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A Genuine Commitment or a Greenwashing Trap: Investigating Sustainability-linked Bonds from a Shareholder Perspective

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Abstract

This thesis investigates how sustainability-linked bonds (SLBs) are perceived by industry participants and the alignment of shareholder views with issuer motives. Using an event study on a sample of 318 SLBs issued by global firms between 2019-2023, the results show a positive but insignificant stock market reaction following SLB announcements. First-time issuances, SLBs issued outside of Europe as well as by firms from industries which are not specifically recognised as carbon intensive receive higher cumulative abnormal returns while showing a trend of statistical significance. This suggests that investors perceive the sustainability commitment signal sent by firms to be generally positive, with the effect driven by certain sub-groups. A difference-in-difference analysis using a matched sample of conventional bond issuers, however, shows that the environmental and social performance decreases following SLB issuances, suggesting that investor views and issuer motives are not aligned. Instead of improving their overall ESG performance, issuers appear to focus solely on the sustainability performance targets set in their SLBs, as despite the overall reduction in ESG performance, emission intensity is still reduced. A similar difference-in-difference analysis also shows that, contrary to green bonds, SLB issues are not able to significantly increase, nor decrease, institutional ownership in the underlying stock, suggesting that the signal is not strong enough to attract interest from a wider investor base.

Keywords ESG, sustainability-linked bonds, sustainable bonds, ESG performance, institutional ownership

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Abstract

Denna avhandling undersöker hur hållbarhetslänkade obligationer uppfattas av branschaktörer och hur aktieägarnas åsikter överensstämmer med emittentens motiv. Med hjälp av en eventstudie på ett urval av 318 hållbarhetslänkade obligationer emitterade av globala företag mellan 2019-2023 visar resultaten en positiv men inte statistisk signifikant reaktion på aktiemarknaden efter emitteringen. Förstagångsemissioner, emissioner utanför Europa samt av företag från branscher som inte klassifieras som koldioxidintensiva får högre kumulativ onormal avkastning samtidigt som de visar en trend av statistisk signifikans. Detta tyder på att investerare uppfattar signalen om hållbarhetsåtaganden som företagen sänder ut som generellt positiv, med en effekt som drivs av vissa grupper. En difference-in-difference-analys med hjälp av en jämförelsegrupp av konventionella obligationer visar dock att den miljömässiga och sociala prestationen minskar efter emissioner, vilket tyder på att investerarnas åsikter och företagens motiv inte överensstämmer. I stället för att förbättra sin övergripande ESG-prestation verkar företagen fokusera enbart på de hållbarhetsmål som fastställs i deras hållbarhetslänkade obligation, eftersom utsläppsintensiteten fortfarande minskar trots det försämrade ESG-betyget. En liknande difference-in-difference-analys visar också att hållbarhetlänkade obligationer, i motsats till gröna obligationer, inte ökar eller minskar det institutionella ägandet i den underliggande aktien, vilket tyder på att signalen inte är tillräckligt stark för att locka intresse från en bredare investerarbas.

Keywords hållbarhetslänkade obligationer, hållbara obligationer, företagsansvar, hållbarhets prestation, institutionellt ägande

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1. Introduction

The recent update on the planetary boundaries framework, which identifies crucial processes that regulate our planet's resilience, revealed that six of the nine boundaries have already been crossed due to human activity (Richardson et al., 2023). This suggests that humanity is operating beyond the thresholds essential for Earth's stability, as crossing a boundary increases the risk of causing irreversible environmental changes.

In response to the escalating threats posed by our actions, decision-makers have implemented several measures. Notably, 195 participants in the Paris Agreement committed to limiting global warming to below 2°C, and over 140 countries, representing 88% of global emissions, have set net-zero targets (UNEP, 2023). Although the projected increase in greenhouse gas emissions has slowed since the adoption of the Paris Agreement, the current trajectory and targets are insufficient to meet the goals. UNEP (2023) has called for the acceleration of emission reductions through an overall transition to a low-carbon economy, underscoring the critical need for public and private investments.

In March 2023, McKinsey estimated that green investments worth $9 trillion are needed annually to reach climate neutrality by 2050 (Dahlqvist et al., 2023), with the financial sector holding a crucial role in advancing the low-carbon transition (Sartzetakis, 2021). One key aspect is mobilising capital towards investments that align with the aforementioned climate targets (Maltais & Nykvist, 2020). Sustainable financing instruments, such as green, social, sustainability, and sustainability-linked bonds, have emerged as promising candidates to facilitate this. They reduce the threshold for companies to make green investments by linking the financing to a growing investor appetite for assets with a positive environmental impact (Sartzetakis, 2021).

Green, social, and sustainability bonds were initially introduced to support predefined projects with environmental or social benefits. However, the inherent inflexibility of these instruments prompted a growing acknowledgement of the necessity for more versatile alternatives. This need particularly arose for firms whose sustainable transition strategies are not tied to specific projects but rather an integral part of investment decisions (Lester, 2022).

In response to this demand for flexibility, sustainability-linked bonds (SLBs) entered the scene as a novel financial instrument in 2019. Unlike their predecessors, SLBs do not restrict funding to specific projects but instead incorporate sustainability performance targets (SPTs), which, if not achieved, raise the interest rate payments of the bonds. As such, SLBs incentivise firms to reduce their environmental impact to avoid monetary losses (Kölbel & Lambillon, 2022).

Due to its relatively young age, the SLB remains understudied. Current research on SLBs has focused on identifying whether a pricing difference exists compared to conventional bonds (e.g., Feldhütter et al., 2023; Kölbel & Lambillon, 2022). A potential premium might indicate that investors view the sustainability targets as value-adding and are willing to pay for them (Kölbel & Lambillon, 2022). However, these studies have yielded inconsistent results, suggesting that little is still known about the perception of the instrument by industry participants.

Investigating the stock market reaction following company-specific announcements is another way to uncover investor perceptions, as the abnormal returns around the event provide a direct estimate of the value of the new information as perceived by the market (Krüger, 2015). ESG-bond issuances offer a good study setting, as empirical evidence has generally shown an insignificant stock market reaction following conventional bond issuances (e.g., Mikkelson & Partch, 1986). Consequently, previous literature on other sustainable bonds has examined stock market reactions to assess how investors perceive the additional signal of a firm's commitment to sustainability included in these bonds (Flammer, 2021).

