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# Are green investors fooled?

## The effect of issuer signaling on investors' decision to invest into sustainability-linked bonds.

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# Abstract

Sustainability-linked bonds (SLBs) can be used by companies seeking to demonstrate their commitment to environmental improvement (Pears et al., 2023, p.1). However, can investors be confident that issuers signaling their commitment are credible? In our empirical study, we examine the effects of issuer and SLB characteristics. Specifically, we investigate the impact of the U.N. Global Compact commitment, the callable status of SLBs, and the difference between average public listed companies and those with strong ESG scores. Our objective is to understand how these factors influence the probabilities of achieving a predefined key performance indicator (KPIs) and the extent of mispricing observed in SLBs. Our findings indicate that issuers that are not committed to the U.N. Global Compact initiative, issuing non-callable SLBs, and holding strong ESG score achieve higher KPI success rates individually, compared to their counterparts. Furthermore, we compare the investment strategies of unsophisticated green investors, who only invest in issuers committed to the U.N. Global Compact initiative, and sophisticated green investors, who evaluate multiple factors. On average, both types of investors experience high levels of mispricing. While the portfolio of the sophisticated investor achieves a higher KPI success rate of 92%, twice that of the unsophisticated investor. In conclusion, SLB issuers committed to the U.N. Global compact initiative have lower likelihood of achieving their KPI targets, potentially misleading investors with their commitment. Additionally, we document a positive nonlinear relationship between the probabilities of achieving a KPI target and the extent of mispricing of the SLBs.



Key words: Sustainability-linked bonds, ESG, fixed income, U.N. Global compact, Predictive modelling, Signaling politics, Sustainable Finance, Environmental performance

# Acknowledgments

This thesis was conducted to complete the research requirements of our master's degree in Business Administration with major in finance at Oslo Metropolitan University. The objective of our research is to examine how investors are affected by issuers signaling politics in their investment behavior when investing in sustainability-linked bonds. We have centered our master´s thesis on this topic due to our shared interest in the green debt market. When the opportunity to research the newest instrument in the field presented itself, the choice was easy.

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# List of Figures

# List of tables

# Acronyms

**ESG –** Environmental, Social & Governance

**KPIs –** Key performance indicators

**SLBs –** Sustainability-linked bonds

**SPT –** Sustainability Performance Targets

**ICMA –** International Capital Market Association

**USD –** United states dollars

**UNGC –** United Nations Global Compact

**SDG –** Sustainable Development Goals

Table of Contents

# 1.Introduction

The debt market serves an increasingly important role in funding the green transition (The World Bank, 2021). While green bonds, in general, have already established a strong presence in the green debt markets (Flammer, 2021), sustainability-linked bonds (SLBs) represent a new addition to these markets. Sustainability-linked bonds are distinct from green bonds in terms of how the use of proceeds are structured. Green bonds earmark their use of proceeds to specific green projects (Chase, 2021). In contrast, sustainability-linked bonds allow the issuer to use the proceeds how they see fit. The SLBs follow the logic of linking coupon payments to predefined sustainability targets, where issuers are penalized with increasing coupon rates if they fail to achieve these targets. The progress is measured through specific predefined key performance indicators. (Berrada et al., 2022). The first issuance of a sustainability-linked bond was observed in September 2019, issued by the Italian Energy company Enel. Enel realized they were "doubling" their work by issuing green bonds alongside their overall strategy of decarbonization, as they concentrated on subsets of their sustainable development goals (SDG). The realization resulted in the idea of issuing a bond linked directly to their overall SDG-goals, aiming to increase their effectiveness toward the progress of their SDG-goals and freeing up human capital, which was previously dedicated to monitoring the subsets. (Lester, 2022).

The issuance of their first SLB contributed to demonstrate Enel´s commitment to environmental and social responsibilities, attracting a higher level of interest from investor in their debt instruments (Lester, 2022). This observation is supported by Flammer´s (2021) paper, where the author concludes that companies issuing green bonds provide a credible signal on their commitment toward the environment (Flammer, 2021). The debt market has demonstrated positive adoptions of SLBs following Enel´s success (Lester, 2022), with the biggest issuance in the market observed in 2021 at 128.60 billion USD, according to Refinitiv Eikon.

The existing literature highlights various positive qualities of sustainability-linked bonds, including cost advantages and the ability to signal environmental commitment through their issuance. However, skeptical literature on the effectiveness of these debt instruments in achieving environmental goals is starting to emerge (Hag & Doumbia, 2022; Huttunen & Rich, 2022; PWC, 2022).

In this paper, our aim is to investigate the credibility of issuers´ signaling through the issuance of SLBs. Based on Ortas et al., (2015), which highlight the positive influence of a company´s commitment to the United Nations Global compact initiative on a company´s ESG performance, we identify this commitment as a signal that issuers send to investors, demonstrating their dedication to environmental improvement.

We investigate the issuers´ credibility through three empirical questions, (i) *Does a positive linear relationship exist between the predicted probabilities and the mispricing level?* We examine this relationship by assessing the predicted probabilities and mispricing levels for the SLBs that achieved their KPI targets compared to those that did not. Additionally, we examine the observations in a scatterplot before we evaluate the correlation between the two variables and t-test the correlation coefficient. We observe the relationship to be significantly positive, although it is nonlinear.

(ii) *Which factors contribute to increase the probability of achieving a KPI target?* By examining the p-values for each explanatory variable in our probit model, we assess their significant contributions, whether positive or negative, towards the probability of achieving a predefined KPI target, where we observe the commitment to the U.N. Global compact initiative to contribute negative toward the probability of achieving the KPI target.

(iii) *How do these significant explanatory variables affect the probabilities- and mispricing levels of an SLB?* We examine the effects of differences in the following explanatory variables: Commitment to the UN global compact initiative, The SLBs callable status, and the difference between an average public company and a company with a strong ESG score grade. The objective is to understand the performance differences between two types of investors: those who do not consider these three characteristics individually, and those who consider each characteristic separately. Ultimately, we analyze how a sophisticated investor performs compared to an unsophisticated investor. We find that the sophisticated investor achieves the highest KPI success rate, suggesting an optimal investment strategy for SLB investor is to disregard issuers that are committed to the UNGC initiative in order to make a greater environmental impact. The structure of this thesis is as follows: in section 2, we present

relevant literature for our thesis. Section 3 presents the mechanism of SLBs, the market evolution and criticism of the instrument. Section 4 presents our hypotheses. Section 5 describes the data collection and descriptive data. Section 6 covers the methodologies. Section 7 presents the probit model, and section 8 tests the robustness of the model. In section 9 we present the results of our analysis. Section 10 discusses the result. In section 11, we conclude, before we present our limitations, contributions, and proposals for further research.

## 2. Literature Review

In 2007 the intergovernmental Panel for Climate Change published a report linking human activities to global warming. As a result of the report, the world´s first green bond was issued by the World Bank in November 2008 (The World Bank, 2021). Over the following 15 years, the green debt market experienced explosive growth. Simultaneously, the literature on the topic has experienced a similar growth. This research paper is based on the latest and most relevant literature in the fields of fixed income and environmental, social and governance (ESG) literature. Starting with Flammer (2021), who documents a positive relationship between stock prices and the announcement of green bond issuances. Additionally, the author finds companies issuing green bonds for the first time and simultaneously achieving a third-party certification to experience an even stronger response from equity investors. Furthermore, Flammer uncovers a correlation between companies issuing green bonds and improvements on their overall environmental performance post-issuance. The author concludes that companies issuing green bonds give a credibly signal to their commitment toward the environment.

The international capital market association defines the purpose of sustainability-linked bonds to create future improvements in sustainability/ESG objectives (ICMA, 2020, p. 3). Kölbel and Lambillon (2022) examine who is paying for this improvement. The authors aim to understand whether investors pay for the impact of an SLB or if companies pay for signaling their commitment to sustainability. Through their paper Kölbel and Lambillon present a comparative analysis on the pricing of SLBs and vanilla bonds where they study the effect on issuance price when a sustainability target is included. Their results can be divided into two main findings. (i) They find statistically significant evidence of a sustainability premium comparing yields between their sample of SLBs and the sample of vanilla bonds at the time of issuance, which

they conclude is on average 29,2 bps in favor of SLBs. They conclude that the difference between the sustainability premium and the penalty size provide a positive net benefit for the issuer, i.e., sustainability premium > penalty size. (ii) Secondly, they observe issuers including a call provision in the structural characteristics of their SLB to achieve even higher premiums (Kölbel and Lambillon, 2022).

Furthermore, Berrada et al., (2022) present a one period pricing model for sustainability-linked bonds analyzing (i) the incentive compatibility structure of the coupon penalty, i.e., whether the penalty size incentivize the issuer reaching their key performance indicators (KPIs), and (ii) the level of mispricing. In essence, the mispricing level provides an indication of whether the SLB is over- or underpriced relative to its expected price range. In conclusion the authors find evidence on how a large enough coupon payment incentivizes the issuer to raise larger amount of capital toward their sustainability goal. Additionally, Berrada et al. (2022) establishes three empirical findings. (i) ML > 1 indicates the SLB to be overpriced, where the effect can be observed in the secondary market on the post-issuance price. (ii) they document a significant wealth transfer from the bondholders to the shareholders of the issuing firm when the SLB is overpriced, where the greater the level of ML, the greater effect on the issuing firm's stock price post-issuance. (iii), the authors document a significant nonlinear relationship between the mispricing level and the issuing-firms environmental, social, and governance (ESG) rating. (Berrada et al., 2022)

The United Nations Global Compact (UNGC) is the world's largest corporate sustainability initiative and aim to enable change as well as promoting accountable companies to deliver on the UN Sustainable Development Goals (SDG) and UNGCs core principles (UN Global Compact, n.d.) Ortas et al. (2015) investigates the impact of UNGC commitment on companies ESG and financial performance. In their empirical analysis they find a positive and significant impact on ESG performance for the companies committed to UNGC. They uncover that the positive relationship is present in bear market periods, which demonstrates a strong relationship between the systematical improvement on ESG performance and companies' voluntary commitment to the UNGC initiative (Ortas et al., 2015, p. 20).

Lastly, Hag & Doumbia (2022) research the structural characteristics of the sustainability-linked bonds and how issuers can abuse this type of instrument in a form of greenwashing, where the company signal that they are motivated to contribute to the environment through issuing SLBs while the overall net effect may be negative for the environment by assessing (i) The effect of keeping penalties low (ii) pushing target dates for the penalty close up to the maturity date and (iii) the callability feature of an SLB. Their research presents evidence suggesting that SLB issuers can abuse SLBs through minimizing penalties, setting target dates close to maturity, and including a callable feature. Their analysis finds call provisions to be more likely to be found in SLBs containing penalty step-ups. An option incentivizing the issuer to call the SLB early if they are not able to achieve their KPI target. The paper concludes that the most concerning factor is when both loopholes are present within one SLB, with late step-up penalties and the callable function. Additionally, they conclude that issuers may use SLBs as a source of cheap financing through the SLB premium they collect at issuance with little to no thought toward their sustainable impact. (Haq & Doumbia, 2022).

