as a costly signaling device.

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[26] Kolbel and Lambillon (2023). Who Pays for Sustainability? An Analysis of Sustainability-Linked Bonds. Swiss Finance Institute. Research Paper Series N°23-07

[27] Berrada, Engelhardt, Gibson, and Krüger (2022). The Economics of Sustainability Linked Bonds. European Corporate Governance Institute. Finance Working Paper N° 820/2022

[28] Barbalau and Zeni (2021). Designing Green Securities: Action- vs Outcome-Based Incentives. https://ssrn.com/abstract=4155721

Liberadzki, Jaworski, and Liberadzki (2021)[29] examined the case of Tesco's issuance of SLBs. Tesco's SLBs are tied to the company's commitment to reduce greenhouse gas emissions by 60%, prioritizing a decrease in reliance on nonrenewable grid electricity, which contributes to 65% of Tesco's global carbon emissions footprint. Fall short the specified goals trigger a coupon step-up of 25 basis points on the last three coupons. They explore the existence of what they call "ESG spread", characterized by a negative yield differential between SLBs and regular bonds. This phenomenon is analogous to 'greenium,' where bondholders pay a premium for green bonds compared to non-green bonds. They conduct a comparative analysis of bid and ask yields for SLBs with interpolated yields calculated for Tesco and Carrefour notes. Finally, they examine SLB yields in a coupon step-up scenario to assess whether the issuer's failure to meet KPIs leads to a change in the ESG spread.

[29] Liberadzki, Jaworski, and Liberadzki (2021). Spread Analysis of the Sustainability-Linked Bonds Tied to an Issuer's Greenhouse Gases Emissions Reduction Target. Energies. https://doi.org/10.3390/en14237918

Chapter 3

3.1. Research gap and hypothesis

The existing gap in the literature, at my current knowledge, is the necessity to understand which are the industries that substantially benefit from the issuance of Sustainability-Linked Bonds (SLBs).

The reasoning behind is the need to better understand how market prices these instruments and if the “greenness”, of the industry in a cross-industry framework and of the issuer in a within-industry framework, is effectively taken into consideration by the instrument’s price at issuance.

The central question of this research pertains to the identification of industries exhibiting a pronounced incentives for SLBs issuance. Moreover, the study aims to understand whether greener firms, characterized by robust environmental performance, experience favorable issuance terms in the SLB market compared to their counterparts with less stringent sustainability credentials.

In addition, compared with previous studies, this analysis diverges by focusing on the firm's cost of debt rather than the yield for investors. Consequently, the yield at issue is employed as a more suitable proxy for approximating the firm's cost of debt. Unlike the coupon yield, which lacks insights into the risks priced by the market, the yield at issue contains information regarding the market's assessment of the probability of the step-up coupon at the moment of debt issuance.

The analysis will be executed at two distinct levels. Initially, an industry-level examination will be undertaken to evaluate the existence of differences between industries characterized by structural higher emissions and those with comparatively lower emissions.

Subsequently, the analysis will transition to the individual company level, where the distinctions within the "High CO2 industries" and "Low CO2 industries" macro-categories will be analyzed. Specifically, the focus will be on the difference between companies that have a higher emission efficiency and outperform the industry average, and those emitting above the sectoral average.

Dividing between a firm's score and an industry's score is fundamental in order to distinguish between two effects: the first is the belonging to a sector that is characterized by a business models with higher CO2 emissions; the second effect is the ability of the single company to be more efficient in terms of resources used than the industry average.

According to the literature supporting the existence of the green premium, it is expected a lower yield at issue within greener industries. Such industries are expected to exhibit lower financial risk levels (*Zerbib, 2019*) and enhanced stock liquidity alongside diminished information asymmetry (*Zhang et al., 2021*).
The same reasoning could be expanded in the individual analysis, where companies demonstrating higher environmental performance are presumed to secure lower yields at issue, ceteris paribus, reflecting their higher attractiveness to investors and perceived lower risk profiles.

3.2. Data and Methodology

3.2.1. Data search and selection

From the universe of bonds that are on Bloomberg, all active sustainability-linked bonds were included in the initial dataset. Subsequently, bonds lacking information regarding the EBITDA to interest expenses ratio were systematically excluded from further analysis. Additionally, bonds issued within the "financials" industry, as per the Bloomberg Industry Classification Standard (BICS), were omitted from the dataset. Finally, bonds lacking of information on the yield at issue were excluded from the final dataset.

The comparative analysis with the Interest Coverage Ratio (elucidated further in the chapter) necessitates the exclusion of the financial services industry from the study. This is because of the inherent complexity associated with delineating the concepts of debt and interest expenses within this industry. Unlike conventional corporate entities, where debt primarily functions as a financing instrument, for commercial and investment banks, insurance firms, and similar financial institutions, debt assumes a multifaceted role,

serving both as a raw material for financial activities and as a mean of financing operations[30].

Consequently, establishing a clear and standardized definition of interest expenses becomes challenging within the financial services industry, where financial instruments are intricately interwoven with operational functions.

As a result of this selection process, a dataset comprising 250 SLBs has been curated for the subsequent analysis.

3.2.2. Dataset description

The dataset encompasses a diverse array of variables crucial for our analysis.

Yield at issue

This variable denotes the rate equating the face value of the bond to its issue price. It serves as a fundamental metric for estimating the cost associated with corporate debt issuance. Central tendency statistics pertinent to this variable are as follows:

```
Yield at Issue
Min.   :-0.120
1st Qu.: 1.578
Median : 3.462
Mean   : 3.428
3rd Qu.: 4.750
Max.   :13.562
```

Figure 3 – Descriptive statistics of the variable "Yield at issue"

Source: Bloomberg

EBITDA to interest expense

This variable serves as a quantitative measure of a company's financial risk. Specifically, it concers the Interest Coverage Ratio (ICR), calculated as the ratio of Earnings Before Interest and Taxes (EBIT) to interest expenses. This synthetic approach offers insights into both the estimation of the cost of debt and the rating of a firm's debt obligations.