The results suggest that investors view green bond issuances positively, as multiple studies have found significantly positive cumulative abnormal returns following green bond issuances (e.g., Baulkaran, 2019; Flammer, 2021; Tang & Zhang, 2020). This positive expectation for future sustainability improvements seems to be aligned with issuer intentions, with findings indicating that firms who have issued green bonds improve their environmental performance post-issuance (e.g. Alamgir & Cheng, 2023; Fatica & Panzica, 2021; Flammer, 2021; Yeow & Ng, 2021).

The differing structure of SLBs compared to sustainable use-of-proceeds bonds raises the question of whether SLBs can achieve a similar conformity, where shareholder trust is rewarded with future sustainability improvements. This study aims to address this gap by shedding light on how sustainability-linked bond (SLB) issuances are perceived by shareholders and the alignment of shareholder views with

issuer motives. This is done by studying two main research questions: 1) Do investors view SLB issuances as a credible signal of a firm's future sustainability improvements. 2) Are SLB issuers committed to improving their overall sustainability performance.

To answer the first research question, this study used an event-study methodology to analyse the stock market reaction following SLB issuances. The sample consisted of 318 global SLB issuances by public firms, from the first issuance in September 2019 until the end of 2023. The results show positive but insignificant cumulative (average) abnormal returns (CAAR) in a 16-day time window around the announcement. Alternative significance tests, however, suggest borderline statistical significance, as the nonparametric Corrado (1989) rank test and parametric adjusted-BMP (Kolari & Pynnönen, 2010) test statistics are significant. According to expectations that the market has inherited the sustainability signal following a firm's inaugural issuance (Flammer, 2021), sub-sample analyses show that first-time issuances face a more robust reaction, with the CAAR significant at a 10% level using the t-test and at a 5% level for the alternative significance tests. The response for issuances outside of Europe, as well as by firms in industries not categorised as carbon-intensive, show similar statistical significance, with the magnitude of the CAARs exceeding 1% over the main event window. These results suggest that investors outside Europe value the sustainability signal more, while the signal is not strong enough to overcome the negative screenings of firms in carbon-intensive sectors (Bolton & Kacperczyk, 2021). Given a relative decrease in SLB issuances compared to other ESG bonds since the start of 2022, concerns were raised about the future of the instrument (Binnie, 2023). Contrary to concerns, the results show that CAARs have increased since 2022, indicating that the overall market does not widely hold the greenwashing beliefs. In short, although results for the overall sample showed statistical insignificance, the sub-sample findings suggest a positive perception by investors about the sustainability signal inherent in the SLBs.

To better understand what drives the reaction, this study aimed to identify whether particular firm- and bond characteristics explain variations in abnormal returns following SLB issuances. This was done by regressing the cumulative abnormal returns obtained from the event study on several bond- and firm characteristics. The findings mainly indicate that individual characteristics are inadequate at explaining the cumulative abnormal returns. Firm size, measured in the natural logarithm of total assets, was the only relatively consistent predictor of

announcement returns. Firm size had a positive coefficient in all models and statistical significance ranging between 5% for the entire sample and 10% for first-time issuances. Aouadi and Marsat (2018) argued that larger firms receive more visibility, which could explain the higher reaction following SLB announcements. Nevertheless, given the varying statistical significance, the overall impact on announcement returns is negligible.

To address the second research question, further analysis was conducted to determine the credibility of SLB issuers' commitments to enhance their environmental performance. A difference-in-difference analysis was performed to investigate the ESG performance development following SLB issuances. The sample consisted of 105 SLB and conventional bond issuers between 2019 and 2022, matched on specific accounting variables and sustainability metrics. This allowed the examination of whether SLB issuers improve their performance regarding different ESG metrics compared to a counterfactual if no SLB had been issued. The results suggest a concerning motivation structure behind SLB issuances, as SLB issuers decrease their sustainability performance compared to conventional bond issuers regarding Refinitiv's Environmental and Social pillar scores. The results are significant at a 5% level.

Additionally, there is evidence of a negative impact on the overall ESG score and emission score, with the difference-in-difference coefficient found to be negative and significant at a 10% level. Furthermore, the results suggest that firms focus mainly on the specific targets included in the SLBs, as the emission intensity is reduced, with the result also significant at a 10% level. These findings align with the greenwashing argument proposed by Flammer (2021), which suggests that SLBs are used by firms to portray themselves as sustainable without intending to fulfil the commitment on a broader scale. These results also confirm findings from an unpublished Master's thesis by Jalonen (2023), who found that the Refintiv E, S and ESG scores significantly decreased for a smaller sample of 60 SLBs.

To complement the first research question, this study also examined how institutional ownership of the underlying stock evolves following the SLB issuance. Given the rising share of sustainable investment strategies introduced by institutional investors (Bernow et al., 2017), the findings could shed light on whether the signal sent by the SLB issuance is credible enough to attract the attention of a broader investor base. A similar difference-in-difference analysis as in the ESG performance analysis

was performed. However, due to superior data availability, the sample included 140 matched bond issuers between 2019 and 2023. Institutional ownership data from FactSet was used, with institutional ownership as a percentage and the natural logarithm of the total market capitalisation owned (in USD) as the dependent variable. The findings report no significant changes in institutional ownership following SLB issuances. When foreign and domestic ownership were introduced as separate dependent variables, the results suggested that domestic investors reduced ownership in terms of the percentage of shares owned (10% significance), while foreign institutional ownership showed no notable changes. However, when the log of market capitalisation is introduced as the dependent variable, the coefficient becomes positive and insignificant, suggesting that portfolio rebalancing measures may drive the negative impact of shares owned by domestic institutional investors. Contrary to findings of a positive increase in institutional ownership following green bond issuances (Tang & Zhang, 2020), SLBs do not increase the demand by institutional investors for the underlying stock.

Taken together, the findings of this study indicate that investors generally welcome sustainability-linked bond issuances, as the market reaction is positive for all samples while showing trends of significance for several sub-groups. Nevertheless, the insignificance of the cumulative abnormal returns for the total sample suggests that the relationship is more complex than for the more mature green bond, which has consistently found significant abnormal returns (e.g., Flammer, 2021; Tang & Zhang, 2020). The finding of an insignificant increase in institutional ownership implies that the sustainability signal may not be as persuasive for SLBs. However, it is worth noting that Flammer (2021) found no significant increase in overall institutional ownership despite significant CAARs, indicating that the two are not mutually exclusive. The evidence of a deteriorating sustainability performance following issuances reveals a troubling incentive behind SLB issuances. Although the market reaction following SLB issuances was insignificant, it is, on average, positive. This confirms a gap in how shareholders perceive the sustainability signal and the intention behind the issuance.