# 3. Sustainability-linked Bonds (SLB)

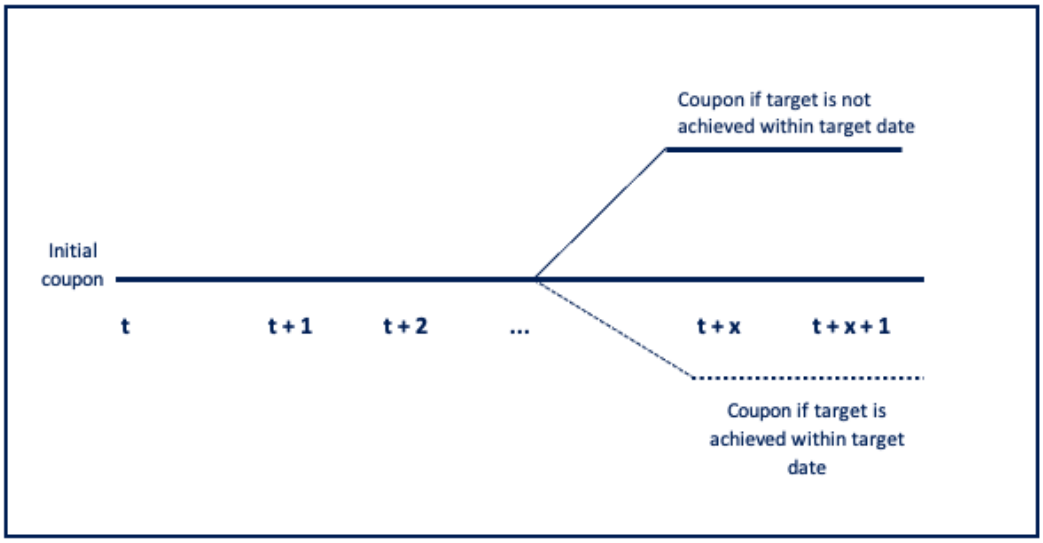
The debt markets play an increasingly important role in funding the green transition. While green bonds have been a part of the debt market for almost two decades (The World Bank, 2021), SLBS were not introduced before the Italian energy company ENEL issued their first SLB in September 2019. (Quiry & Le Fur, 2020, p.1). In this section we will describe the mechanism of a SLB before we explain the difference between SLBs to the other ESG bonds. Additionally, we include an example of a SLB issuance before we shortly cover the most profound criticism of this new instrument.

## 3.1 The mechanism of a SLB

Sustainability-linked bonds are fixed income instruments where the financial and structural characteristics are linked to the achievement of specific ESG objectives. When issuing an SLB the issuer commits to achieve predefined sustainability objectives within a given timeframe. The progress during the period is measured using predefined key performance indicators (KPI´s) assessed against sustainability performance targets (SPTs). (ICMA, 2020, p. 3). The KPI and bond structure is designed by the issuer. To create mutual trust between issuer and investor, the issuer often employs a Second Party Provider (SPO) who´s task is to evaluate the

issuers alignment to their sustainable goals through factors such as relevance, rationality, reliability, and the level of ambition (ICMA, 2020, p. 4-5). If the issuer is not able to reach their objective(s) in time, the SLBs are structured in a way that penalizes the issuer. If the sustainability objective(s) are met in time, the coupon payment stays the same or experience a coupon step-down, depending on the structural characteristics. The penalty function can be understood as the incentive mechanism of the SLBs. Figure 1 illustrates the incentive mechanism of a sustainability-linked bond with a coupon step up or step down, the first is the most used structural penalty for SLBs.

**Figure 1**: Incentive mechanism of a sustainability-linked bond




*Source: Kölbel, J., Lambillon, A.-P., (2022).*

## 3.2 Difference between SLBs and ESG bonds

Sustainability-Linked bonds are classified as a type of ESG Bonds. ESG labeled bonds can be split up into the category's green bonds, social bonds, sustainability bonds and sustainability-linked bonds. For instance, capital raised through social bonds is used to fund projects which focus on mitigating social issues. Green bonds earmark the use of the proceeds to finance specific green projects (Chase, 2021), and sustainability bonds finance both environmental and social projects (ICMA, 2021, p. 3). In contrast, sustainability-Linked bonds are defined by ICMA 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." (ICMA, 2020, p. 3). The two main differences between ESG labeled debt instruments and SLBs is (i) the SLBs structural properties, in terms of the penalty structure, while the latter ESG bonds have a fixed coupon rate and no penalty. (ii) The use of the proceeds for SLBs are not tied to a

specific investment project and the issuer is rather evaluated on their overall SPT objectives. Structuring the SLBs this way, the issuer experiences a higher degree of flexibility (Quiry & Le Fur, 2020, p.1-3). While the degree of flexibility is attractive for the issuers, the downside is higher level of risk, where the issuers experience a risk of a potential cost increase, if they are not able to achieve their KPI targets within the predefined time limit. Nevertheless, as Kölbel and Lambillon (2022) state, the sustainability premium the issuer gain from SLBs exceeds the penalty costs.

## 3.3 Example of a SLB issuance

On December 1st, 2022, Norsk Hydro, a Norwegian aluminum and energy supplier, issued an SLB with a floating fixed margin over index rate, including a KPI linked step-up option. In table 1 we display an overview of the structural characteristics for the SLB.

**Table 1:** Bond Summary of ISIN: NO0012767252

| | | | |
|---|---|---|---|
| Issue date | 01.12.2022 | Penalty Step-up | 0,5% |
| Maturity date | 30.11.2028 | Coupon frequency | Quarterly |
| Rating | BBB | Amount outstanding (in NOK) | 1,500,000,000 |
| Coupon rate | 5,25% | Par Value | 100% |

KPI 1: Reduce CO2 emissions with 10% within 2025 compared to 2018 values
KPI 2: Increase the post-consumer scrap recycling capacity by 660.000 ton within 2025
*Source: Refinitiv Eikon database*

KPI (1) measures Norsk Hydro´s reduction in $CO_2$ emissions, where the objective is to reduce the emissions by 10% within 2025 compared to their 2018 baseline. A failure to reach this KPI target will subsequently increase the coupon payments of the bond by 50 basis points. The increase in coupon rate is a clear financial incentive for the issuer to work towards their $CO_2$ emission reduction objective.

KPI (2) measures the progress of increasing the post-consumer scrap recycling capacity, where Norsk Hydro has set an objective to reach 660,000 tons by 2025. Although the second KPI target does not penalize the issuer if the objective is not reached the KPI is included in the bond prospectus to signal investors about Norsk Hydro's broader sustainability targets. Additionally, it is included to signal their efforts aligning their operational activities towards the UN Paris Climate agreement. While the second KPI does not offer a financial incentive for the

issuer, it´s inclusion support Flammer´s findings that companies issue ESG bonds to signal their commitment toward the environment.

### 3.4 Market size, Evolution, and regulation

The sustainability-linked bond market has grown exponentially since its first issuance. From a total amount issued at 5.669 billion USD in 2019 to 254.7 billion USD by mid-March 2023, according to the Refinitiv database. The compounded annual growth rate is 114% for amount issued, while number of issues have a compounded annual growth rate of 157%. The market has been dominated by European issuers, who are responsible for 54.5% of all SLBs issued from 2019-2023. The majority of issuances contain KPIs linked to Climate and Gas emissions. This indicates that EU regulation and climate agreements, like the Paris Agreement, are contributing to the rapid growth of SLBs issuances. Based on the Refinitiv Eikon Database we observe SLBs to be present in over 21 different currencies. Although the debt markets have shown a positive adaptation of SLBs, the instrument is still not dominating the market. (OECD, 2022). However, by examining the compounded annual growth rate for SLB issuances, it can provide an indication on how the green debt market could evolve in the future. Furthermore, the creator of SLBs, Enel, has already committed to exclusively using SLBs in their financing in the future (Lester, 2022), which supports the idea of SLBs future growth in the debt markets.

### 3.5 Investor concerns with Sustainability-linked bonds

The structural properties of SLBs have raised concerns and criticisms from investors and institutions. For instance, Hag & Doumbia (2022) identify loopholes issuers may abuse to minimize their total penalties. They highlight how late step-up penalty target dates in the bond's duration minimize the penalty pay-outs and how the inclusion of a callable feature in their structural properties contribute to minimize or altogether cancel the penalties by calling the bond early, Hag & Doumbia (2022). These are findings and concerns AEGON asset management share in their assessment of the sustainability-linked bond market report from March 2022. They label these factors "red flags", claiming an issuer may have no material financial incentives by setting the target date close to maturity, and/ or by calling the bonds before the issuer is held accountable to their SPT performance. (Huttunen & Rich, 2022). Additionally, PWC express their concerns in their press article on Sovereign Sustainability-

linked bonds where they identified the same factors to be the primary issue with sustainability-linked bonds in today's market (PWC, 2022).

The international capital market association presents one way to counter these loopholes in their SLB principles. They highlight how the use of a Second Party Provider (SPO) is able to mitigate the risk for investors. This is because the SPO will report any misleading information or lack of issuer competence to the market (ICMA, 2020, p. 4). Although the SPO is an important institution for investors it is voluntary for issuers to engage them (ICMA, 2020).

# 4. Hypotheses

Sustainability-linked bonds have become a popular instrument for companies seeking to demonstrate their commitment toward ESG improvement (Pears et al., 2023). There is evidence of various benefits associated with issuing SLBs compared to their counterfactual vanilla bonds. For instance, Kölbel and Lambillon (2022) find evidence of a sustainability premium from SLBs compared to vanilla coupon bonds, where they observe a yield differential of 29.2 basis points. Furthermore, they also highlight the net benefit for the SLB issuers, where the financial savings are bigger than the penalty cost (Kölbel & Lambillon, 2022). Additionally, Berrada et al., (2022) point out that the benefits extend beyond cost advantages, highlighting the value of signaling the company´s commitment toward ESG objectives through their issuance. This finding supports Flammer (2021), who argues that issuing green bonds give a credible signal of a company´s commitment toward the environment.

While the literature on the positive benefits of SLBs is growing, literature on the negative aspects of the bonds is also starting to emerge. We have presented research by Hag & Doumbia (2022), who suggest issuers may abuse the structural loopholes of SLBs to achieve low to no material financial incentives, casting doubt on the effectiveness in making a green impact through this type of instrument. Findings supported by large institutions, such as AEGON asset management and PWC (Huttunen & Rich, 2022; PWC, 2022).

Given these conflicting findings, it is important to understand the credibility of issuers when they signal their commitment to environmental improvements through the issuance of SLBs.

In our study, we use the commitment to the U.N. Global Compact initiative as a proxy variable to capture the issuers´ ESG performance. A commitment Ortas et al., (2015) found to have a

positive influence on a company's ESG performance. Therefore, commitment to the U.N. Global compact serves as a means for issuers to signal their commitment toward environmental improvement before issuing their SLBs, demonstrating to investors their willingness to work toward their SPT goals. Our hypothesis is the following:

### Hypothesis one

$H_0$: There is no statistically significant positive linear relationship between the predicted probabilities and the mispricing levels for the SLBs

$H_1$: There is a statistically significant linear relationship between the predicted probabilities and the mispricing levels for the SLBs.

### Hypothesis two

$H_0$: Companies committed to the U.N. Global compact initiative have the same likelihood of achieving their KPI targets as companies not committed to the initiative

$H_1$: Companies committed to the U.N. Global compact initiative are less likely to achieve their KPI targets compared to companies not committed to the initiative

# 5. Data

In this section we will give a description of the data used for our thesis, before we present descriptive statistics on the most relevant features and characteristics from the SLB market and our sample data.