[30] Valuing Financial Service Firms, Aswath Damodaran, April 2009

This method was developed by Damodaran between 1999 and 2000[31].

In the present analysis, a modified version of the original approach is employed, substituting EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) for EBIT. This adaptation potentially yields a higher ratio, but despite this modification, the primary objective of this analysis is not to estimate the cost of debt, as in Damodaran's original model, but rather to utilize the ICR as a fundamentals-related measure of the default risk, besides which the analysis aims to understand if there are other factors that explain the yield at issue.

Central tendency statistics pertaining to this variable are delineated:

```
EBITDA to Interest Expense
Min.   : -5.699
1st Qu.:  3.514
Median :  7.611
Mean   : 12.887
3rd Qu.: 15.035
Max.   :131.028
```

Figure 4 – Descriptive statistics of the variable "EBITDA to interest expense"

Source: Bloomberg

Issue date

It denotes the moment at which the operational implications of a financial instrument come into effect. It signifies the formal initiation of the instrument's validity period, from which rights and obligations, including interest accrual and maturity schedules, commence.

Maturity

The maturity date denotes the contractual deadline by which bond issuers are obliged to reimburse the principal amount borrowed from bondholders. In the regression analysis, the variable 'maturity' will serve as an explanatory factor to account for the variance in the yield at issue attributable to the heterogeneous maturity profiles.

[31] Estimating a synthetic rating and cost of debt, Aswath Damodaran, https://pages.stern.nyu.edu/~adamodar/New_Home_Page/valquestions/syntrating.htm

Coupon

These payments signify the periodic disbursement of accrued interest on the principal loaned. Central tendency statistics pertaining to this variable are provided.

```
      Cpn
Min.   : 0.000
1st Qu.: 1.500
Median : 3.388
Mean   : 3.383
3rd Qu.: 4.750
Max.   :13.500
```

Figure 5 – Descriptive statistics of the variable "Coupon"

Source: Bloomberg

Currency

This denotes the currency denomination in which the instruments were initially issued. Notably, the distribution reveals that 38% of the issues were denominated in euros, followed by 30% in USD, with 15% in Japanese yen. The residual 17 percent encompasses a diverse array of 12 other currencies, among which are the Thai Baht and Canadian Dollar.

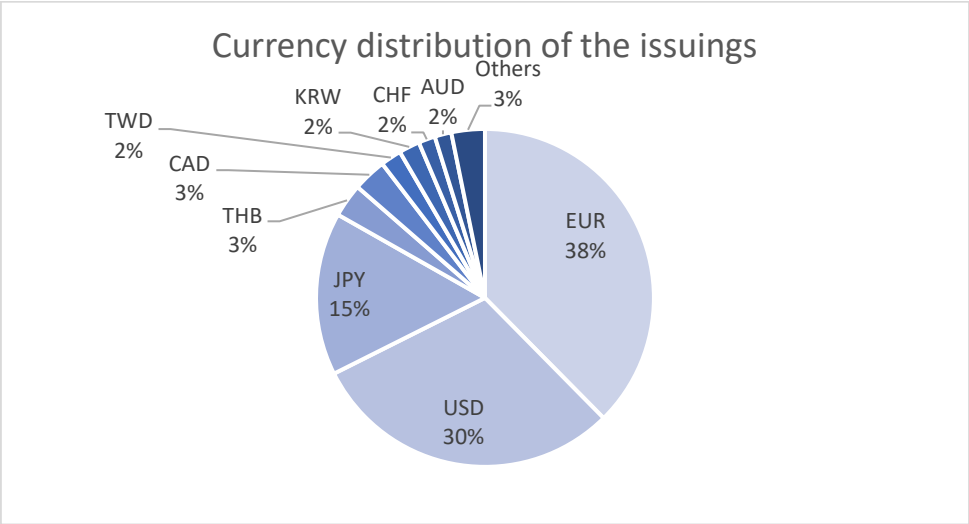

Figure 6 – Percentage of currency of issuing

Source: Bloomberg

Amount issued

This variable pertains to the magnitude of the bond issuance. It is incorporated into the regression model as a control variable to mitigate the influence of issue size on the variance of the issuance rate. By including this variable, the analysis aims to isolate and account for the impact of size-related factors on the yield at issue.

```
   Amt Issued
Min.   :7.730e+06
1st Qu.:1.502e+08
Median :5.000e+08
Mean   :5.318e+08
3rd Qu.:8.000e+08
Max.   :2.300e+09
```

Figure 7 – Descriptive statistics of the variable "Amount Issued"

Source: Bloomberg

Revenues

The data concerning issuers' revenues were collected with reference to the fiscal year preceding the issuance of the instrument. This information will be integrated into the regression analysis as a control variable to account for the size factor. However, caution must be exercised regarding potential multicollinearity issues between this variable, the amount of debt issued and EBITDA to interest expenses, as there exists a plausible correlation between size, as measured by revenues or amount issued, and other metrics related to financial risk.

```
    Revenues
Min.   :   0.0001
1st Qu.:   3.0944
Median :   7.9312
Mean   :  34.1063
3rd Qu.:  17.8935
Max.   :1766.9000
NA's   :79
```

Figure 8 – Descriptive statistics of the variable "Revenues"

Source: Bloomberg

BICS Industry classification

In this analysis the BICS industry classification is used, encompassing both Level 1 and Level 2. This facilitates the segmentation of companies according to their industries. This classification system enables the assessment of the influence of the 'sector' variable on various financial metrics and performance indicators.