This study draws inspiration from Flammer (2021) and Tang and Zhang (2020), who conducted extensive reviews on green bonds. Altering the focus to SLBs makes several contributions to the literature.

First, this paper contributes to the limited literature on sustainability-linked bonds. SLBs differ from other sustainable use-of-proceeds bonds due to their

performance-based structure. Therefore, more research is required to understand the unique structure's implications for the market and its potential in combatting climate change (Vulturius et al., 2022).

Second, this study offers the most comprehensive study on the relationship between SLB issuances and stock prices, complementing the tentative results presented by Lahtinen (2023) and Berrada et al. (2022). This study examined the stock market reaction of a significantly larger sample of SLB issuances while providing novel information on the relationship between abnormal returns and several firm and bond characteristics.

Third, this study offers further insights into the motivation behind a firm's decision to issue SLBs, adding to the greenwashing evidence found by Jalonen (2023). Additional evidence on the complexity of the environmental performance following issuances was also provided by including emission intensity as a new variable. In addition, the study offers novel information on the alignment of shareholder expectations and the issuers' sustainability development by contrasting the stock market reaction and the post-issuance ESG performance development.

Lastly, this study offers novel evidence on the impact of SLB issuances on institutional investors' demand for the underlying stock, complementing the findings from Boermans (2023), who found European institutional bond investors to prefer SLBs over conventional bonds.

The remainder of this paper is organised as follows. Section 2 discusses relevant literature on the subject and presents the hypothesis development. Section 3 describes the sample selection and data sources used in the study. Section 4 presents the methodologies used to test the hypotheses, while Section 5 presents the results from the different analyses. Section 6 discusses the implications of the results, with Section 7 concluding the paper.

2. Literature review

2.1. An introduction to SLBs

The first sustainability-linked bond was issued in September 2019 by the Italian energy company Enel (Stubbington, 2021). As mentioned, SLBs differ from other sustainable bonds as they include predefined sustainability targets measured with Key

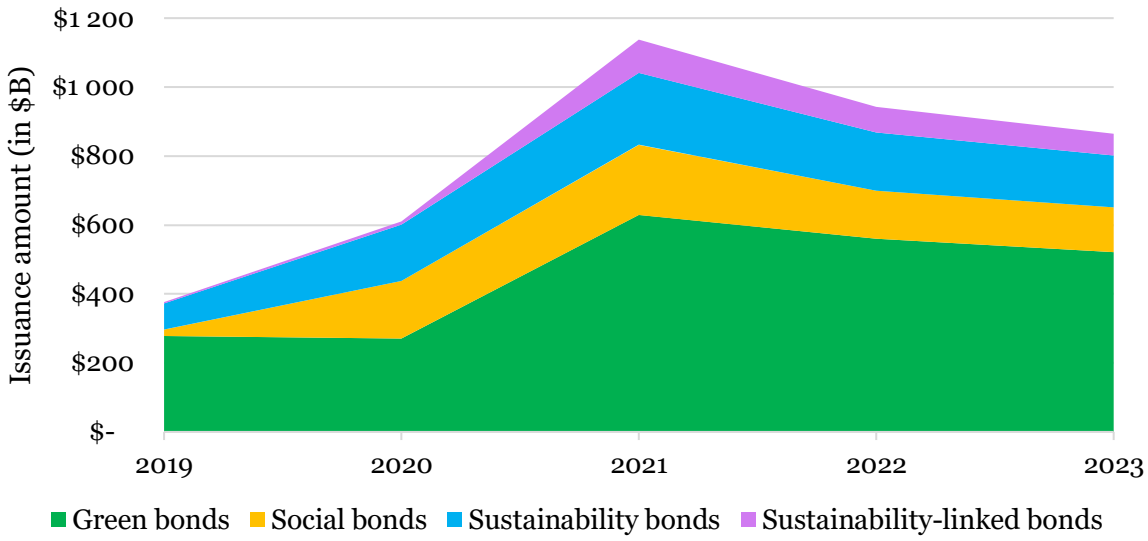
Performance Indicators (KPIs), which result in a monetary penalty if not met by the predefined timeline (ICMA, 2023).

The first SLB issued by Enel featured a 0.25% coupon step-up if the company fails to increase its percentage of installed renewable generation capacity to 55% by the end of 2021 (Refinitiv Workspace). Although SLBs can feature different penalties and KPIs, subsequent SLB issuances have followed a similar framework to Enel. Most bonds include a coupon step-up as the penalty and focus on targets concerning the environment, especially greenhouse emissions. In a working paper by Berrada et al. (2022), 95% of the SLBs in the sample included a step-up option, while 89% focused solely on environmental SPTs and 48% specifically on greenhouse gas emissions.

Unlike other sustainable bonds, SLBs are not tied to specific projects, offering more flexibility by allowing issuers to tailor sustainability targets to their strategies (Mishra et al., 2023). For example, Enel motivated its decision to issue an SLB by claiming that all investment decisions made by the company were aligned with its decarbonisation strategy and that a project-specific financing instrument like the green bond would, therefore, not be an optimal instrument to finance its overall sustainability transition (Lester, 2022). Investors who prefer forward-looking, measurable sustainability objectives may also favour the instrument. Feldütter et al. (2023) argue that use-of-proceed bond issuers lack the direct financial incentive to continue to perform sustainably following the issuance. SLBs address these concerns by directly linking future sustainability performance to financial outcomes (OECD, 2024).

Figure 1 presents the issuance amounts for different ESG bonds since the introduction of the sustainability-linked bond in 2019. Since then, the SLB market volume has grown rapidly, with the yearly issuance amount peaking in 2021 at $97 billion. However, this upward trend reversed in 2022 and 2023, with the issuance amount dropping by 23% and 20%, respectively, ending 2023 with $59 billion in SLBs issued (Refinitiv Workspace).

Figure 1. Sustainable bond issuances by bond type



*This figure displays the yearly issuance amount (in $B) of different sustainable bonds since 2019.