## 5.1 Data description

The majority of data used in this thesis has been collected through Refinitiv Eikon. We have supplemented with information from corporate websites and bond prospectuses if the information was missing from Refinitiv. Furthermore, regarding the U.N Global compact commitment, we retrieved data on their committed members through their webpage. In Refinitiv Eikon we used the feature "ESG bond guide" to collect data on all Sustainability-linked bonds issued from 2019 to March 2023. By the end of March, we retrieved a sample of 559

unique SLBs with their respective ISIN-identifiers. The earliest issue date from the sample extracted is 10/09/2019 and the latest is 21/03/2023.

The ISINs of the SLBs were used to extract our full dataset with *currency, maturity date, KPI target met, KPI reporting date, Penalty rate, Pay effective date, coupon frequency, Face issued, TRBC industry name, TRBC Economic sector name, Issue date, Issue price, Coupon rate, Rating, issuer name, issuer country, coupon type description, pay dates, organization is public flag, second opinion provider, valuation date, ESG combined grade score and first payment date.*

Additionally, we collected descriptive information regarding the KPI themes and KPI action types for each bond.

In total we observe 233 SLBs which have passed their KPI assessment date, where 43 SLBs have reached their KPI target and 190 have not. Refinitiv Eikon does not provide comprehensive information for all sustainability-linked bonds, which is a factor reflected in both our descriptive statistics and in our sample size, i.e., we observed several SLBs without information regarding penalties rates, what type of penalty the SLB is carrying (coupon step-up, down or premium redemption) and their ESG performance. Regarding the unavailable ESG information, portions of the unavailable information can be explained by the non-disclosure requirements for private companies. However, we also observed missing ESG information on public companies.

Completing our sample, we filter on the SLBs which have reached their KPI targets, removing SLBs with uncomprehensive information, we ended with a sample of 24 SLBs.

Furthermore, we include 24 SLBs which have not met their KPI targets. We chose these SLBs based on similar characteristics, such as economic sector, industry, and country of origin.

Additionally, the credit quality for our sample of SLBs is evaluated using the bond rating provided through Refinitiv Eikon and supplementing with issuer rating when the bond rating was missing.

## 5.2 Descriptive Statistics

We display descriptive statistics in Table 2-9 providing basic information on SLBs and their issuers. In table 2 we display issuance per year. The biggest issuance from SLBs was in 2021 while the smallest issued amount was in 2019.

**Table 2:** SLB issuance per year

| Year | Percentage | Amount (in billion USD) |
|---|---|---|

| | | |
|---|---|---|
| 2021 | 50.50% | 128.6 |
| 2022 | 35.30% | 89.99 |
| 2023 | 8.30% | 21.06 |
| 2020 | 3.70% | 9.45 |
| 2019 | 2.20% | 5.67 |
| Sum | 100.00% | 254.78 |

In Table 3 and 4 we display a descriptive breakdown of the region and economic sector for the SLBs. The majority of SLBs issued is from either European or Asian countries with a combined share of 75.8%, where the American markets, both north and south, only holds 20.3% of issued SLBs.

**Table 3:** Number of issuers by continents

| Issuer Locations | Percentage | Number of issuers |
|---|---|---|
| Europe | 54.50% | 279 |
| Asia | 21.30% | 109 |
| South America | 10.70% | 55 |
| North America | 9.60% | 49 |
| Other | 3.90% | 20 |
| Sum | 100.00% | 512 |

Table 3 reports the total number of corporate sustainability-linked bonds issued in the period 2019-2023 (March) divided into their respective issuer continents.

In table 4 we observe the industrial sector to be the leading sector of issuances - an industry with a high level of pollution. This implies that industries facing difficulties in raising capital through ordinary green bonds, due to the non-green nature of their operations, are the main issuers of SLBs.

**Table 4:** Breakdown of the economic sector of SLB issuers

| TRBC Economic Sector | Percentage | Number of issuers |
|---|---|---|
| Industrials | 18.10% | 98 |
| Utilities | 15.00% | 81 |
| Basic Materials | 13.10% | 71 |
| Financials | 13.10% | 71 |
| Consumer Non-Cyclicals | 9.10% | 49 |
| Technology | 8.30% | 45 |
| Energy | 5.90% | 32 |
| Real Estate | 5.50% | 30 |
| Consumer Cyclicals | 5.40% | 29 |
| Healthcare | 5.40% | 29 |
| Government Activity | 1.10% | 6 |

| | | |
|---|---|---|
| Sum | 100.00% | 541 |

In table 5 we display a descriptive overview of the KPI target themes, which give an in-depth understanding of the various SLBs KPI´s. We observe that the dominating KPI target theme is "Climate change", with 86.2% of the issuers opting for this alternative. The theme focuses mainly on Gas emission and Energy. This observation suggests that both easy to measure and controllable KPI targets, like a reduction in emission output, are the most preferable and understandable KPI targets for issuers and investors in today's markets. Additionally, we observe the governance theme "working conditions" to be the least used KPI target theme with only 0.2% of the issuers aligning their target themes to focus on working conditions for their employees.

**Table 5:** KPI Target themes

| KPI Target Theme | Percentage | Number of issuers |
|---|---|---|
| Climate Change (GHG Emissions and Energy) | 86.20% | 363 |
| Air Quality | 5.20% | 22 |
| Raw Material Sourcing and Recycling (Circular Economy) | 3.60% | 15 |
| Rating | 1.90% | 8 |
| Access & Affordability | 1.70% | 7 |
| Diversity | 0.70% | 3 |
| Waste | 0.50% | 2 |
| Working Conditions (Employee Engagement, Labor Practices and Labor Rights) | 0.20% | 1 |
| Sum | 100% | 421 |

In table 6, we display the diversity of the penalty structures available for the issuers. While the International Capital Market Association (ICMA) has published principles for structuring SLBs, table 6 displays a freedom of choice which may not be optimal in the long run, prompting a need for stricter regulations. A statement supported by PWC in their press article from 2022 on Sovereign Sustainability-linked bonds, where they claim the freedom of choice to contribute negatively toward the environmental impact of SLBs (PWC, 2022)

**Table 6**: Penalty structures

| Penalty Structures | Percentage | Number of penalties |
|---|---|---|
| Coupon Step-up | 76.50% | 140 |
| Premium Redemption | 15.80% | 29 |
| Coupon step down | 2.70% | 5 |
| Coupon Step-up & Premium Redemption | 1.60% | 3 |
| Carbon Credit | 1.10% | 2 |

| | | |
|---|---|---|
| Coupon Step-up & Maturity Extension | 1.10% | 2 |
| Early Redemption | 1.10% | 2 |
| Sum | 100.00% | 183 |

Throughout our research we have observed the majority of SLBs to be callable. In table 7, we observe 63.8% of the SLBs to carry this characteristic, which is highlighted as one of the major structural loopholes by Hag & Doumbia (2022) in their research paper and one of the key value drivers for issuers identified by Kölbel and Lambillon (2022).

**Table 7:** Number of callable SLBs and non-callable

| Is Callable | Percentage | Number of callable |
|---|---|---|
| Yes | 63.8 % | 328 |
| No | 36.2 % | 186 |
| Sum | 100.0 % | 514 |

In table 8 we present the descriptive statistics of the variables used in this thesis. Examining the table, we observe the logarithmic coupon rate to exhibit a high level of kurtosis, suggesting a distribution which is more heavy-tailed than the mean and potentially demonstrating more extreme values in the tails of the distribution.

**Table 8:** Descriptive Statistics

| | N | SD | Variance | Min | Max | p1 | p25 | p75 | p99 | Kurtosis |
|---|---|---|---|---|---|---|---|---|---|---|
| KPITargetMet | 48 | .505 | 0.255 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| UNGC Commitment | 48 | .504 | 0.254 | 0 | 1 | 0 | 0 | 1 | 1 | 1.028 |
| Bond Callable | 48 | .504 | 0.254 | 0 | 1 | 0 | 0 | 1 | 1 | 1.028 |
| Second party | 48 | .41 | 0.168 | 0 | 1 | 0 | 1 | 1 | 1 | 3.063 |
| DummyisPublic | 48 | .501 | 0.251 | 0 | 1 | 0 | 0 | 1 | 1 | 1.063 |
| rating numeric | 48 | 1.732 | 3.000 | 1 | 7 | 1 | 1 | 5 | 7 | 1.838 |
| Payout G high | 48 | .438 | 0.191 | 0 | 1 | 0 | 0 | .5 | 1 | 2.333 |
| Penalty timingtT | 48 | .266 | 0.071 | .25 | 1.501 | .25 | .529 | 1 | 1.501 | 2.558 |
| ln coupon PMT | 48 | .757 | 0.574 | -6.32 | -2.733 | -6.32 | -3.851 | -3.418 | -2.733 | 5.354 |
| Payout G high | 48 | .438 | 0.191 | 0 | 1 | 0 | 0 | .5 | 1 | 2.333 |
| Public Good R | 48 | .476 | 0.227 | 0 | 1 | 0 | 0 | 1 | 1 | 1.5 |

In table 9 we present the summary statistics of the portfolios used for calculating the mispricing level denoted (ML). We display respectively the portfolios of B(F,C+G,T), B(F,G,t), $B_{0,}$ which display the SLB price at issuance, the upper bound portfolio (UB) and the lower bound portfolio (LB). The UB and LB are reported in million USD, to fit the table better.

Additionally, we include summary statistics of ML, ML>1 and ML<1. We observe the ML variable and ML > 1 variable to exhibit similar values. The reason for the similarity is due to only two of the SLBs from our sample inhabiting a ML < 1.

**Table 9:** Variables used for ML

| Variables | Obs | Mean | Std. Dev. | Min | p1 | p99 | Max |
|---|---|---|---|---|---|---|---|
| B(F,C+G,T) | 48 | 893.2 | 1143.5 | 16.6 | 16.6 | 4916.3 | 4916.3 |
| B(F,G,t) | 48 | 72.0 | 82.4 | 3.4 | 3.4 | 420.3 | 420.3 |
| B(F,0,t) | 48 | 67.1 | 79.8 | 2.7 | 2.7 | 406.7 | 406.7 |
| $B_0$ | 48 | 1311.3 | 1378.8 | 200.0 | 200.0 | 5000.0 | 5000.0 |
| UB | 48 | 888.3 | 1142.4 | 16.0 | 16.0 | 4906.8 | 4906.8 |
| LB(B,F,C,T) | 48 | 821.2 | 1078.2 | 8.5 | 8.5 | 4630.0 | 4630.0 |
| ML | 48 | 33.8 | 89.4 | 0.018 | 0.018 | 462.8 | 462.8 |
| ML>1 | 46 | 33.8 | 89.4 | 0.000 | 0.000 | 462.8 | 462.8 |
| ML<1 | 2 | 0.018 | 0.12 | 0.000 | 0.000 | 0.8 | 0.8 |

# 6. Methodology

In this section, we will go through the methodology used in this thesis. To begin, we will introduce the concept of the mispricing level, which was introduced by Berrada et al. (2022), and explore the underlying logic behind it. Secondly, we go more in-depth in the construction of the variable, specifically discussing the yield curves applied and how we interpolated for unavailable yield curves. Furthermore, we discuss the construction of the probit model, including an overview of the variables used in the probit model. Lastly, we review the assumptions we apply in our in-depth analysis on investor behavior.