Key Performance Indicators (KPIs)

KPIs represent the sustainability metrics to which the company has pledged its commitment when subscribing the debt instrument. These metrics serve as benchmarks for evaluating the company's performance in different ESG topics and are linked to the coupon step-up mechanism. Each bond within the dataset is associated with sustainability KPIs falling within these categories:

- Greenhouse gasses emissions (89.60%)
- Circular economy (9.20%)
- Renewable energy (5.60%)
- Gender equality (5.60%)
- Water consumption (4.80%)
- Affordable housing (3.60%)
- Energy efficiency (2.80%)
- Sustainable sourcing (0.80%)
- Biodiversity (0.40%)
- Transport (0.40%)
- Others (11.20%)

Most of the issuers committed to multiple Key Performance Indicators (KPIs). In the context of this research, particular emphasis has been placed on greenhouse gas emissions, which emerge as the most prevalent KPI among the selected instruments. CO2 emissions per sales data, available on Bloomberg, have been chosen to quantify this measure.

CO2 emissions per sales

The variable, as defined on Bloomberg[32], is expressed in metric tons of carbon dioxide emissions per millions of sales. CO2 emissions per sales serves as a normalized measure of a company's emissions, accounting for its size as measured by sales revenue. This metric provides a standardized basis for assessing the environmental impact of companies.

[32] Definitions from the Bloomberg terminal - Definitions

Industry-level data on this metric were collected utilizing the Bloomberg function Fixed-Income SEARCH. Through a systematic filtering process of all available bonds across various BICS Level 2 industries, average CO2 emissions per sales for each industry were compiled. These aggregated averages are presented in the subsequent table.

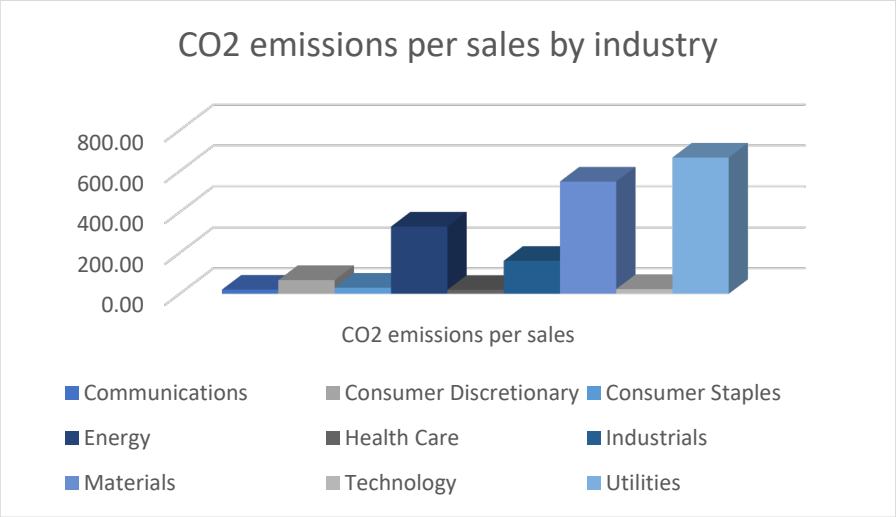

Figure 9 - Average CO2 emissions per sales by industry

Source: Bloomberg

Disclosure score

Flammer (2021) underscores the criticality of signaling a firm's commitment to Environmental, Social, and Governance (ESG) issues. To achieve this, it is imperative to consider the firm's capacity to effectively communicate its dedication to sustainability to the market.

The disclosure scores, obtained from Bloomberg, are represented as a percentage ranging from 0 to 100 and encompass the three fundamental dimensions of non-financial disclosure: Environmental, Social, and Governance (ESG). These scores are defined as a percentage that quantifies the company's disclosure relative to the expected disclosure mandated by Bloomberg's materiality framework[33].

[33] Bloomberg definition

In alignment with the focus of the analysis, only Environmental scores are incorporated into the regression model. This inclusion aims to measure the impact of an accurate disclosure on environmental responsibility on the yield at issuance of instruments linked to the company's environmental performance.

3.2.3. Variables transformation

CO2 per sales

The dataset comprises a diverse array of bonds from across the globe, necessitating the adjustment of "per sales" metric to facilitate global comparability. To achieve this standardization, all metrics will be converted to USD, except for those already denominated in USD. This conversion will be executed by dividing the values by the average exchange rate observed over the preceding 6-month period between the respective local currency and USD.

Subsequently, an individual CO2 emissions score is computed for each firm to facilitate the evaluation of the firm's performance compared to its industry. This score is computed as the difference between the average CO2 emission per sales for each BICS Level 2 industry and those of the individual firms. This difference is then standardized based on average industry emissions, yielding a percentage score. Positive scores denote firms that outperform their industry in sustainability efficiency, while negative scores indicate underperformance relative to their industry peers.

At the end of these transformations, the resultant individual CO2 score emerges as a continuous variable, providing insights into the individual firm's sustainability performance relative to its competitors.

High and Low CO2 industries

The industry average variables are categorized into two different groups: high and low. Industries with an average above the 50th percentile are classified as high, while those below the 50th percentile are categorized as low.

Within the high-emission category, we find Energy, Materials, and Industrial sectors. Conversely, in the low-emission category, we observe Communications, Consumer Discretionary, Consumer Staples, Health Care, and Technology sectors.

Subsequently, the dataset is divided in two distinct subsets based on the previous classification: high-emission sectors on one side and low-emission sectors on the other. This approach allows a better individual analysis of firms and assessment of differences between the two classes of industries. By conducting separate analyses on the two categories, it will be possible to identify the specific characteristics and influences for each of them.