All ESG bond issuances declined from their highs in 2021; however, the drop for SLBs has been steeper. For example, the more developed green bond market only saw decreases of 11% in 2022 and 6% in 2023. The overall drop in issuances has been attributed to central banks tightening the market to combat rising inflation. However, the increased relative appeal of green bonds and the decline in SLB issuances are speculated to be due to concerns about unambitious targets, irrelevant KPIs, and negligible penalties associated with SLBs (Binnie, 2023). These concerns are further discussed in Section 2.6.

2.2. Literature on SLBs

The early literature on SLBs has primarily focused on their pricing compared to conventional bonds (e.g., Berrada et al., 2022; Feldhütter et al., 2023; Kölbel & Lambillon, 2022). A potential pricing premium would highlight key motivations for using SLBs, indicating that issuers benefit from lower financing costs while bond investors bear the cost of the sustainability improvements (Kölbel & Lambillon, 2022).

Kölbel and Lambillon (2022) studied pricing differences between a sample of 102 SLBs and conventional bonds from the same issuers, finding a significant premium for SLBs. In over half of the cases, the premium was higher than the potential penalty, revealing a clear misalignment of incentives. Berrada et al. (2022) challenged this finding, arguing that pricing premiums found using a matching methodology may

be overstated for SLBs, as the penalty incurred is not accounted for. Using a novel mispricing measure that considers the inherent penalty of SLB, their methodology finds that SLBs are underpriced on average. Feldhütter et al. (2023) used a mispricing measure similar to Berrada et al. (2022), also finding no evidence of mispricing. Consequently, the contradicting findings suggest insufficient evidence to draw definite conclusions on a pricing premium for SLBs.

The current literature regarding the stock market reaction following SLB issuances is nearly nonexistent. As of February 2024, Berrada et al. (2022) was the only publicly available paper found to mention stock price reactions following SLB issuances. However, the study does not report the findings from the performed event study. Instead, it only presents the regression results using the CARs of 99 SLBs as the dependent variable to determine if mispriced SLBs affect stock returns. The study finds that the stock price reaction is significantly higher for large and overpriced SLBs.

In an unpublished Master's thesis from Aalto University, Lahtinen (2022) studied cumulative abnormal returns around a 16-day event window on a sample of 32 SLBs. The study found a positive but insignificant stock price reaction, with CAARs of 0.62% and 0.89% using domestic and global indexes, respectively. It is worth mentioning that the author also replicates the green bond event study in Flammer (2021), finding positive but insignificant results. Given that Flammer (2021) reports significant abnormal returns, no inferences are drawn from the tentative results by Lahtinen (2022). Therefore, the current evidence leaves a gap for a more in-depth analysis of the stock price reaction following SLB issuances.

Outside of uncovering pricing differences, Hinsche and Klump (2023) analysed the ability of the SLB market to attract firms from carbon-intensive sectors and firms lagging in their sustainability transition. Using a probit regression, the study finds that a company from a carbon-intensive industry is three times more likely to issue an SLB. However, ESG laggards are 80% less likely to issue SLBs than higher-performing peers. The study also finds that issuers in EU countries are more likely to issue SLBs, while the probability of issuances increases with the maturity of the SLB market.

2.3. ESG and stock price reactions

Previous studies on green bond issuances (e.g. Flammer, 2021) report that there is generally no stock market reaction following conventional bond issuances. Therefore,

a positive reaction to sustainable bond issuances is attributed to the added information about a company's sustainability improvements. To investigate this claim, I explore the potential reactions to conventional bond issuances, which could be positive due to increased investments or negative due to heightened default risk or information asymmetries (Mikkelson & Partch, 1986). Empirical evidence supports the latter, with studies by Eckbo (1986), Dann and Mikkelson (1984), Mikkelson and Partch (1986) all reporting a negative but insignificant market reaction to straight debt issuances, while the more recent Krishnaswami and Yaman (2007) found negative and significant announcement returns. Building on this evidence, this study follows the logic of previous studies, assuming that the sustainability signal drives a positive abnormal reaction.

Given the lack of research on the market reaction following SLB issuances, I explore event studies on sustainable use-of-proceeds bonds and other ESG-related events to draw insights into the potential reaction to SLB issuances.

In a review of green bond literature, Bhutta et al. (2022) show that most studies have found positive abnormal returns related to green bond announcements. This study primarily draws on Flammer (2021) and Tang and Zhang (2020), who study green bonds extensively using samples of 384 and 241 green bond announcements, respectively.

Flammer (2021) conducts an exhaustive review of corporate green bonds and offers several relevant implications for this study. The paper finds a significantly positive market reaction to green bond announcements, which is higher for first-time issues, third-party certified green bonds and firms in environmentally material industries. The study argues that green bond issuers signal a credible environmental impact as they improve their environmental performance and widen their "green" investor base following the issuance. In contrast, a green bond premium is not found, which could suggest ulterior motives.

Tang and Zhang (2020) also find an abnormal increase in the stock price following a green bond announcement. Like Flammer (2021), the study does not find evidence of a green bond premium but instead finds evidence of what the authors named the "investor attention" channel. This channel suggests that the increased visibility following issuances leads to higher demand and a broader investor base, which drives up the stock price following the announcement.

In the relatively under-researched and less prominent segment of sustainability bonds, Mocanu et al. (2021) and Mathew and Sivaprasad (2022) study announcement returns following 48 and 66 issuances, respectively. Contrary to green bonds, both studies are limited to small sample sizes and provide contradictory results. For example, Mocanu et al. (2021) found negative announcement returns that disappeared after the release of the Sustainability Bond Guidelines by ICMA in July 2018. On the other hand, Mathew and Sivaprasad (2022) found a positive and significant reaction in a 21-day event window, while shorter event windows (3- and 11-day) had a negative reaction. However, the reaction in all event windows was significantly higher than a matched conventional bond sample, which suffered a more significant negative reaction.

No inferences can be drawn from the literature on social bond issuances either. To the authors' knowledge, there have been no studies on the impact of social bond issuances on shareholder wealth. It is worth noting that governments or government-related institutions have issued most social and sustainability bonds (Beteta Vejarano & Swinkels, 2023), which could explain the limited research on market reactions.

A working paper by Kim et al. (2022) studied stock market reactions following public announcements of sustainability-linked loans, finding a positive reaction for high-transparency loans, while the CAAR for low-transparency loans remained insignificant. As sustainability-linked loans include similar sustainability performance targets as SLBs, the findings reported by Kim et al. (2022) offer another implication of the direction of the stock market reaction. Specifically, high-transparency loans have more publicly disclosed information (Kim et al., 2022) and could be assumed to have similarities to SLBs.