## 6.1 ML

We apply the mispricing level (ML) to determine whether a SLB is over, under or fairly priced. When ML $\in$ [0,1], the SLB is fairly priced. When ML > 1 it indicates the extent of overpricing and when ML < 0 indicates the extent of underpricing of the instrument (Berrada et al., 2022). The mispricing level consists of four portfolios, where (i) the initial coupon- and penalty payment for each SLB are paid from issuance to maturity, including the face value, and discounted to its present value. (ii) The second portfolio consists of the coupon- and penalty payments up to the step-up date, i.e., up to the point in time where the issuer either has to start paying out penalties or not. (iii) The last portfolio consists of the ordinary vanilla coupon payments up to the step-up date for each bond. Together, these three portfolios form the basis for the upper bound portfolio, which is the upper limit of potential pay-outs for the SLBs. The

last portfolio is the value of the SLBs if it achieves its KPI target, denoted as the lower bound portfolio. In other terms, we can state that the mispricing level reflects the degree of deviation of the market price from the upper- and lower bounds. We use ML to capture the level of mispricing in our sample SLBs. The measure is used to compare against the predicted probabilities obtained from our probit model.

### 6.1.1 Construction of ML

The construction of the ML can be explained with an SLB at price $B_0$, which is the price at issuance, maturity (T), Face value (F), initial coupon payment (C) and the penalty (G) starting at $\tau < T$. By denoting the SLB B(x,y,z), we have the price of a vanilla coupon bond at face value x, coupon payment y and maturity z.

With this framework as our foundation, it is possible to calculate the variable upper bound (UB) and Lower bound (LB). The upper bound variable is replicable by using two different bond portfolios, and the lower bound is a straight vanilla coupon bond, with no penalty (G). (Berrada et al., 2022). We then get the following equation:

$$\begin{aligned} UB &= B(F, C+G, T) - B(F, C+G, \tau) + \mathrm{B}(\mathrm{F}, \mathrm{C}, \tau) \\ &= B(F, C+G, T) - B(F, G, \tau) + \mathrm{B}(\mathrm{F}, 0, \tau) \\ LB &= B(F, C, T) \end{aligned}$$

After the calculations of the upper bound and the lower bound it is possible to define the mispricing level variable ML through the following expression:

$$\mathrm{ML} = \frac{\mathrm{B}_0 - \mathrm{LB}}{\mathrm{UB} - \mathrm{LB}}$$

### 6.1.2 Credit curves

We assume a fixed credit spread derived by calculating the difference between yield curves of a given country, rating, and sector at each SLB maturity and the risk-free rate. In cases where yield curves are not available for a certain rating, we use the closest available rating as a proxy. The fixed credit spread is added to the risk-free rate for each payment date for the bonds in our sample. While our sample includes bonds with payment frequencies of up to four payments per year, for simplicity, we only consider the last payment date for each bond. In the

case of bonds with payment frequencies of two, three and four, we add all the payments together and discount them from the last payment date annually.

Additionally, we use linear interpolation to construct our yield curves from the available yields for the payment dates of the respective SLBs. The interpolation equation is given by:

$$= Lower\ bound\ rate + \frac{(Upper\ bound\ rate - Lower\ bound\ rate)}{(Upper\ bound\ maturity - Lower\ bound\ rate)} * (Time\ to\ maturity\ in\ years - Lower\ bound\ maturity)$$

## 6.2 Probit model

The probit model is utilized in this thesis due to its properties of approximating an unknown population regression function, where it captures the nonlinear nature of the true population regression function (Stock, J.H & Watson, W. M, 2019, p. 403). The concept of a probit model with multiple regressors can be expressed with the following notation:

$$\Pr(Y_i = 1|X_1X_2 \ldots . X_k) = \Phi\ (b_0 + b_1X_1 + b_2X_2 + \cdots + b_kX_k$$

Where the dependent variable $Y_i$ has a binary function $\in \{0,1\}$. $\Phi$ is the cumulative standard normal distribution function, and X1, X2, …, Xk are the regressors. The probit model can best be interpreted by evaluating the predicted probabilities and the effect of change from the regressors (Stock, J.H & Watson, W. M, 2019 p. 400).

The probit model is constructed to predict the probability of a SLB achieving its predefined KPI target at the time of issuance, only using information available at that point in time, except of whether the KPI target is met or not. The variable for whether the KPI target is met or not serves as our dependent variable.

The probit model serves two main objectives in this thesis. Firstly, it aims to identify the significant explanatory variables and examine their impact on the calculated probabilities for our sample of SLBs. Secondly, the predicted probabilities obtained from the model are used in further analysis, specifically in comparing them to the level of mispricing observed for each SLB.

For the construction of the model, we assume the existence of an underlaying latent relationship between KPI target met and the explanatory variables.

Hence, one can express the probability of observing a SLB achieve its KPI with the following notation (Stock, J.H & Watson, W. M, 2019):

$$Pr\{Y_{1i} = 1\} = Pr\{Y_{1i} > 0\} = \Pr\{X_{1i}\beta_1 + Y_{2i}\beta_2 + \epsilon_i > 0\} = \Pr\{-\epsilon_i < X_{1i}\beta_1 + Y_{2i}\beta_2\}$$

$$\Phi\,(X_{1i}\beta_1 + Y_{2i}\beta_2)$$

The full probit model including all regressor for our study is given by

$$\begin{aligned} Y_{(KPImet)} = \beta_0 &+ \beta_1 \mathrm{UNGC}_{\mathrm{committment}} + \beta_2 \mathrm{Bond}_{\mathrm{callable}} + \beta_3 \mathrm{second}_{\mathrm{party}} + \beta_4 \mathrm{dummy}_{\mathrm{is}_{\mathrm{public}}} \\ &+ \beta_5 \mathrm{rating}_{\mathrm{numeric}} + \beta_6\, \mathrm{payout}_{\mathrm{g_{high}}} + \beta_7 \mathrm{Penalty}_{\mathrm{timmingT}} + \beta_8 \ln_{\mathrm{coupon}_{\mathrm{pmt}}} \\ &+ \beta_9 \mathrm{Penalty}_{\mathrm{g_{high}}} + \beta_{10} \mathrm{Public}_{\mathrm{Good_R}} + \epsilon_{\mathrm{i}} \end{aligned}$$

The coefficients are estimated through maximum likelihood estimation, while we adjust the standard errors for potential heteroscedasticity by using robust standard errors.

The pseudo-R-squared are examined to evaluate the proportion of the variation in the dependent variable explained by the independent variables. To validate the model, we perform a goodness-of-fit test, examining how the observed data aligns with the predicted values.

Lastly, we perform a robustness test of the model, utilizing two randomized subsamples derived from the original sample.

## 6.3 Variables

For validation of the variables implemented in the probit model, we examine whether one or more of them exhibit extreme values in the tails of the distribution. We display the observations for each variable in a boxplot, in figure 3. The variable with the biggest outliers is the logarithmic variable for the coupon rates. While we observe outliers in the variable, they provide a portion of the explanation of the probability of achieving the KPIs through pre-penalty coupon rates and, hence, are not excluded. Furthermore, we examine the variables through a correlation matrix, displayed in table 10, before the implementation in the probit model.

**Table 10:** Matrix of correlations

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) KPITargetMet | 1.000 | | | | | | | | | | |
| (2) UNGC_Commitment | -0.084 | 1.000 | | | | | | | | | |
| (3) Bond_Callable | -0.167 | 0.343 | 1.000 | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (4) Second_party | -0.000 | 0.455 | 0.266 | 1.000 | | | | | | | |
| (5) DummyisPublic | -0.042 | 0.306 | 0.116 | 0.349 | 1.000 | | | | | | |
| (6) rating_numeric | 0.243 | 0.500 | 0.622 | 0.195 | 0.214 | 1.000 | | | | | |
| (7) payout_g_high | 0.192 | 0.145 | 0.435 | 0.059 | -0.121 | 0.337 | 1.000 | | | | |
| (8) Penalty_timingtT | -0.126 | -0.462 | -0.353 | -0.189 | -0.138 | -0.431 | -0.240 | 1.000 | | | |
| (9) ln_coupon_PMT | -0.063 | -0.127 | -0.014 | -0.217 | -0.298 | 0.017 | 0.047 | -0.113 | 1.000 | | |
| (10) Penalty_G_high | 0.250 | -0.000 | 0.167 | -0.103 | -0.126 | 0.194 | 0.289 | -0.010 | -0.222 | 1.000 | |
| (11) Public_Good_R | 0.088 | 0.384 | 0.148 | 0.363 | 0.802 | 0.232 | -0.000 | -0.136 | -0.222 | 0.088 | 1.000 |

### 6.3.1 Definitions of explanatory Variables

**The UNGC_commitment** variable is a binary variable with ∈ {0,1}. Where 1 indicates that the company is committed to the U.N. Global compact and 0 indicates that they are not. The inclusion of the UNGC variable is due to the lack of requirements for private companies in our sample to disclose ESG information. The portion of private listed companies in our sample is 43.75%. Based on Ortas et al., (2015) research linking commitment to the initiative to improvement in ESG performance for a company, we include the variable to capture the ESG performance of the issuers in our sample.

**The Bond_Callable** variable is a binary variable with ∈ {0,1}, depending on the specific SLB and its structural properties. If the structural properties are set to give the issuer a callable option the variable display 1, if not it displays 0. The inclusion of the callable option as a variable is to capture the effects on how issuers can abuse the SLBs, rather calling the bond at an early maturity date instead of not reaching its KPI target. This results in cheaper capital for the issuer at the cost of investors.

**Second_party** is a binary variable with ∈ {0,1}. Where second_party = 1, indicates that the issuer uses a secondary party provider to assess the issuers alignment to their sustainable goals, while 0 indicates that the issuer has not used a secondary party provider to confirm whether the issuer incentives is misaligned or not.

**Dummy_is_public** is a binary variable with ∈ {0,1}. Where 1 indicates that the company is a public company, and 0 indicates that the company is private. The variable is included due to the private companies not disclosing their ESG numbers, while public companies disclose this type of information to the public.

Rating_numeric is an ordinal categorical variable due to the ratings of each SLB being in natural order based on their creditworthiness. With a higher number the variable indicates lower creditworthiness. The variable range is from 1-6, where 1 = "AAA" credit rating and 6= “B”.

The Payout_G_High is a binary variable with ∈ {0,1}. The variable is based on a ratio with the difference between the upper and the lower bound for the bond price in the numerator and the lower bound in the denominator. If Payout_G_high = 1, it indicates that the SLB has a ratio greater or equal to the average ratio in the sample. The average is 0.319%. Berrada et al., (2022) concluded in their study that a higher penalty imposed on the issuer is associated with a higher probability of achieving their KPI targets. This finding forms the basis for the variable´s logic. We have set the threshold at the average, observing the average to be sufficiently high enough. However, it could be set higher, or lower, depending on what one would perceive as “high enough”.

Penalty_timing_T is a numeric variable derived from dividing the time from issuance up to the coupon step-up date by the time from issuance day to maturity day.

Penalty_G_High is a binary variable with ∈ {0,1}. The variable = 1, when the step-up penalty for the coupon payments is >= the average coupon step-up from our sample, which is 0.219%. The variable builds on the same logic as the Payout_G_high variable.