Multicollinearity

It's crucial to assess multicollinearity before constructing the regressions. To achieve this, a covariance matrix has been constructed, to identify and exclude variables that exhibit perfect multicollinearity. These variables should be omitted from the regression analysis as they redundantly convey similar information to the model, thereby inflating the standard error of the parameter estimations[34].

```
> cov_matrix
                yield_at_issue ebitda_to_int_exp   CO2_score e_disclosure     maturity   amt_issued    revenues
yield_at_issue      1.000000000       -0.40022613 -0.26628166  0.031623824  0.008043181  0.314313356 -0.07648203
ebitda_to_int_exp  -0.400226128        1.00000000  0.05638295 -0.016297598 -0.060192849 -0.147032218  0.35536626
CO2_score          -0.266281662        0.05638295  1.00000000 -0.010893386  0.061853712 -0.106744223  0.05447018
e_disclosure        0.031623824       -0.01629760 -0.01089339  1.000000000 -0.124321770 -0.002590802 -0.10549469
maturity            0.008043181       -0.06019285  0.06185371 -0.124321770  1.000000000  0.093129883 -0.03049567
amt_issued          0.314313356       -0.14703222 -0.10674422 -0.002590802  0.093129883  1.000000000 -0.10347277
revenues           -0.076482029        0.35536626  0.05447018 -0.105494694 -0.030495670 -0.103472771  1.00000000
```

Figure 10 – Covariance matrix of the variables in the regression

Source: Bloomberg

As evident from the covariance matrix, there are no indications of either perfect or partial multicollinearity that would negatively impact the outcome of the analyses. This observation suggests that the variables included in the regression models exhibit minimal redundancy or correlation.

[34] Statistical methods for the social sciences, A. Agresti and B. Finlay, Pearson, fourth edition, Upper Saddle River, New Jersey 07458

3.2.4. Regression analysis

Two regression analyses are configured: the industry analysis and the individual performance analysis.

Industry analysis

At the industry level, the primary aim is to deepen the impact of specific business models within the same industry on the likelihood of experiencing higher or lower yields at issue. This analysis seeks to discern how different operational frameworks can influence debt issuance conditions and will be conducted on the complete dataset.

The predictors for the yield at issue in this analysis include:

- EBITDA to interest expense
- Environmental disclosure
- Amount issued
- Revenues
- Maturity
- Industry average CO2 emissions

The results of the aforementioned regression analysis are presented below:

Individual performance analysis

At the firm level, the focus shifts to investigating whether top-performing green companies within the same industry classification can get better debt conditions compared to their underperforming counterparts. This aspect of the analysis aims to explore whether companies demonstrating exemplary environmental performance are rewarded with more favorable debt terms and if it is attributable to the better Environmental disclosure or to the effective higher greenness.

This analysis will be performed on the two datasets divided into high- and low-emission.

The predictors for the yield at issue in this analysis include:

- EBITDA to interest expense
- Environmental disclosure
- Amount issued
- Revenues
- Maturity

- CO2 individual score

As previously indicated, parallel regression analyses were conducted on the datasets divided according to high and low emission industries. The results of these two regressions are presented in the next chapter.

- High CO2 industries (Energy, Materials, and Industrial)
- Low CO2 industries (Communications, Consumer Discretionary, Consumer Staples, Health Care, and Technology)

Backward elimination

This statistical procedure allows the development of a more significant model and involves the iterative refinement of a regression model by progressively eliminating explanatory variables based on their significance levels[35].

Initially, a model is constructed encompassing all explanatory variables, and the regression results are analyzed. Subsequently, a new model is iteratively developed by excluding the variable with the highest P-value. This process is repeated, evaluating the regression results and refining the model through each iteration, until all remaining variables exhibit statistical significance.

Such iterative model-building technique is commonly used in the context of multiple regression analyses with numerous variables, with the objective to refine the final model by keeping only significant variables. While this iterative process may lead to a reduction in the model's goodness of fit (the R^2 statistic) because the reduction of independent variables, it can enhance the statistical significance of the resultant variables allowing for a more robust model.

All preceding regressions underwent this statistical procedure. The results are exposed and commented in the subsequent chapter.

[35] Statistical methods for the social sciences, A. Agresti and B. Finlay, Pearson, fourth edition, Upper Saddle River, New Jersey 07458

Chapter 4

4.1. Results

In this chapter the results of the previus regression analysis (industry analysis and individual performance analysis) are delineated and discussed

Each regression model is described both in its initial form and in the final modelling through the backward elimination process. Subsequently, the final models' implications will be discussed.

4.1.1 Industry analysis

The followings are the results of the first regression analysis, focusing on industry-level factors:

```
Call:
lm(formula = yield_at_issue ~ ebitda_to_int_exp + e_disclosure +
    amt_issued + revenues + maturity + industry_average_CO2_emission)

Residuals:
    Min      1Q  Median      3Q     Max
-2.9405 -1.3129 -0.1263  1.1277  4.6896

Coefficients:
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                     3.596e+00  6.838e+00   0.526  0.59974
ebitda_to_int_exp              -3.753e-02  7.403e-03  -5.070 1.09e-06 ***
e_disclosure                   -1.096e-01  4.588e-01  -0.239  0.81145
amt_issued                      1.115e-09  3.854e-10   2.894  0.00433 **
revenues                        8.460e-04  8.900e-04   0.950  0.34331
maturity                       -1.171e-05  1.447e-04  -0.081  0.93558
industry_average_CO2_emission -1.008e-04  5.941e-04  -0.170  0.86546
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.729 on 160 degrees of freedom
  (83 observations deleted due to missingness)
Multiple R-squared:  0.2138,    Adjusted R-squared:  0.1843
F-statistic:  7.25 on 6 and 160 DF,  p-value: 7.333e-07
```

Figure 11 – Industry Regression Analysis

Source: Bloomberg

The model yields a moderately good R-squared value (R^2=21.38%), implying that the model fits the variance of observations quite well.

The intercept is found to be positive but not statistically significant, mirroring the insignificance of the coefficient for revenues. Conversely, coefficients associated with

Environmental disclosure, maturity, and industry average exhibit negative signs, but lack statistical significance.
Only the coefficients for EBITDA to interest expenses and amount issued emerge as statistically significant.