Regarding other sustainability-related events, Flammer (2015) studied the impact of ESG-related shareholder proposals decided by a narrow margin, finding a positive stock market reaction to proposals that are passed. Similarly, Dimson et al. (2015) found successful investor engagements on ESG issues to be followed by abnormal returns and increased institutional ownership. Flammer (2013) demonstrated a positive stock market reaction to green initiatives, while corporate news showing irresponsible environmental behaviour had an adverse reaction. Krüger (2015), on the other hand, looked at the reaction following CSR events, showing a negative, albeit small, overall reaction to positive events. The reaction, however, was positive for firms with prior CSR-related issues, suggesting that investors value

announcements of CSR improvements. Studying a more recent period, Serafeim and Yoon (2023) found the market to respond favourably to positive ESG news, which was less pronounced for companies with superior ESG ratings, suggesting that the stock price already reflects the positive news. In another study, Serafeim and Yoon (2022) examine stock prices following ESG news, finding positive and significant abnormal returns for unexpected economically meaningful news, which is more pronounced for positive news with high news coverage. Overall, the results suggest that events signalling a material improvement in a company's sustainability engagement generate abnormal returns, while immaterial news does not have an impact.

Market characteristics may also play a role in the stock market reaction. Naughton et al. (2019) show that CSR-related activities receive a positive market reaction when the market places a valuation premium on ESG performance. In contrast, results by de Vincentiis (2023) suggest that the reaction varies between geographical areas.

2.3.1 Announcement return sources

Previous literature has proposed different sources of a positive stock price reaction following ESG-enhancing activities. This study focuses on the two main channels identified by past studies.

First, according to a taste-based framework proposed by Fama and French (2007), investors can derive utility from factors that do not affect the financial payoff of the asset. Environmentally conscious investors can, therefore, gain additional utility from sustainability performance and accept lower expected returns (Riedl & Smeets, 2017). Following this logic, an improved environmental performance signalled by the ESG activity would result in the stock trading at a higher price (Flammer, 2021). Evidence shows that even a small shift in the demand can affect stock prices (Koijen & Yogo, 2019). Therefore, the effect can be enhanced if the SLB issuance attracts a broader investor base, increasing the demand for the issuer's shares (Tang & Zhang, 2020).

Second, several papers have identified a relationship between environmental and fundamental performance (e.g., Flammer, 2015). These studies suggest that ESG activities can enhance growth prospects. Therefore, an increase in the stock price would reflect an increase in future cash flows.

Determining which channel drives the reaction is complex from only observing the stock price reaction. However, Tang and Zhang (2020) argued that if the

fundamental channel drives the reaction, there should be no significant differences between the reaction for first and subsequent issuances, as every issuance would signal increasing ESG investments.

2.4. ESG performance

The literature on stock market reaction suggests that the market reacts positively to events representing a material improvement in a firm's sustainability performance. To uncover whether this expectation of an improvement in the ESG performance by shareholders is aligned with the issuer's intentions, it is rational to study the development of a firm's sustainability performance following SLB issuances. A positive development would indicate that firms issue SLBs to signal a credible sustainability commitment. Conversely, a deteriorating performance could uncover more devious greenwashing incentives, in which a firm would try to benefit from a lower cost of debt or improve its branding.

As of February 2024, no publicly available scientific papers study the relationship between SLB issuances and subsequent ESG performance, with an unpublished Master's thesis (Jalonen, 2023) being the only paper to study this topic. Therefore, this section also draws from academic literature on other sustainable financing instruments to better understand possible outcomes.

As mentioned in Section 2.3, Flammer (2021) found green bond issuers to improve their environmental performance compared to 157 matched conventional bond issuers, which was measured in terms of Refinitiv's Environmental score and CO2 emissions scaled by total assets. Multiple subsequent studies (e.g., Alamgir & Cheng, 2023; Fatica & Panzica, 2021; Yeow & Ng, 2021) have also found a positive relationship between green bond issuances and environmental performance. Representing the minority, Mao (2023) suggests that the environmental improvements following green bond issuances are due to investments that would have been funded despite the issuance and can not be causally attributed to green bonds.

An IMF working paper (Schmittmann & Chua, 2021) finds that green bond issuers and green and sustainability-linked loan borrowers reduce CO2 intensity faster than other firms. This finding was contradicted by Kim et al. (2022), who found that sustainability-linked loan borrowers decreased their sustainability performance measured by Refinitiv ESG, ES, E and emission scores. This reduction, however, was

driven by low-transparency loan borrowers, with high-transparency borrowers showing no significant change. On the other hand, Dursun-de Neef et al. (2023) found that sustainability-linked loan borrowers increase their Refinitiv ESG score in the long term using a similar difference-in-difference analysis as Kim et al. (2022) but on a larger sample. Additionally, the study found green loan borrowers to not improve their ESG scores, with the author suggesting that the sustainability performance targets and the monetary penalty of failing to reach them incentivise firms to improve their ESG performance. This argument heightens expectations for SLBs, which include similar targets.

In a Master's thesis from Aalto University, Jalonen (2023) studied pricing premiums and post-issuance ESG performance of SLBs. Using a matched sample of 60 SLB issuers and 53 conventional bond issuers, the thesis found that SLB issuers decrease their ESG performance regarding Refinitiv's E, S and overall ESG scores. This finding is directly related to this study, as a similar analysis will be performed on a larger sample of SLB issuers. Flammer (2021) found the positive environmental performance following green bonds to be driven by changes two years after issuance. Therefore, the transferability of this finding to a larger sample is of specific interest, as Jalonen's (2023) sample mainly consisted of issuances until 2021, with only limited ESG scores available for 2022.

2.5. Institutional ownership and ESG

As this study is interested in uncovering how investors view sustainability-linked bonds, the impact on the demand for the underlying stock by the largest holders of shares in public companies globally, namely institutional investors (Matos, 2020), is of interest.

Many studies have documented investors' preference for sustainable investments, with e.g., Kaustia and Yu (2021) documenting that ESG-labelled funds receive higher inflows than similar non-ESG counterparts. Institutional investors have responded to the demand by increasing funds directed to responsible investing (Bernow et al., 2017). In 2022, more than $30 trillion was managed in alignment with responsible investment criteria globally, with Europe accounting for almost half of it (GSIA, 2022).