Public_Good_R is a binary variable with ∈ {0,1}. The variable equals 1 when the specific company is public and has a disclosed ESG Combined Score Grade over "B". Because of the non-disclosure requirements of ESG performance for the private companies, in our sample the binary variable value 0 indicates the company is private with no disclosed ESG information or a public company with an ESG score of “B” or lower. Furthermore, it is important to clarify that the public companies with an ESG score grade of B and below and the private companies are not grouped together in this variable due to the inclusion of the dummy variable for the public companies. As a result, the coefficient provides information about the performance difference between a public company with a good rating and the average public company.

Ln_Coupon pmt is a logarithmic variable of the initial coupon rate for the SLBs. It is classified as a continuous variable and is included to capture the effect of the initial coupon payments.

## 6.4 Investor behavior assumptions

We conduct parts of our analysis by considering two types of investors: The unsophisticated green and the sophisticated green investor. These investors allow us to examine the differential effects on the predicted probabilities of achieving a predefined KPI and the mispricing levels of the SLBs they are exposed to. We limit the unsophisticated green investor to only invest in SLBs where the issuer is committed to the U.N. Global compact initiative. A logical choice for a green investor, which is support by previous research performed by Ortas et al., (2015). On the other hand, the sophisticated green investor follows several assumptions. Firstly, the sophisticated investor invests only in SLBs where the predicted probability of achieving a predefined KPI target is 50% or higher. Secondly, the sophisticated green investor evaluates multiple factors before deciding on an investment strategy, thus, the investor decided to not invest in SLBs where the issuer is committed to the U.N. Global compact initiative. Furthermore, the sophisticated investor prefers to invest in unlisted companies. However, if a company is listed, the investor favors the issuers with an ESG score grade above "B". In cases where the ESG score is undisclosed, but the predicted probability is favorable the investor examines the credit quality rating of the issuer before making an investment decision. Lastly, the investor generally avoids investing in callable bonds, except, when the investor observes the issuer to align with the previous assumptions: no UNGC commitment, issuer being an unlisted company, or a listed company with a good ESG score, or a high credit rating if the ESG score is unavailable. Additionally, the predicted probability of achieving its KPI target must be above the threshold value of 50%.

# 7. The probit model

**Table 11:** The probability model and the effect of the inclusion of each independent variable in the model.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| UNGC_Commitment | -.211 | -.154 | -.138 | -1.067** | -1.251** | -1.312** | -1.405** | -1.332** | -1.727** |
| | (.368) | (.431) | (.439) | (.539) | (.529) | (.56) | (.598) | (.603) | (.733) |
| Bond_Callable | | -.422 | -.425 | -2.451*** | -2.896*** | -2.77*** | -2.636*** | -2.716*** | -3.462*** |
| | | (.399) | (.4) | (.733) | (.784) | (.689) | (.592) | (.598) | (.868) |
| Second_party | | .225 | .258 | .807 | .985 | .98 | .917 | 1.049 | 1.211 |
| | | (.518) | (.528) | (.598) | (.7) | (.698) | (.726) | (.816) | (.885) |
| DummyisPublic | | | -.094 | -.409 | -.254 | -.265 | -.331 | -.323 | -2.328** |
| | | | (.402) | (.446) | (.451) | (.444) | (.442) | (.448) | (.949) |
| rating_numeric | | | | .854*** | .861*** | .809*** | .777*** | .757*** | 1.064*** |
| | | | | (.279) | (.25) | (.245) | (.209) | (.202) | (.362) |
| Payout_G_high | | | | | 1.02* | .98* | .948 | .826 | .822 |
| | | | | | (.615) | (.595) | (.583) | (.577) | (.578) |
| Penalty_timingtT | | | | | | -.436 | -.711 | -.676 | -.291 |
| | | | | | | (1.153) | (1.227) | (1.215) | (1.438) |
| ln_coupon_PMT | | | | | | | -.315 | -.152 | -.243 |
| | | | | | | | (.3) | (.272) | (.305) |
| Penalty_G_high | | | | | | | | .574 | .12 |
| | | | | | | | | (.485) | (.527) |
| Public_Good_R | | | | | | | | | 2.348** |
| | | | | | | | | | (1.022) |
| _cons | .114 | .097 | .104 | -1.479** | -1.736** | -1.252 | -2.049 | -1.772 | -2.676 |
| | (.271) | (.414) | (.416) | (.69) | (.725) | (1.579) | (1.601) | (1.642) | (1.873) |
| Observations | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 |
| Pseudo $R^2$ | .005 | .024 | .025 | .277 | .33 | .333 | .345 | .364 | .427 |
| SE/ROBUST | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| P-Value | .5665 | .6743 | .8044 | .0138 | .0113 | .0058 | .0011 | .0009 | .0012 |

*Robust standard errors are in parentheses.*
**** p<.01, ** p<.05, * p<.1*

In table 11 we introduce the probability model constructed for our research. The model displays a pseudo-R-squared value of 0.427. Interpreting this value, we observe the explanatory variables generally explain 42,7% of the dependent variable, which suggests that the model has moderate to strong predictive power in terms of explaining the variation in the results.

In table 12 we display the results from the goodness of fit test for the model. Evaluating the test results, we observe the Pearson chi-square test statistic to be 39.33 and the p-value to be 0.2822. Interpreting these values, we do not find evidence of a lack of fit for the variable

"KPITargetMet". The result suggests that the observed data aligns well with the expected values based on the probit model, which supports the interpretation of the pseudo-R-squared. Additionally, we observe the P-value for the model to be 0.0012, hence, we conclude the model to be significant at the 1% level.

**Table 12:** Goodness-of-fit test for probit model

| Variable | KPITargetMet |
|---|---|
| Number of observations | 48 |
| Number of covariate patterns | 46 |
| Pearson chi2(35) | 39.33 |
| Prob > chi2 | 0.2822 |

## 7.1 Results from the Probit model

In table 13, 14 & 15, we observe the results from the probit model compared against the reality of the outcomes for each SLB in our sample. We utilize respectively a 50%, 70% and 90% threshold in evaluating the probit models accuracy.

| **Table 13:** 50% threshold | Reached target | Did not reach target |
|---|---|---|
| Correctly predicted | 92% | 71% |
| Incorrectly predicted | 8% | 29% |

In table 13 we observe the performance of the probit model with a 50% threshold. We observe the model to correctly predict the outcome for 92% of the SLBs in our sample reaching their KPI targets, which equals to 22 of 24 SLBs from our sample. Additionally, we observe the model to predict 71% correctly for the SLBs which did not achieve their KPI targets.

| **Table 14:** 70% threshold | Reached target | Did not reach target |
|---|---|---|
| Correctly predicted | 58% | 92% |
| Incorrectly predicted | 42% | 8% |

In Table 14, we observe the performance of the probit model with a 70% threshold. We observe the portion of the correctly predicted outcomes of the SLBs achieving their KPI target go down 34%. In table 13, we observe 22 of 24 correctly predicted outcomes, while in table 14 we observe 14 of 24 compared correctly. Furthermore, we observe the correctively predicted outcomes of not achieving the KPI target to increase to 92%.

| Table 15: 90% threshold | Reached target | Did not reach target |
|---|---|---|
| Correctly predicted | 29% | 100% |
| Incorrectly predicted | 71% | 0% |

Lastly, in table 7.1.3, we observe the performance of the probit model with a 90% threshold. While it makes sense that the correctly predicted percentage for the SLBs which reached their target decrease when we introduce a higher threshold, it is still interesting to see the model to predict 29% correctly with a 90% threshold, which equals to 7 of the 24 SLBs in the sample that were able to reach their KPI target.

# 8. Robustness

To test the robustness of the model we divided our sample into two subsamples of N=24 and randomized and mixed the order of observations within each subsample. Furthermore, we mixed the order between the subsamples to ensure their validity. The subsamples are used to evaluate the stability of the model's coefficient estimates, predictive performance and to ensure the model is not overfitting specific characteristics from the original sample. We display the results of the robustness test in table 16.

**Table 16:** Robustness test with two subsamples

| | (1)<br>Subsample (1) | (2)<br>Subsample (2) | (3)<br>Original model |
|---|---|---|---|
| UNGC_Commitment | -3.96*** | -5.22* | -1.727** |
| | (.56) | (3.042) | (.733) |
| Bond_Callable | -2.65*** | -15.320 | -3.462*** |
| | (1.40) | (11.673) | (.868) |
| Second_party | (omitted) | 1.34 | 1.211 |
| | | (1.66) | (.885) |
| DummyisPublic | -1.60* | -2.161 | -2.328** |
| | (-.932) | (1.54) | (.949) |
| rating_numeric | -.152 | 5.462 | 1.064*** |
| | (.562) | (3.601) | (.362) |
| Payout_G_high | 2.98*** | -.3133 | .822 |
| | (.978) | (2.150) | (.578) |
| Penalty_timingtT | -6.25 | -12.23 | -.291 |
| | (2.171) | (12.633) | (1.438) |
| ln_coupon_rate | -1.171 | 3.101 | -.243 |
| | (.480) | (2.49) | (.305) |
| Penalty_G_high | 1.404 | 4.23 | .12 |
| | (.706) | (3.833) | (.527) |

| | | | |
|---|---|---|---|
| Public_Good_R | 2.323 | 5.69 | 2.348** |
| | (1.210) | (5.251) | (1.022) |
| _cons | 2.39 | -7.37 | -2.676 |
| | (2.134) | (7.453) | (1.873) |
| Observations | 22 | 24 | 48 |
| Pseudo $R^2$ | .5767 | .5941 | .427 |
| SE/ROBUST | Yes | Yes | Yes |
| P-value | .0035 | .0377 | .0012 |

*Robust standard errors are in parentheses.*

**** p<.01, ** p<.05, * p<.1*

Subsample one indicates that the model is robust and reliable. With an average change in the coefficient estimates of 1.524. The test further indicates that the model is not overly sensitive to specific characteristics from our initial sample and yields a higher pseudo-R-squared, indicating a better explanatory effect from the model. While subsample two see a slightly higher increase in average coefficient difference of 1.6 and a higher pseudo-R-squared compared to our original sample. Further supporting the robustness of the original model.

Additionally, we observe the p-value of subsample one to be statistically significant at 1% levels, while for subsample two, we find evidence for its statistical significance at 5% levels. While the results from the subsample analysis provide medium to strong evidence in favor of the stability of the predictive power of the model, it should be noted that subsample two yields high increases in more than one coefficient. Indicating the model to display non-robust coefficient estimates and highlighting the issue with our small sample size.

# 9. Results

In this section we will present the results from our analysis, where we examine three empirical questions, (i) whether we observe a positive linear relationship between the predicted probabilities of reaching a KPI target and the mispricing level of the respective SLBs. (ii) Which of the independent variables significantly contribute to explain the variation in the predicted probabilities and (iii) how these significant variables affect the predicted probabilities and mispricing level when they are used in an investment strategy.

## 9.1 Does a positive linear relationship exist between the predicted probabilities and the mispricing level of an SLB?

**Table 17:** Summary of probabilities and ML when KPI target = {0,1}, and results for the full sample size.

| | *KPI Met = 1* | | *KPI Met = 0* | | *Full sample* | |
|---|---|---|---|---|---|---|
| | Probability | ML | Probability | ML | Probability | ML |
| Average | 74% | 57.06 | 25% | 10.51 | 50% | 33.78 |
| Median | 76% | 11.45 | 13% | 2.95 | 57% | 5.15 |

In table 17, we observe a positive relationship between the mispricing level and the predicted probabilities. We observe the average mispricing level increases when the average probability increases. Furthermore, we observe when the average probability decreases, the average mispricing level decreases. This finding is supported by table 18, where we observe the correlation coefficient between the predicted probabilities and the mispricing levels to be 0.376. Additionally, we observe the p-value of this relationship to be significant at 1% levels.