In accordance with the backward elimination process, as outlined earlier, variables will be systematically excluded iteratively based on their decreasing statistical significance. At the end of this process, the final regression model of this analysis then becomes as follows:

```
Call:
lm(formula = yield_at_issue ~ ebitda_to_int_exp + e_disclosure +
    industry_average_CO2_emission)

Residuals:
    Min      1Q  Median      3Q     Max
-3.7035 -1.4511 -0.1216  1.0383  8.9926

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                    4.6728417  0.2568236  18.195  < 2e-16 ***
ebitda_to_int_exp             -0.0471605  0.0073586  -6.409 7.46e-10 ***
e_disclosure                  -1.2232125  0.3772039  -3.243  0.00135 **
industry_average_CO2_emission -0.0008202  0.0005033  -1.630  0.10447
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.959 on 245 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.2026,    Adjusted R-squared:  0.1928
F-statistic: 20.75 on 3 and 245 DF,  p-value: 5.175e-12
```

Figure 12 – Industry Regression Analysis - Final model

Source: Bloomberg

In this specific scenario, the variable "Industry average CO2 emissions" was retained for clarity purposes despite its lack of statistical significance.
Conversely, the following variables were excluded, in sequential order: revenues, maturity and amount issued (which lost significance during the process).
The resulting regression model exhibits a slightly reduced R-squared value of 20.26%, compared to the previous model's 21.38%, although three variables were exluded from the analysis.

The intercept is positive and statistically significant, with a value of 4.67.
As expected, the coefficient for EBITDA to interest expense is negative, with a value of -0.05. This implies that an increase in interest coverage ratio, reflecting an higher level of

financial strength of the issuer, corresponds to a decrease in the issuer's default risk and thus to a reduction of the yield at issue.

The coefficient for Environmental disclosure becomes statistically significant and negative, equal to-1.22 after the refinement process. This indicates that an enhancement in the accuracy of non-financial disclosure is associated with a decrease in yield at issue, aligning with expectations and previous literature.

The coefficient associated with the variable "Industry average CO2 emission" was expected to be positive and statistically significant, in line with studies supporting the existence of the green premium. This would have indicated empirical evidence of a discount in yield at issue for industries characterized by a lower average CO2 emissions per sales.
However, the analysis shows that the coefficient is slightly negative in value and is not statistically different from zero. Consequently, within the scope of this research, it is not possible to assert a substantial deviation in yield at issue between different sectors.

4.1.2. Individual performance analysis

High CO2 industries

```
Call:
lm(formula = yield_at_issue_high_co2 ~ ebitda_to_int_exp_high_co2 +
    e_disclosure_high_co2 + revenues_high_co2 + amt_issued_high_co2 +
    maturity_high_co2 + CO2_score_high_co2)

Residuals:
    Min      1Q  Median      3Q     Max
-2.6581 -1.2191 -0.1311  0.8230  4.3175

Coefficients:
                             Estimate Std. Error t value Pr(>|t|)
(Intercept)                 1.766e+01  9.499e+00   1.859  0.06782 .
ebitda_to_int_exp_high_co2 -4.033e-02  1.494e-02  -2.700  0.00896 **
e_disclosure_high_co2      -5.172e-01  8.029e-01  -0.644  0.52187
revenues_high_co2           6.505e-04  1.624e-03   0.400  0.69020
amt_issued_high_co2         1.688e-09  6.927e-10   2.437  0.01773 *
maturity_high_co2          -3.071e-04  1.977e-04  -1.553  0.12557
CO2_score_high_co2         -2.593e-01  8.631e-02  -3.004  0.00386 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.67 on 61 degrees of freedom
  (76 observations deleted due to missingness)
Multiple R-squared:  0.3219,    Adjusted R-squared:  0.2552
F-statistic: 4.826 on 6 and 61 DF,  p-value: 0.0004334
```

Figure 13 – Individual Performance Regression Analysis, High emissions industries

Source: Bloomberg

These are the results of the regression analysis on the dataset with bonds issued within industries with an high level of CO2 emissions per sales.
It shows a good fit to the variance of the dataset, with an R-squared equal to 32.19%.

The intercept is marginally positive and statistically significant, whilt the coefficients for maturity and Environmental disclosure exhibit negative signs but lack of statistical significance. The coefficient for revenues is positive but not statistically significant.

The only statistically significant findings comprise the negative coefficients of EBITDA to interest expenses and CO2 score, and the positive coefficient of amount issued.

Subsequently, the model undergoes the process of backward elimination, through which the following variables are excluded from the analysis: revenues, environmental disclosure, and maturity.

At the end of the process, the following final model for high CO2 industries is derived.

```
Call:
lm(formula = yield_at_issue_high_co2 ~ ebitda_to_int_exp_high_co2 +
    amt_issued_high_co2 + CO2_score_high_co2)

Residuals:
    Min      1Q  Median      3Q     Max
-4.3454 -1.4617  0.0393  1.0653  4.5479

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)
(Intercept)                  3.186e+00  4.351e-01   7.323 5.79e-11 ***
ebitda_to_int_exp_high_co2 -4.595e-02  1.579e-02  -2.911  0.00443 **
amt_issued_high_co2         1.130e-09  5.179e-10   2.182  0.03138 *
CO2_score_high_co2         -1.952e-01  8.645e-02  -2.258  0.02610 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.863 on 102 degrees of freedom
  (38 observations deleted due to missingness)
Multiple R-squared:  0.188,     Adjusted R-squared:  0.1641
F-statistic: 7.869 on 3 and 102 DF,  p-value: 8.957e-05
```

Figure 14 – Individual Performance Regression Analysis, High emissions industries – Final model

Source: Bloomberg

In the final model, the R-squared value experiences a reduction from the previous iteration, settling at 18.8%.
The intercept of the regression has a value of 3.19 and is statistically significant.

The coefficient of the Interest Coverage Ratio remains negative -0.05, consistent with the previous model and aligned with expectations regarding the influence of financial risk measures.
The coefficient for amount issued is very close to zero but retains slight positivity and statistical significance. This suggests that the volume of debt issued increases has a negligible impact on yield at issue.