Cao et al. (2022) found that ESG-oriented institutional investors prefer sustainability performance over quantitative signals of value, which impacts the stock price patterns of their shares. Further, the study finds that abnormal returns are larger for firms preferred by ESG-oriented institutional investors. The increasing amount of assets invested sustainably and evidence of the impact on abnormal returns suggest a potential impact on the announcement returns of SLBs.

A working paper by Lopez-de-Silanes et al. (2022) showed that ESG performance positively affects institutional investor holdings in the U.S., while Wei and Chengshu (2023) found similar evidence in China. In a review of existing literature, Velte (2020) concludes that ESG performance positively relates to the share of institutional investors. However, the relation is not entirely robust, with Lopez-de-Silanes et al. (2022) finding that institutional investors' increased preference for high-ESG stocks was driven by the governance score. Similarly, Nofsinger et al. (2019) showed that institutional investors prefer underweighting stocks with negative E&S performance, while no evidence of overweighting stocks with E&S strengths was found. If the latter findings are wide-ranging, institutional demand may not significantly increase following issuances, given the high share of environmental targets in SLBs.

Similarly, due to the high prominence of carbon emission targets inherent in SLBs (Berrada et al., 2022), the impact of carbon emission on institutional ownership is also relevant. Bolton and Kacperczyk (2021) found that institutional investors apply exclusionary screens on Scope 1 emission intensity for firms active in carbon-intensive industries. Boermans and Galema (2023) and Bolton et al. (2024) found that although institutional investors have decreased holdings in foreign carbon-intensive stocks, they display high ownership in domestic high-emitting companies. This suggests that the impact on institutional investor demand may differ between domestic and foreign investors.

More closely related to this study, previous literature on green bonds has found evidence of increased institutional ownership in the issuer’s stock. Tang and Zhang (2020) show an increase in institutional ownership, primarily driven by domestic investors, following green bond issuances. Flammer (2021) looked at a sample of U.S. green bond issuers and found the overall institutional ownership to be insignificant, while the increase in ownership by investors considered long-term or green was positive and statistically significant.

Regarding sustainability-linked bonds, Boermans (2023) studied SLB and green bond preferences of different European investor groups between 2016 and 2022. The portfolio holdings demonstrated that European pension and mutual funds prefer sustainability-linked bonds over non-ESG bonds. This was consistent with findings on green bonds, concluding that there is no evidence that the demand for green and sustainability-linked bonds differ. The findings on green bonds from Boermans (2023) and Tang and Zhang (2020) suggest that institutional demand for the bond and issuer's stock might align, which could translate to SLBs.

2.6. Greenwashing concerns

As shown, related research on the stock price reaction, ESG performance, and institutional ownership following ESG events paints a relatively optimistic picture of expectations for SLBs. However, several concerns surrounding the instrument could impact the results of this study.

Ul Haq and Doumbia (2022) identify two design flaws in several sustainability-linked bonds: late target dates and options to call the bond early. Late target dates allow issuers who do not meet their targets only to pay the penalty on the last coupon payments. In contrast, call options before the target date incentivise issuers to withdraw the bond if the penalty is likely to be applied. However, Erlandsson and Korangi (2023) allayed some of these concerns, finding limited quantitative evidence of an excess proportion of callable SLBs compared to other bonds.

In addition to structural loopholes, SLBs have faced scrutiny on the materiality and relevance of targets included in the bonds (Vulturius et al., 2022). For example, JBS raised $3.2 billion through an SLB in 2021; however, the targets only concerned Scope 1 and 2 emissions, ignoring activities accounting for 97% of JBS' emissions (Mufson, 2023). These weak incentive structures signal a higher likelihood of greenwashing motives, reducing the chance that investors see them as credible (Vulturius et al., 2022).

The Sustainability-Linked Bond Principles (SLBP) published by the International Capital Market Association (ICMA) and Second Party Opinion Providers (SPOs) constitute the primary standards and governance structures for SLBs (Vulturius et al., 2022). The SLBP aims to provide transparency on the information disclosed by issuers, offering best practices regarding the selection of targets, bond

characteristics, reporting and external verification (ICMA, 2023). The purpose of the SPOs, which represents the external verification, is to provide assurance on the SLB's alignment with the framework by examining the relevance and ambition of selected KPIs. This external validation can reduce the cost of retrieving information and alleviate greenwashing concerns in market participants (Dorfleitner et al., 2021).

Critics argue that the voluntary nature of the Sustainability-Linked Bond Principles (SLBP) and lack of legal enforceability provide too much leeway for the issuers (OECD, 2024). Conflicts of interest further enhance this issue as the issuer firm hires the SPOs to conduct the external review. Several studies have found conflict of interest to affect the outcome in similar situations within finance, with equity analysts hired by the analysed firm showing bias in their recommendations (Chan et al., 2007; Mokoaleli-Mokoteli et al., 2009).

Greenwashing efforts may also impact institutional demand, with Vulturius et al. (2022) pointing out that green investors may face a dilemma with SLBs. Failing to meet the targets may decrease the sustainability of the investment and result in reputational harm for both the issuer and the investor. In addition, once the KPI is reached, the firm has little incentive to improve its performance further. For example, Ahold Delhaize achieved its 2025 emissions target for its SLB issued in 2021 already in the same year, which reduces the incentive for further reductions (Turner et al. 2024). Despite these arguments, the only empirical evidence on institutional ownership and SLBs comes from Boermans (2023), which contradicts the critics' concerns. In addition, Turner et al. (2024) mention that Public Power Corporation's missed KPI did not result in a sell-off following the news, which would be expected if environmentally-conscious investors were offloading them.

Nevertheless, the structural loopholes and the subsequent negative media attention on SLBs raise the question of whether issuers genuinely intend to improve their ESG performance. Alternatively, issuers might exploit the lack of standardisation to capitalise on the potential reputational and monetary benefits of issuing SLBs. The stock price reaction could also be impacted if SLB issuances are not considered credible signals of a firm's environmental commitment.