**Table 18:** Pairwise correlations

| Variables | (1) | (2) |
|---|---|---|
| (1) phat | 1.000 | |
| (2) ML | 0.376 | 1.000 |
| | (0.008) | |

*P-value is in parentheses.*

However, while we observe a positive relationship between the predicted probabilities of achieving a KPI target and the mispricing level, we observe in figure 4 the relationship to be nonlinear. Indicating a positive nonlinear relationship between the outcome of reaching an KPI target and the extent of mispricing. Furthermore, we observe the median probability for reaching a KPI target to be consistent with the average value of reaching a KPI target. While examining the difference between the probability and median value of not achieving the KPI targets – we observe the median value to plunge to 13% compared to the average value of 25%. We interpret this observation to be caused by outliers in our data. The two biggest outlier contributions to the difference between the average and median observations is depicted in table 19.

Table 19: The two biggest outliers from the sample.

| ISIN | KPI Met | Phat | ML | UNGC | Is callable | Public_Good_R |
|---|---|---|---|---|---|---|
| US11042CAA80 | No | 88% | 60.52 | No | No | No |
| USG95248U432 | No | 89% | 46.51 | No | Yes | Yes |

The outliers indicate an underlying effect the independent variables used in our research do not capture. However, despite the observed complexity in the relationship between the predicted probabilities and mispricing levels, the overall findings confirm our initial understanding of the mispricing level and how green investor cluster their investments around SLBs with a perceived higher probability of achieving their KPI targets, which contributes to increase the price at issuance.

## 9.2 Which factors contribute to the increase of probability of achieving a KPI target?

Through our research we have found evidence of five factors that significantly increase the probability of achieving a KPI target. First, we observe that companies committed to the U.N. Global compact initiative are less likely to achieve their KPI targets, where the coefficient in the probit model exhibits a significant negative factor of -1.727 at 5% levels. This finding does not align with previous literature, such as Ortas et al. (2015), who found evidence on how participants of the initiative experience an increase in ESG performance. By examining figure 2, we confirm this finding, where we observe a greater proportion from our sample to achieve their KPI targets if they are not committed to the initiative. Secondly, we observe the coefficient indicating whether a SLB is callable or not to significantly contribute negative toward the achievement of KPI targets, at 1% levels, further confirming the research conducted by Haq & Doumbia on SLBs structural loopholes.

Thirdly, we observe an interesting relationship between the dummy variable for public companies and the dummy variable for public companies with an ESG score grade above “B”. We observe the coefficients to exhibit respectively a significantly negative coefficient of -2.32 and a positive coefficient of 2.347 at 5% level. Interpreting these coefficients, we observe the relationship to indicate how much better a public company with a good rating is performing compared to an average public company.

Lastly, we observe the effect of the credit rating of each bond through the numeric rating variable, which contributes significantly positively toward the achievement of reaching a KPI target, at 1% levels. This indicates that for each level increase in bond rating, there is a subsequent standard deviation increase for the probability of the outcome variable occurring.

### 9.2.1 How do these significant explanatory variables affect the probabilities- and mispricing levels of an SLB?

Additionally, we analyze the impact of these significant variables on investors´ investment behavior by examining the level of probability of achieving KPI targets for the SLBs and the level of mispricing the investors are exposed to. We specifically focus on four significant variables: the issuers commitment to the U.N. Global compact initiative, The SLBs callable status, and whether the issuer is a public listed company or a public listed company with an ESG score grade above "B". The results of this analysis are presented in tables 20, 21 and 22.

**Table 20:** Differences in the outcome for UNGC_commitment and callable SLBs.

| | **UNGC_Commitment** | | |
|---|---|---|---|
| | No | Yes | Differences |
| Average Probability | 46% | 54% | 8% |
| Median Probability | 56% | 61% | 5% |
| Average ML | 28.56 | 40.02 | 11.47 |
| Median ML | 6.82 | 1.54 | -5.28 |
| KPI success rate | 46% | 55% | 8% |
| | **Callable** | | |
| | No | Yes | Differences |
| Average Probability | 51% | 58% | 6% |
| Median Probability | 57% | 62% | 5% |
| Average ML | 31.88 | 48.56 | 16.68 |
| Median ML | 8.60 | 2.69 | -5.91 |
| KPI success rate | 55% | 58% | 3% |

Note 1: The difference factor is derived from sophisticated investor – unsophisticated investor
Note 2: The KPI success is derived from the number of achieved KPI targets divided on the total number of SLBs in the portfolio.

While we initially included the UNGC variable to capture the effects of each issuer´s ESG performance, table 11 reveals a negative coefficient value for the UNGC_commitment, indicating its contribution towards SLBS not achieving their KPI targets. Furthermore, figure 2, visualizes this relationship in a scatterplot, showing that a greater proportion of SLBs in our sample failed to achieve their KPI targets when the issuer was committed to the UNGC

initiative. In table 20, the relationship becomes more evident, with SLBs where the issuer is not committed to the UNGC initiative having, on average, 8% higher probabilities of achieving their KPI targets. Analyzing the median outcomes for the probabilities, we observe a decrease in the difference between "No" and "Yes" categories, while the overall probability increases for both.

The mispricing level follows a similar pattern, where SLBs in the "Yes" column exhibits higher average mispricing levels. Examining the median outcomes, SLBs in the "Yes" column display a lower mispricing ratio. Lastly, we consider the KPI success rate, which is derived from the proportion of SLBs that achieved their KPI target divided by the total number of SLBs with UNGC_commitment equal to "No" or "Yes". We observe that SLBs where the issuer is not committed to the UNGC initiative obtain a KPI success rate of 56%, while SLBs where the issuer is committed achieve a success rate of 48%.

Based on the results for the SLBs callable status, we observe a similar pattern in the average probabilities as observed for the UNGC_commitment criterion. SLBs without a call provision display an average probability that is 6% higher compared to those with a call provision. When examining the median outcomes, we observe the median probabilities to increase for both categories, "No" and "Yes". However, SLBs without a call provision still obtain a higher probability of achieving their KPI targets.

The mispricing levels for the SLBs with and without a call provision display the same similarity as the probabilities. On average, SLBs invested in by investors in the "Yes" category tend to experience higher levels of mispricing on their investments. However, examining the median outcomes, we observe that investors in the "Yes" category experience lower levels of mispricing. Additionally, it is interesting that there is minimal difference in the KPI success rates. Specifically, 58% of the SLBs in the "Yes" category achieved their KPI targets, compared to 55% in the "No" category.

Table 21: Differences between the Dummy_Public and Public_Good_R variables

| **Dummy_Public VS Public_Good_R** | | | |
|---|---|---|---|
| | No | Yes | Differences |
| Average Probability | 46.7% | 55% | 8% |
| Median Probability | 57% | 64% | 7% |

| | | | |
|---|---|---|---|
| Average ML | 53.40 | 40.36 | -13.04 |
| Median ML | 5.57 | 10.40 | 4.83 |
| KPI success rate | 48% | 56% | 9% |

Note 1: The difference factor is derived from sophisticated investor – unsophisticated investor
Note 2: The KPI success is derived from the number of achieved KPI targets divided on the total number of SLBs in the portfolio.

In table 21, we examine the differences in results on the probability of achieving a KPI target and the level of mispricing between public companies, and public companies with an ESG score grade above "B".

We observe three interesting effects for the SLBs in the "No" and "Yes" categories. Firstly, investors who invest in SLBs in the "Yes" category allocates significantly [1] less capital towards their investments on average, at a 5% level, by investing in public listed companies with a strong ESG score. Secondly, when examining the median outcomes of the analysis, we find that these same investors tend to overpay. This indicates the presence of a sustainability premium, where higher-ranked companies can demand larger sustainability premiums at issuance. Thirdly, we observe that the KPI success rate for "Yes" category is 56%, compared to the average listed companies, which achieved a 48% success rate.

In summary, we have observed how the significant variables from the probit model, excluding the credit rating, perform individually. Lastly, we want to analyze how a green unsophisticated investor perform against a green sophisticated investor. The assumptions for the investors are presented in methodology section 6.4. In table 22, we present the results.

**Table 22:** Unsophisticated investor vs sophisticated investor

| | **Unsophisticated investor** | | **Sophisticated investor** | | **Differences** | |
|---|---|---|---|---|---|---|
| | Phat | ML | Phat | ML | Phat | ML |
| Average | 46% | 28.56 | 74% | 63.75 | 28% | 35.19 |
| Median | 56% | 6.82 | 71% | 6.63 | 16% | (0.19) |
| Min | 0% | 1.34 | 55% | 0.84 | 55% | (0.49) |
| Max | 100% | 406.98 | 100% | 462.81 | 0% | 55.83 |
| KPI success rate | 46% | | 92% | | 46% | |

Note 1: The difference factor is derived from sophisticated investor – unsophisticated investor
Note 2: The KPI success is derived from the number of achieved KPI targets divided on the total number of SLBs in the portfolio.

In table 22, we observe the unsophisticated investor, who only invest in SLBs where the issuer is committed to the UNGC initiative, obtains an average probability of 46% and a mispricing 28.56. However, when considering the median outcomes, the unsophisticated investor

[1] The t-test for the mispricing level is presented in figure 5, located in the appendix.

experiences slightly better results with a 10% increase in the probability and a lower ML-ratio. On the other hand, the sophisticated investor demonstrates the ability to assess multiple factors and combine them into a smart investment strategy, as reflected in the results.

Both the average and median probabilities for the sophisticated investor are similar, with SLBs showing probabilities of achieving their KPI targets at 74% and typically 71%, respectively. These outcomes are 28% and 16% higher than those observed for the unsophisticated investor. Regarding the mispricing levels, the sophisticated investor is generally exposed to high levels for mispricing on average. However, the sophisticated investor typically obtains a slightly lower ML-ratio. Furthermore, it is worth noting that both investors have invested in two different Japanese SLBs, which contribute to explain a proportion of the high mispricing levels observed. When examining the maximum values for their portfolios[2], we observe that the ML-ratio for the Japanese SLB in which the unsophisticated investor invested in is 406.98, whereas for the sophisticated investor, it is 462.81.

Additionally, the most notable finding from this analysis is the KPI success rate. We observe that the sophisticated investor achieves a 92% KPI success rate on their SLBs, which is twice as high as that of the unsophisticated investor.