The coefficient for the individual CO2 score emerges as statistically significant and negative, equal to -0.1952. This finding is aligned with expectations and previous literature, indicating that a better performance in terms of CO2 emissions per sales within high-emission sectors corresponds to a decrease in yield at issue.
It's important to note that the coefficient of environmental disclosure, while it appears negative in the dataset, its not statistical significant, and thus it is not possible to maintain that in the population of SLBs the coefficient is different from zero.

Low CO2 industries

```
Call:
lm(formula = yield_at_issue_low_CO2 ~ ebitda_to_int_exp_low_CO2 +
    e_disclosure_low_CO2 + revenues_low_CO2 + amt_issued_low_CO2 +
    maturity_low_CO2 + CO2_score_low_CO2)

Residuals:
    Min      1Q  Median      3Q     Max
-2.8315 -1.2566 -0.1582  1.1572  3.9092

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)               -1.372e+01  1.184e+01  -1.159 0.251079
ebitda_to_int_exp_low_CO2 -3.512e-02  9.261e-03  -3.793 0.000353 ***
e_disclosure_low_CO2       6.413e-01  8.197e-01   0.782 0.437157
revenues_low_CO2           1.345e-03  1.095e-03   1.229 0.224132
amt_issued_low_CO2         1.472e-09  6.377e-10   2.308 0.024526 *
maturity_low_CO2           3.351e-04  2.504e-04   1.338 0.185970
CO2_score_low_CO2         -4.136e-02  1.713e-01  -0.241 0.810043
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.64 on 59 degrees of freedom
  (39 observations deleted due to missingness)
Multiple R-squared:  0.3101,    Adjusted R-squared:   0.24
F-statistic: 4.421 on 6 and 59 DF,  p-value: 0.000936
```

Figure 15 – Individual Performance Regression Analysis, Low emissions industries

Source: Bloomberg

The analysis conducted on low-emission industries exhibit a high R-squared value (31.01%), showing a good fit of the model. The intercept is negative but not significant, as is the coefficient for the individual CO2 score. The coefficients for environmental disclosure, revenues, and maturity are positive but not significant. The only statistically significant findings from this analysis are the coefficient of the Interest Coverage Ratio, which is negative as expected, and the coefficient of amount issued, which is positive.

Through the process of backward elimination, the following variables were progressively eliminated in this order: revenues, amount issued, maturity and CO2 score.
The following is the final model for the low CO2 emissions industry:

```
Call:
lm(formula = yield_at_issue_low_CO2 ~ ebitda_to_int_exp_low_CO2 +
    e_disclosure_low_CO2)

Residuals:
    Min      1Q  Median      3Q     Max
-3.3876 -1.2834 -0.3148  1.1545  8.8414

Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)                4.795587   0.312680  15.337  < 2e-16 ***
ebitda_to_int_exp_low_CO2 -0.041727   0.009184  -4.543 1.52e-05 ***
e_disclosure_low_CO2      -1.825799   0.555802  -3.285   0.0014 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.01 on 102 degrees of freedom
Multiple R-squared:  0.287,     Adjusted R-squared:  0.273
F-statistic: 20.53 on 2 and 102 DF,  p-value: 3.221e-08
```

Figure 16 – Individual Performance Regression Analysis, Low emissions industries – Final model

Source: Bloomberg

The final model, despite the removal of numerous predictor variables, still exhibits a good R-squared value of 28.7%.
The intercept is positive and statistically significant, equal to 4.8.

The coefficient for EBITDA to interest expense remains negative (-0.04), in line with expectations and consistent with observations from previous analyses.
The coefficient for environmental disclosure score emerges as statistically significant, with a negative value of -1.82. This implies that an increase in the level of disclosure correlates with a tangible reduction in yield at issue.

4.2. Findings discussion

The preceding results can be summarized in the following table:

	Industry analysis	High CO2 industries	Low CO2 industries	Delta High-Low
Intercept	4.67	3.19	4.80	-1.6096
EBITDA to interest expenses	-0.05	-0.05	-0.04	-0.0042
Environmental disclosure	-1.22	-	-1.83	1.8258
Amount issued	-	0.00	-	0.0000
CO2 score	n.d.	-0.20	-	-0.1952
Industry average CO2 emissions	-	n.d.	n.d.	n.d.

Figure 17 – Summary table of the three models

Source: Personal elaboration on Bloomberg data

4.2.1 Industry analysis

Primarily, the industry-level analysis exhibits the significant influence of the environmental disclosure score on yield at issue, characterized by a coefficient of -1.22. This underscores the pivotal role of disclosing pertinent environmental information, as it can facilitates the transmission of insights regarding the firm's performance to investors. This result is in accordance with *Flammer (2021*) and *Barbalau and Zeni (2021)* about the signaling thesis, as it results costly not to publish non-financial information.

The findings underscore the broader implications of environmental disclosure beyond mere regulatory compliance. Engaging in transparent disclosure practices not only enhances informational transparency but also serves as a mechanism for firms to signal their commitment to environmental sustainability. This, in turn, may generate a greater investor confidence and potentially yield favorable financial outcomes in the form of reduced financing costs.

In essence, the empirical evidence highlights the strategic and financial significance of environmental disclosure as a means for firms to leverage their environmental performance to secure competitive advantages in the financial markets.

It is fundamental to note that there is absence of significant disparities in yield at issue across various industries. The independent variable designed to measure the impact of the industry effect, characterized by distinct business models, fails to attain statistical significance.
Consequently, it can be inferred that there is no differentiation between, for instance, companies operating within the energy industry and those within the healthcare industry.

This result holds significant implications, elucidating that the interest towards sustainability is not contingent upon specific business factors. Rather, it shows the emergence of a pervasive mega-trend with profound ramifications across industries. Sustainability is not merely a transient phenomenon confined to select sectors deemed "green"; rather, it represents a transformative force that has reshaped market dynamics and imposed novel imperatives upon all market participants.

The absence of a discernible "industry" effect shifts the focus of the analysis to examination of another crucial factor: individual firm performance.