Despite the concerns, Vulturius et al. (2022) maintain that the sustainability-linked bond has the potential to foster sustainable investments and assist issuers in their net zero strategy. Sustainability-linked bonds have also received significant demand from investors, with many firms reporting their SLB issuances to have been

oversubscribed (Kölbel & Lambillon, 2022). Additionally, in a recommendation in June 2023, the European Commission recognised sustainability-linked bonds as an essential tool for driving transition objectives (European Commission, 2023a). Future regulatory efforts have also been put forward to foster the growth of the SLB market, with the European Commission set to create a report assessing the need to regulate the instrument within three years (European Commission, 2023b).

Greenwashing concerns are not solely directed towards SLBs, with critics highlighting similar considerations for green bonds. In addition to the structural constraints that led to the development of SLBs, Fatica and Panzica (2021) suggested that, similarly to SLBs, the risk of greenwashing emerges due to the absence of regulation. Namely, the green bond market also primarily depends on voluntary certification standards, such as the Green Bond Principles (ICMA, 2022).[1] Tuhkanen and Vulturius (2022) confirmed some of these concerns, finding a disconnect between the climate targets of issuers and the objectives outlined in the green bond framework and a lack of pressure to reach material science-based targets.

2.7. Hypotheses development

2.7.1 Stock price reaction

As highlighted in the literature review, previous findings have mainly found positive abnormal returns following ESG-related announcements, with the evidence on green bonds undeniably supporting this trend. Greenwashing criticism surrounding SLBs and the relative decrease in issuances, however, does raise concerns about the credibility of the signalling effect of SLBs. Due to the qualitative nature of the criticism, which makes it difficult to determine the extent of the issue, there is insufficient evidence to change the direction of the hypothesis. Additionally, the comparable greenwashing criticism faced by green bonds (e.g., Tuhkanen & Vulturius, 2022) further supports this stance. As such, the first hypothesis states:

Hypothesis 1. Stock prices increase after firms' SLB announcement.

[1] This was changed recently, as regulations on green bonds wishing to be labelled as "European green bonds" were adopted by the European Union in November 2023 (European Commission, 2023b).

Previous literature also indicates several properties that may impact the announcement returns of sustainability-linked bonds. The literature is summarised below to motivate additional analyses.

Flammer (2021) and Tang and Zhang (2020) found inaugural issuances to drive announcement returns for green bonds, arguing that the market has already embraced the sustainability signal before the subsequent issue. Therefore, I examine whether the stock price reaction is higher for firms issuing their first SLB.

Flammer (2021) found that the stock price reaction is higher following green bond issuances for firms operating in industries with above-median environmental materiality, suggesting that market participants place value on the magnitude of the impact of the bond. Given the high share of targets concerning carbon emissions within SLBs (Berrada et al. (2022), the potential impact of the instrument on total emissions may be more significant for firms within carbon-intensive industries. On the other hand, findings on exclusionary screens by investors for firms in carbon-intensive industries (Bolton & Kacperczyk (2021) could suggest a lower stock market reaction for firms in carbon-intensive industries. As such, I examine whether the magnitude of stock price reactions differs between issuers active in carbon-intensive and other industries.

De Vincentiis (2023) found geographical differences in announcement returns following ESG news, with European investors only reacting to negative ESG news. Given the popularity of SLBs in Europe (Hinsche & Klump, 2023), it is of interest to see whether similar results hold for SLB announcements. European countries rank highest in social norms toward E&S (Dyck et al., 2019), and Bauer et al. (2021) link the demand for sustainable investments to these social preferences. This could translate into higher announcement returns if investors gain more utility from the sustainability targets, especially since European investors have exhibited a bias towards European assets (Balli et al., 2010). On the other hand, it could result in lower announcement returns if findings from de Vincentiis (2023) hold for SLBs and investors see the proposed ESG developments by European firms as a given (Serafeim & Yoon, 2023). Additionally, the growth rate in sustainable investing in the rest of the world has surpassed Europe's in recent years (GSIA, 2022), indicating that the gap in investor interest in ESG matters may have decreased. Given the differing market standards and investor preferences, I examine whether the stock price reaction differs between SLBs issued by firms in Europe and other geographies.

In a market report on SLBs, CBI (2024) argued that the quality of the SLB issues has increased as the market has matured. In contrast, the relative decrease in SLB issuances compared to green bonds since the start of 2022 raises concerns about whether industry participants see SLB issuances as a credible instrument to increase sustainability. Therefore, I examine whether these concerns are noticeable in the market by analysing stock price reactions for SLBs issued before and after January 2022.

2.7.2 ESG performance

Given the positive findings on ESG performance following green bond issuance (e.g., Alamgir & Cheng, 2023; Fatica & Panzica, 2021; Flammer, 2021; Yeow & Ng, 2021), I expect SLB issuers to show similar improvements in their ESG performance.

Findings on a negative ESG performance following SLB issuances by Jalonen (2023) and greenwashing concerns raised in Section 2.6 argue against this direction, instead suggesting greenwashing incentives as the primary motivation behind issuances. However, Flammer (2021) found that sustainability improvements following green bond issuances manifest primarily two years post-issuance. This indicates that ESG score improvements may take time to manifest because they become evident only when sustainability investments start to pay off and are subsequently reflected in the ESG ratings. Additionally, Dursun-de Neef et al. (2023) found sustainability-linked loan borrowers to increase their ESG performance using a larger and more recent sample than Kim et al. (2022), who had previously documented a deteriorating performance. Therefore, considering the limited sample size and period examined in Jalonen (2023), the hypothesis remains unchanged:

Hypothesis 2. Firms improve their sustainability performance following SLB issuances

2.7.3 Institutional ownership

Following Flammer (2021) and Tang and Zhang (2020), I expect that if SLB issuances send a credible signal about improving a company's sustainability performance, the demand for the issuer's stock by environmentally conscious investors will likely increase. Given the magnitude of the assets managed by institutional investors and findings that environmentally conscious investors can impact stock prices (Cao et al.,

2022), an increase in the share of institutional owners could partly explain positive abnormal returns following SLB issuances. Given the evidence of increased institutional ownership following green bond announcements (Tang & Zhang, 2020) and ESG-related engagements (Dimson et al., 2015), as well as the demand shown for the sustainability-linked bond itself by European institutional investors (Boermans, 2023), the third hypothesis states:

Hypothesis 3. Firms experience an increase in institutional ownership following SLB issuances

The literature suggests a home bias among institutional investors (Coval & Moskowitz, 1999), with Schumacher (2018) proposing that domestic investors are more likely to have their attention drawn than foreign investors. Similarly, findings show that institutional investors' exclusionary screens on carbon-intensive firms mainly apply to foreign firms (Boermans & Galema, 2023; Bolton et al., 2024). Therefore, changes in both foreign and domestic institutional ownership are examined to determine whether domestic investors drive a potential change in institutional ownership.