## 10. Discussion

Throughout our research we have observed a positive nonlinear relationship between the probabilities of achieving a predefined KPI and the extent of mispricing for the respective instruments. This observation implies that the market evaluates sustainability risk and opportunities in its pricing of a SLB, where SLBs with high probabilities of achieving their KPI target are priced higher compared to SLBs with lower probabilities. We observe this relationship in table 17. However, the nonlinear relationship between the probabilities and the mispricing level suggest that the relationship depend on other factors. We suggest these factors can be the KPI target theme, how ambitious the KPIs are, the market conditions, penalty size, the issuer´s reputation and previous record on ESG performance. These findings align with Berrada, et al. (2022), who documents evidence of a nonlinear relationship between ML and the issuer´s ESG rating. While the relationship is nonlinear, it is still interesting to see how investors are eager to pay high sustainability premiums for SLBs the market observe to be more

[2] We include the two portfolios in table 23 and 24, located in the appendix

likely in achieving its KPI targets. This observation aligns with the research from Berrada et al. (2022), who document a wealth transfer between the bond holders and the equity holders of the issuer, through the issuance of SLBs. Additionally, we also observe a high mispricing level for the SLBs with a low probability of achieving their KPI targets, further supporting previous literature. The average mispricing level for the SLBs in our sample which did not achieve their KPI target is 10.506 and their median level is 2.952. This observation suggests that issuers who signal their environmental dedication to investors may experience favorable higher levels of mispricing on their instruments, despite not achieving the signaled environmental impact, thus blindsiding the investors.

Furthermore, the purpose of our research is to identify factors which contribute positive toward the achievement of SLBs KPI targets. We identified five statistically significant variables, where we will focus on four of them for the remainder of this discussion. For the first variable, UNGC_commitment, we observed an inverse functionality of its coefficient value in our probit model, contradicting existing literature on ESG performance for companies committed to the initiative. An interesting observation which raises the question; whether participation in this initiative could potentially mislead investors and contribute to greenwashing. This occurs when issuers signal their commitment to environmental improvement by aligning with the initiative, while they underperform on their SPT targets. We have visualized this observation in figure 2.

Additionally, we examine the callable status of the SLBs and its impact on the achievement of the predefined KPI targets. In table 11, we observe a negative coefficient for the dummy variable indicating whether a SLB is callable or not, suggesting that non-callable SLBs tend to perform better compared to callable SLBs. We have visualized this observation in figure 6, where we observe the probit model to predict higher probabilities for the SLBs without a call provision. Lastly, in table 20, we observe the investors typically allocate statistically significant lower levels of capital toward SLBs which are not callable and simultaneously achieve a greater environmental impact, where the KPI success rate for non-callable SLBs is 58%. These observations further support the research from Haq & Doumbia (2022) on how loopholes in SLBs structure are used to hedge against the penalties of not reaching KPI targets. However, we have only examined whether the SLBs are callable or not, explaining why the KPI success rate for callable SLBs is 55% in our sample. If we had limited the callable SLBs to only be those

with a call provision close to the step-up date for the penalties, we assume the KPI success rate would be lower.

For the last part of our analysis on the effects from single factors, we observe the impact on the probabilities of achieving a KPI target and the mispricing levels for an average public listed issuer compared to a public listed issuer with an ESG score grade over "B". We observe the issuer with a better ESG score than the average public company to offer investors higher predicted probabilities on both average and median observations. This observation is logical, because we assume an issuer with a good ESG score is more incentivized to maintain their good ESG score. We observe this effect in the results for the SLBs, where the KPI success rate is 56% for the "Yes" category compared to 48% for the "No" category.
We observe the investors who invest in the "Yes" category on average allocate lower levels of capital for these SLBs compared the investor who invest in the "No" category. On the other hand, when examining the median outcomes, we observe the "Yes" category experience higher mispricing levels. Indicating that investors typically allocate higher levels of capital for these types of SLBs compared to what they do for an average public listed company. Nevertheless, both categories experience a degree of mispricing. This observation indicates the presence of a sustainability-premium which increases simultaneously with the ESG score of the issuers.

In the fourth, and final part of our analysis, we shift our focus from examining single factors to considering how an unsophisticated investor performs compared to a sophisticated investor when investing in SLBs. Specifically, we investigate the impact on the probabilities of achieving a KPI target and the mispricing levels when considering multiple factors simultaneously. This broader analysis allows us to gain a more in-depth understanding of the relationships between these factors and the observed outcomes.

Examining the results of our comparative analysis between the unsophisticated green investor and the sophisticated green investor. The difference in probabilities between the average and median outcomes is 3% for the sophisticated investor. This observation indicates that the investment strategy of the sophisticated investor is robust in terms of average and median outcomes. These probabilities are, on average, 28% higher and typically 16% higher than the

average and median probabilities observed in the portfolio of the unsophisticated investor. Observing the mispricing levels, the unsophisticated and sophisticated green investor experience on average different levels of mispricing. While both experiences a high degree of mispricing, we observe the sophisticated investor to experiences the highest ML-ratio. However, analyzing the median outcomes we observe the sophisticated investor tends to experience slightly lower ML-ratios in their portfolio. Lastly, when assessing the KPI success rate, we find that the sophisticated investor achieves a success rate on their SLBs that is twice as high as that of the unsophisticated investor. Although both investors experience a high degree of mispricing on average, these findings suggest that the unsophisticated investor may be misled by issuers´ environmental signaling, resulting in the payment of a high sustainability premium for portfolio achieving only a 46% KPI success rate.

# 11. Conclusion

This paper provides valuable insight into the sustainability-linked market and the driving forces for value creation, benefiting both companies and investors. The diverse sample used in this study ensures a good representation of the overall SLB market. Our findings reveal a nonlinear relationship between the probabilities of achieving a KPI target and the mispricing level, failing to reject the null hypothesis for hypothesis 1. Furthermore, our analysis on the single effect of significant explanatory variables reveals that SLBS issued by issuers who are not committed to the UNGC initiative, do not contain a call provision, and have obtained an ESG score above “B” to achieve the highest level of KPI success rate, indicating a greater environmental impact. Additionally, when comparing the performance of a sophisticated investor against an unsophisticated investor, we find that the sophisticated investor achieves the highest KPI success rate, suggesting an optimal investment strategy for SLB investor is to disregard issuers who are committed to the UNGC initiative in order to make a greater environmental impact.

In conclusion, we reject the null hypothesis for hypothesis 2 that issuers committed to the U.N. Global compact initiative have the same likelihood of achieving the KPI targets observed in their SLBs. This finding suggests that issuers who signal their commitment through this initiative mislead investors regarding the actual environmental impact of their investments. As a result, investors end up paying sustainability premiums that does not align with the expected environmental impact the investors anticipate.

# 12. Contributions, Limitations, and further research

Our research contributes on various levels to the growing literature on sustainability-linked bonds. We demonstrate how evaluating critical structural properties of a SLB, such as the callable status, the length of the penalty period of the instrument and the size of the penalty at issuance can explain affect the achievability of KPI targets through our probit model. Furthermore, we examine the effect of issuers signaling politics, concentrating on issuers who commit to the U.N. Global impact initiative, demonstrating how commitment to this initiative can be used to mislead investors and affect their investment behavior.

Sustainability-linked bonds have only existed a couple of years and the data available is still in its infancy. Resulting in three main limitations in our research paper, (i) The sample size is our greatest limitations. When we started our thesis there were no sufficient amount of SLBs who had reached their KPI targets, resulting in the same sample being used both for building our probit model and testing it. (ii) In order to calculate the mispricing level, it was necessary to discount the future cash flows from our sample SLBs with yield curves matching issuer country, industry, and rating. However, given that the yield curves were not available for our full sample, we had to make assumptions on a fixed credit spread for each year added onto the risk-free rate for each issuer country for each year. (iii) We observed only a proportion of the public companies and no private companies in our sample disclosing their ESG performance, resulting in little to no ESG data being available.

Sustainability-linked bonds are an interesting instrument to research, and we have multiple suggestions for further research. One suggestion is to recreate our research paper with a bigger sample size, including full ESG performance data for each issuer and examine the effects of ESG performance, whether KPI targets are achieved and the commitment to the U.N. Global compact initiative – were the objective would be (i) to see the full effect of the ESG performance in light of KPI target achievements and (ii) examine whether a positive linear relationship exists between the ESG performance and the U.N. Global impact initiative. Another suggestion would be researching the KPI target themes, examining the effects of the main themes used in today's market and their environmental impact.