4.2.2. Individual performance analysis

The summarized outcomes of the preceding regressions are presented in the table, with an additional column introduced to emphasize the differences between the findings derived from analyses conducted on sectors characterized by higher emissions and those with lower emissions.

First, the variable measuring the firm's default risk: EBITDA over interest expense. The difference between them, taking into account approximations for the sake of clarity, is marginal.
Across both scenarios, the coefficient consistently has a negative sign, signifying that a higher EBITDA interest coverage corresponds to a reduced default risk for the firm. Consequently, debt instruments are assigned higher valuations in the market, resulting in lower yields, as investors compensate for the diminished risk associated with these instruments.

Distinct observations arise concerning the other two variables, that present substantial disparities between high-emission and low-emission sectors: CO2 score and environmental disclosure.

The CO2 score related to individual firms, which assess their ability to have a greater emission efficiency compared to the industry average, emerges as a significant variable with a negative coefficient in the high-emission industries. This suggests that achieving emission efficiency within sectors such as Energy, Industrial, and Material can have a meaningful influence in mitigating yield at issue, that is the cost of the debt.

The consistency of this outcome with expectations suggests that market participants consider the likelihood of a company failing to achieve the sustainability objectives associated with the bond's step-up coupon mechanism when determining pricing.
The presence and significance of this coefficient make it possible to assess that in these industries the link between the financial and non-financial performance can be appreciated, since the market seems to be willing to attribute value not solely based on the financial risk profile of the company, but also on its enhanced sustainability performance.

In the Energy, Industrial, and Material industries, there exists a significant incentive for highly sustainable companies to issue SLBs and reap a premium that investors are willing to pay. This mechanism could establish an incentive structure that, while rewarding companies already exhibiting strong sustainability practices, simultaneously places a "penalty" on firms that are less efficient in terms of emissions, making the issuance of these instruments less favorable in comparison to their competitors.

Such an incentive-disincentive mechanism poses a great challenge for less sustainable companies operating within high-emission industries. They would need to undertake substantial investments to reduce their emissions and enhance competitiveness within the industry also from a sustainability perspective.

One might have expected a similar rationale within the counterpart class of industries. However, the absence of a significant CO2 score coefficient in the low-emission dataset precludes the determination of any discernible impact of individual firm performance in terms of sustainability on yield at issue and, consequently, on the cost of debt.

A scenario emerges where being sustainable within sustainable industries fails to yield rewards, while being less efficient does not incur in penalties. This phenomenon may be attributable to one of the risks highlighted by Kenza Bryan[36] in her Financial Times article: unambitious target setting.

Companies operating within sectors such as Communications, Consumer Discretionary, Consumer Staples, Health Care, and Technology, given their inherently low CO2 emissions, either they may encounter a limited scope for improvement, or they may deem investment in sustainability and emission reduction as less economically viable endeavors, in relative terms, compared to their high CO2 emissions industries counterparts.

The disclosure of non-financial data, particularly pertaining to the environmental footprint of a company's operations and its efforts to reduce it, emerges as a negative independent variable within low-emission industries. Conversely, this variable does not show significance within high-emission industries.

A pronounced impact is observed in low-emission sectors, including Communications, Consumer Discretionary, Consumer Staples, Health Care, and Technology, where it results that the absence of comprehensive disclosure regarding environmental impacts and mitigation initiatives exerts a negative effect on yield at issue, that is the firm’s cost of debt.

This result is consistent with the intrinsic nature of the analyzed instrument. Sustainability-Linked Bonds are based greatly on transparent and exhaustive

[36] A very bad product, destined to fail’, Financial Times, 17/07/2023

communication with investors concerning sustainability performance, given that the coupon step-up mechanism is directly related to these metrics.

A parallel assumption was made for sectors characterized by higher levels of emissions per sales, such as Energy, Materials, and Industrial sectors. This assumption primarily are, in fact, based on the structural aspects of the debt instrument rather than industry-specific dynamics.
However, there is a strong difference with the coefficient of environmental disclosure in the high emission industries, that lacks significance. This suggests that it is not possible to establish a tangible impact of the transparent and comprehensive non-financial disclosure.

A difference in this industry classification to explain the divergences in the coefficients is hypothesized. A significant distinction between the industry classes may be in the predominant business models: those with low emissions primarily operate with a B2C (Business-to-Consumer) models, while high-emission industries are mainly oriented with a B2B (Business-to-Business) frameworks. Media impact on investors and the “news effect” could exerts a considerable effect on price differentials and the emergence of a "greenium."
In this context, the mediatic impact stemming from the issuance of green instruments like SLBs has a more pronounced influence on companies with greater market visibility due to their closer proximity to consumers and investors (B2C).

Together with the absence of a significant impact of a transparent and comprehensive non-financial communication in B2B industries, this implies that there is a strong signaling component in the difference between the yields at issue. This finding is consistent with the hypotheses posited by *Flammer (2021)* and *Barbalau and Zeni (2021)* regarding the notion of costly signaling for firms.

Chapter 5

5.1. Conclusions

Sustainability is increasingly influencing all aspects of our life. The extensive efforts needed to both mitigate and adapt to its impacts are anticipated to be profoundly disruptive.

The role of the capital market can be a key role in orienting investors towards issuers that contribute to the sustainability needs we are experiencing.

Specifically, the debt capital market assumes a central role in the field of sustainable finance, socially responsible investing, and ESG considerations for several reasons, including:

- bonds offer a distinct advantage by facilitating the involvement of a more extensive array of issuers in the transition process.
- the debt market, being larger than the equity market, possesses a greater potential to positively influence the behaviors of firms and investors.

This requires companies and financial markets to respond to this necessity through increased engagement in Environmental, Social and Governance (ESG) issues and non-financial data disclosure.

One of the instruments that were proposed in the debt capital market to support these needs is the Sustainability-linked bond. This instrument has two fundamental characteristics: the general purpose of the proceeds and the link between not reaching of a target Key Performance Indicators (KPIs) and a step-up in the coupon.