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# Appendix

**Figure 2** - Scatterplot between KPI target met and U.N. Global Initiative dummy variable

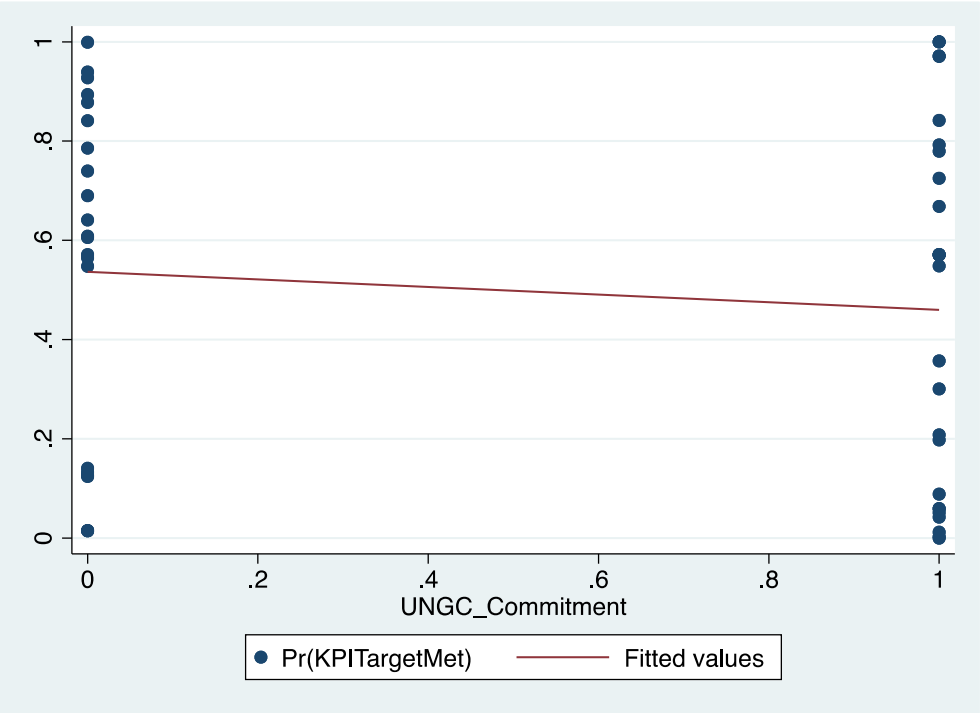


**Figure 3** –Boxplot of potential outliers in the explanatory variables

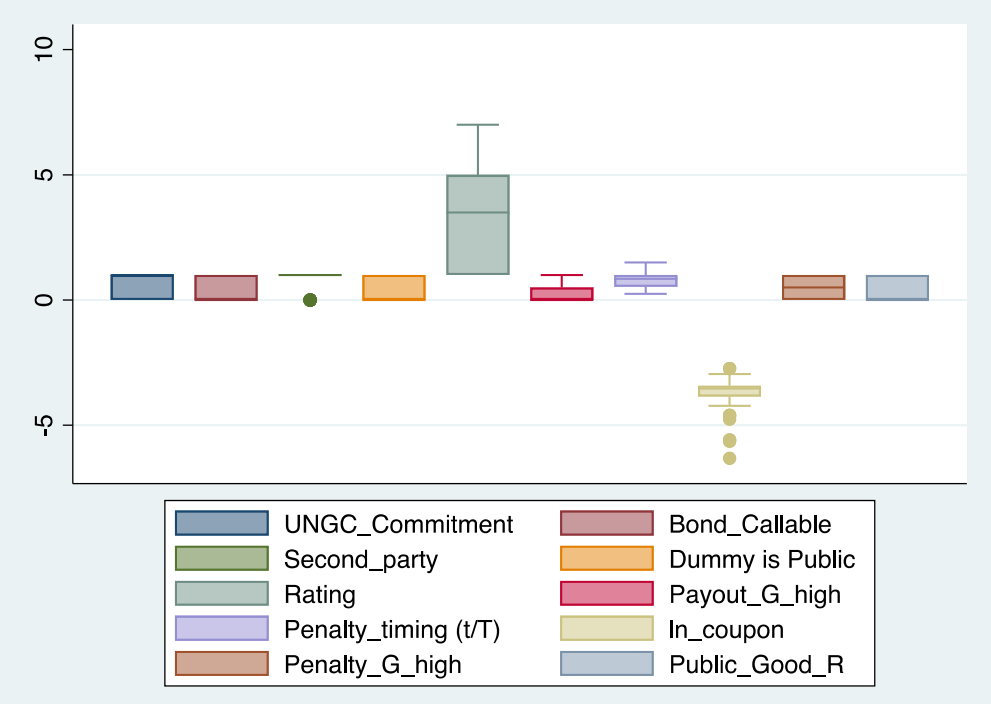

Figure 4 – Scatterplot predicted probabilities and the mispricing levels

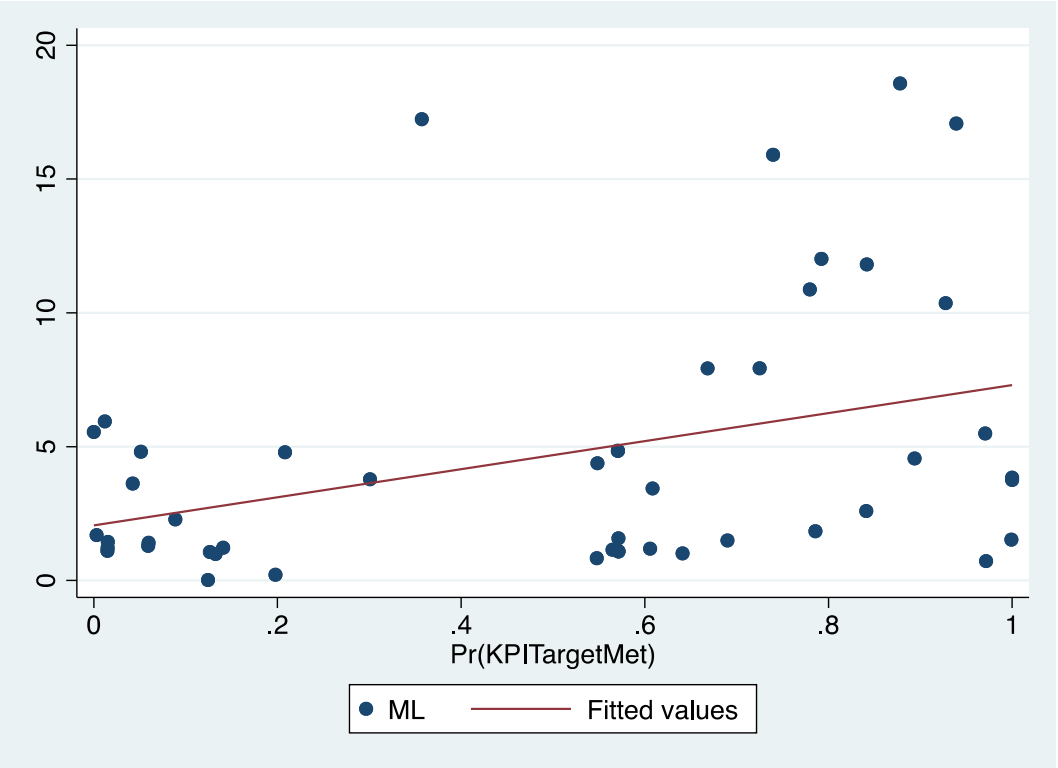


Figure 5 – T-test ML

| | |
|---|---|
| **Mean** | 33.8122 |
| **Standard deviation** | 89.3837 |
| **Count (n)** | 48 |
| **Standard error of mean** | 12.9014241 |
| **Degrees of freedom (df)** | 47 |
| **Hypothesized mean** | 0 |
| | |
| **T-statistic** | 2.62080916 |
| **P-value** | 0.01177934 |

Figure 6 – Scatterplot predicted probabilities (phat) and bond_callable

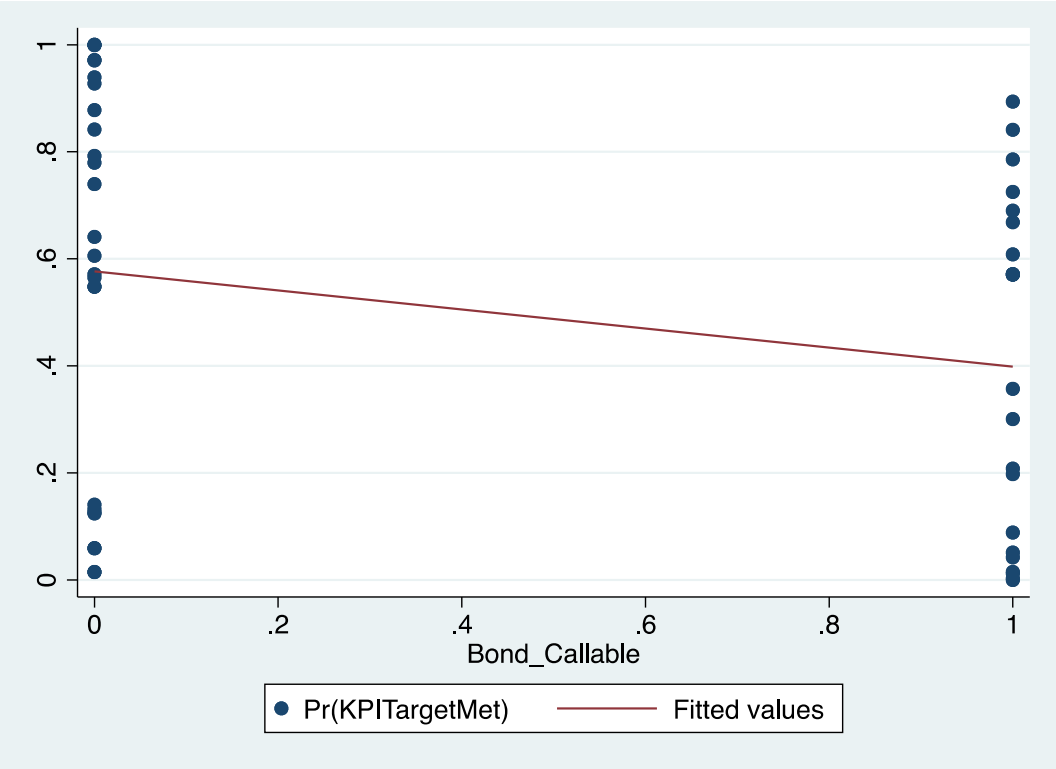


Table 23: Portfolio of the sophisticated investor

| Results Full sample | KPI Met | Phat | ML | UNGC_Committ | Dummy_pub | Is callable | Public_Good_R |
|---|---|---|---|---|---|---|---|
| CND1000488Y8 | Y | 55% | 0.842403761 | 0 | 0 | 0 | 0 |
| CND10004MGR7 | Y | 57% | 1.629897577 | 0 | 1 | 0 | 1 |
| CND10004MVH7 | Y | 64% | 1.043345675 | 0 | 0 | 0 | 0 |
| JP312500AMB9 | Y | 74% | 462.8112315 | 0 | 1 | 0 | 0 |
| NO0010920952 | Y | 100% | 21.18696051 | 0 | 0 | 0 | 0 |
| NO0010981939 | Y | 69% | 14.48720951 | 0 | 0 | 1 | 0 |
| XS2331713011 | Y | 94% | 164.7619502 | 0 | 0 | 0 | 0 |
| XS2331713102 | Y | 93% | 81.84482523 | 0 | 0 | 0 | 0 |
| XS2412267358 | Y | 61% | 4.813016321 | 0 | 0 | 1 | 0 |
| XS2412267515 | Y | 84% | 8.444741013 | 0 | 0 | 1 | 0 |
| XS2412267788 | Y | 79% | 1.845780706 | 0 | 0 | 1 | 0 |
| CND100048JY7 | N | 61% | 1.27545342 | 0 | 1 | 0 | 1 |

Table 24: Portfolio of the unsophisticated investor

| Results Full samp | KPI Met | Phat | ML | UNGC_Commitment | Dummy_public | Is callable | Public_Good_R |
|---|---|---|---|---|---|---|---|
| FR0014003GX7 | Y | 73% | 29.60971139 | 1 | 1 | 1 | 1 |
| JP376280AM31 | Y | 84% | 406.9821161 | 1 | 1 | 0 | 1 |
| SE0013360534 | Y | 100% | 3.756642028 | 1 | 1 | 0 | 1 |
| SE0013360542 | Y | 100% | 3.929178521 | 1 | 1 | 0 | 1 |
| TH0450038706 | Y | 79% | 12.03931381 | 1 | 1 | 0 | 1 |
| TH045003BB04 | Y | 78% | 10.90074105 | 1 | 1 | 0 | 1 |
| US29278GAL23 | Y | 97% | 5.560956554 | 1 | 0 | 0 | 0 |
| US82883PAA21 | Y | 57% | 19.91199317 | 1 | 0 | 1 | 0 |
| USL8449RAA79 | Y | 57% | 19.91199317 | 1 | 0 | 1 | 0 |
| USN30707AM05 | Y | 97% | 6.344623085 | 1 | 0 | 0 | 0 |
| XS2332306344 | Y | 67% | 68.99828212 | 1 | 1 | 1 | 1 |
| XS2403428472 | Y | 36% | 17.57185569 | 1 | 1 | 1 | 1 |
| CA29251ZBU09 | N | 21% | 4.830913214 | 1 | 1 | 1 | 0 |
| CA87971MBV42 | N | 20% | 24.22175512 | 1 | 1 | 1 | 1 |
| DE000BHY0SL9 | N | 55% | 7.301097866 | 1 | 0 | 0 | 0 |
| FR0014003G27 | N | 30% | 3.808833118 | 1 | 1 | 1 | 1 |
| FR0014004UE6 | N | 9% | 2.422371922 | 1 | 1 | 1 | 1 |
| FR0014005OK3 | N | 1% | 9.90538517 | 1 | 1 | 1 | 1 |
| FR0014006ND8 | N | 0% | 2.182817158 | 1 | 1 | 1 | 1 |
| US86964WAK80 | N | 4% | 3.642101316 | 1 | 0 | 1 | 0 |
| US49836AAC80 | N | 57% | 32.71562559 | 1 | 0 | 1 | 0 |
| US86964WAL63 | N | 5% | 4.828616294 | 1 | 0 | 1 | 0 |
| USA35155AE99 | N | 57% | 32.71412668 | 1 | 0 | 1 | 0 |
| CND10004GTQ | N | 6% | 1.456187487 | 1 | 0 | 0 | 0 |
| CND10004GXL | N | 6% | 1.336606077 | 1 | 0 | 0 | 0 |
| US29250NBF15 | N | 0% | 5.570002907 | 1 | 1 | 1 | 0 |