The central question of this research pertains to the identification of industries exhibiting a pronounced incentive for SLBs issuance. The study aims to understand whether greener firms, characterized by high environmental performance, experience favorable issuance terms in the SLB market compared to their counterparts with a lower sustainability profile.

The analysis will be performed at two distinct levels. Initially, an industry-level examination will be undertaken to evaluate the existence of differences in the yield at issue between industries.

Subsequently, the analysis will focus on the individual company level, where the initial dataset will be divided into "High CO2 industries" and "Low CO2 industries". Two parallel regressions will be performed on both the datasets to identify which are the differences in the coefficients of the independent variables.
This process is meant to distinguish between two effects: the first is the belonging to a sector that is characterized by a business model with higher CO2 emissions; the second effect is the ability of the single company to be more efficient in terms of resources used than the industry average.

The results of this research can be summarized in three main points:

1. Industry average CO2 emissions

It seems that there is absence of significant disparities in yield at issue across various industries. The independent variable designed to measure the impact of the industry effect, characterized by distinct business models, fails to attain statistical significance.
Consequently, it can be inferred that there is no differentiation between, for instance, companies operating within the energy industry and those within the healthcare industry.

This result holds significant implications, elucidating that the interest towards sustainability is not contingent upon specific business factors. Rather, it shows the emergence of a pervasive mega-trend with profound ramifications across industries. Sustainability is not merely a transient phenomenon confined to sectors deemed "green"; rather, it represents a transformative force that has reshaped market dynamics and imposed novel imperatives upon all market participants.

2. Environmental disclosure

The environmental disclosure score do have a significant impact on the yield at issue in the industry analysis. It seems that engaging in transparent disclosure practices not only enhances informational transparency but also serves as a mechanism for firms to signal their commitment to environmental sustainability. This, in turn, may generate a greater investor confidence and potentially yield favorable financial outcomes in the form of reduced financing costs.

However, by further investigating the coefficient through individual-level analysis it is possible to discern a pronounced impact in low-emission sectors, including Communications, Consumer Discretionary, Consumer Staples, Health Care, and Technology, and a not significant impact in sectors characterized by higher levels of emissions per sales, such as Energy, Materials, and Industrial.

One possible explanation could be a significant distinction in the predominant business models between the industry classes.
Industries with low emissions primarily operate with a B2C (Business-to-Consumer) models, while high-emission industries are mainly oriented with a B2B (Business-to-Business) frameworks. Media impact on investors and the “news effect” could exerts a considerable effect on price differentials and the emergence of a "greenium."
In this context, the mediatic impact stemming from the issuance of green instruments like SLBs has a more pronounced influence on companies with greater market visibility due to their closer proximity to consumers and investors (B2C).

3. CO2 individual score

The CO2 score related to individual firms emerges as a significant variable with a negative coefficient in the high-emission industries. This suggests that achieving emission efficiency within sectors such as Energy, Industrial, and Material can have a meaningful influence in mitigating yield at issue, that is the cost of the debt.

The consistency of this outcome with expectations suggests that market participants consider the likelihood of a company failing to achieve the sustainability objectives associated with the bond's step-up coupon mechanism when determining pricing.
The presence and significance of this coefficient make it possible to assess that in these industries the link between the financial and non-financial performance can be appreciated, since the market seems to be willing to attribute value not solely based on the financial risk profile of the company, but also on its enhanced sustainability performance.

In the Energy, Industrial, and Material industries, there exists a significant incentive for highly sustainable companies to issue SLBs and reap a premium that investors are willing to pay. This mechanism could establish an incentive structure that, while rewarding companies already exhibiting strong sustainability practices, simultaneously places a "penalty" on firms that are less efficient in terms of emissions, making the issuance of these instruments less favorable in comparison to their competitors. Such an incentive-disincentive mechanism poses a great challenge for less sustainable companies operating within high-emission industries. They would need to undertake substantial investments to reduce their emissions and enhance competitiveness within the industry also from a sustainability perspective.

However, the absence of a significant CO2 score coefficient in the low-emission dataset precludes the determination of any discernible impact in low emission industries of the individual firm performance in terms of sustainability on yield at issue and, consequently, on the cost of debt.
A scenario emerges where being sustainable within sustainable industries fails to yield rewards, while being less efficient does not incur in penalties. This phenomenon may be attributable to one of the risks highlighted by Kenza Bryan in her Financial Times article[37]: unambitious target setting.

Companies operating within sectors such as Communications, Consumer Discretionary, Consumer Staples, Health Care, and Technology, given their inherently low CO2 emissions, either they may encounter a limited scope for improvement, or they may deem investment in sustainability and emission reduction as less economically viable endeavors, in relative terms, compared to their high CO2 emissions industries counterparts.

In conclusion, it can be said that although there are no differences at industry level, this debt instrument has shown that it can create an incentive mechanism in both high-emission and low-emission sectors, which relate to either carbon efficiency or non-financial disclosure.

[37] A very bad product, destined to fail', Financial Times, 17/07/2023

As confirmed by "Sustainability-Linked Bonds Have Long Road to Drive Impact[38]" and the results of this research, SLBs can be a tool that clearly links the financial and non-financial performance of the company, and support companies toward the transition to a sustainable economy.
Given the greater flexibility of this instrument and its relative newness in financial markets, some concerns arise: from unambitious targets to the callability of the bonds before the start of the step-up coupon mechanism.

SLBs are an ambiguous instrument, which may have great potential in supporting firms toward a more sustainable way of doing business, but also be a beautiful carpet under which it is possible to hide a decommitment towards emission reduction and through which to try to obtain a lower debt cost without incurring in the costs of a concrete commitment and a lower risk exposure.

This will be decided only by the supervisory authorities, who will have the objective of regulating the issuance of SLBs and imposing limits at critical points: scientific definition of targes, callability, size and beginning of the coupon step-up mechanism.

[38] Sustainability-Linked Bonds Have Long Road to Drive Impact, Bloomberg NEF, 19/07/2023

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