3. Data

This section presents the data obtained to test the hypotheses outlined in the previous section. The first subsection describes the data sources used and the collection process performed for the different analyses, while the latter subsection presents the sample selection and descriptive statistics. Section 4, which introduces the methodologies utilised for the respective analyses, further explains the motivation behind the use of variables.

3.1. Data sources

In order to conduct an event study on announcement returns, I require the announcement date of SLBs, issuer stock returns, market index returns and additional risk factors. Refinitiv's Green Bond Guide (GRNBNDG), which provides data on global sustainable bonds, is utilised to collect information on all SLBs issued between September 2019 and December 2023. Daily stock price data for 250 days before the announcement date and up to 20 days after is sourced from Datastream for all public

SLB issuers. Additionally, Datastream is used to obtain price data for the domestic market indexes and the MSCI All-Country World Equity Index. Further risk factors, specifically the developed market size (SMB) and value (HML) factors, are retrieved from the Kenneth R. French Data Library.

Refinitiv offers the announcement date for bonds, but the date is also reviewed using Bloomberg's database to ensure that the first announcement and signalling effect of the SLB is captured. The initial review shows significant discrepancies between the announcement dates in the two databases, with Bloomberg possessing the earlier date in most cases.[2]

Several bond—and firm-level variables are also obtained from Refinitiv to determine what drives the potential announcement returns. All the variables are discussed in more detail in their respective subsections in Section 4.

Bond characteristics include maturity, coupon, penalty type, penalty amount, payment effective date, coupon frequency and maturity type (callable/at maturity). The bond rating would also be of interest; however, the initial review showed that only 51% of the SLBs had available ratings. Therefore, bond ratings are excluded from the analysis. In cases where information on the penalty and payment effective date was unavailable on Refinitiv, Bloomberg and bond prospectuses were used to complement the data.[3]

Firm characteristics include Refinitiv's E, S and G pillar scores, total assets, operating income, total debt, operating cash flow, book value of equity and market capitalisation. Following Baulkaran (2019), the value from the previous fiscal year is used for accounting variables, while the market capitalisation is derived for the month before the announcement. These variables are converted to USD to allow for comparability.[4]

I also retrieve the same firm-level information for SLB issuers and potential matched conventional bond issuers for the two years preceding the bond issuance to be used for the matching procedure outlined in Section 4.3.2. The potential matching candidates are identified via Refinitiv's bond deal screener.

[2] From the 318 bond announcement dates included in the final sample, 128 bonds had differing announcement dates. Out of these 128 differing dates, Bloomberg had the earlier announcement date in 117 cases. As mentioned, the first announcement date was used for all SLBs.
[3] Following the data collection process, the data required to define the total penalty amount was calculated for 297 of the 318 bonds.
[4] Accounting and market values were available for all 219 firms, while Refinitiv's ESG scores were only available for 201 firms.

To measure the ESG performance following SLB issuances, several sustainability metrics from Refinitiv ESG are also obtained for SLB issuers and matched conventional bond issuers with available ESG data both pre- and post-issuance. I follow Tang and Zhang (2020) and use ten years of data (2014 to 2023) when available. All ESG scores range from 0 to 100 and are intended to measure a firm's relative ESG performance using reported information (LSEG, 2023). Refinitiv ESG scores and emissions data have also been used in particularly relevant studies to determine the environmental performance following green bond issuances (Flammer, 2021), sustainability-linked loans (Dursun-de Neef et al., 2023; Kim et al., 2022) and shareholder proposals (Busch et al., 2023). The dependent variables used are further discussed in Section 4.3.1.1.

To analyse changes in institutional demand following SLB issuances, institutional ownership data for 2014 to 2023 was retrieved from FactSet Ownership. FactSet has data on ownership by different institutional investors (e.g. pension funds, mutual funds, hedge funds, insurance firms and banks) collected from fund reports, regulatory agencies, fund associations, company announcements and annual reports (Dyck et al., 2019). Factset offers institutional ownership data for firms worldwide and has been used in multiple studies on institutional ownership, including Dyck et al. (2019), Ferreira and Matos (2008) and Tang and Zhang (2020). The dependent variables obtained include the institutional ownership in percentage of total market capitalisation and the total amount owned in USD. In addition, I retrieve the same information for foreign and domestic institutional investors for all matched SLB and conventional bond issuers. The dependent variables used in the institutional ownership analysis are further introduced in Section 4.3.1.2.

3.2. Sample selection and Descriptive statistics

The observation period begins on the 5th of September 2019, when the first SLB was issued and ends on the 31st of December 2023. Within this period, Refinitiv reported 719 SLBs, which included bonds SLBs issued by public and private companies and governments. The final sample of SLBs was determined by confirming the public status of each SLB issuer.

A manual selection approach was used when a non-public issuer had a publicly listed parent. For financing subsidiaries without primary operating objectives, the

press releases of the parent company were used to confirm that the bond was issued primarily by the listed parent. Non-listed subsidiaries with names and domiciles different from those of their listed parent were excluded from the sample as the effect of the SLB issuance may not be material for the parent. For example, Optus, an unlisted Australian subsidiary of the Singaporean firm Singtel, was not included in the sample. In contrast, a bond issued by H&M Finance BV (a financial subsidiary of H&M) was included as a bond by H&M Group. From the initial sample of 719 SLBs issued between 2019 and 2023, 460 bonds from 226 issuers remained after removing private and governmental issuers.

Several of these 460 bonds were issued as multiple tranches, meaning they are part of the same transaction but may include different maturities or coupon rates. These tranches were combined into one issuer-day observation to include the issuance amount of all tranches, leaving 325 issuer-day observations by 226 firms.[5]

Furthermore, I excluded SLB issuances in which the issuer's stock had low or zero trading volume around the estimation or event period to account for thin trading. This resulted in the removal of six firms, while an additional firm whose IPO came after the issuance of the SLB was removed. Therefore, the final sample included 318 issuer-day observations from 219 unique firms.

Table 1 and Figure 2 present the number of bonds (issuer-days) and the amount in billion (USD) for the firms included in the final sample. Looking at Table 1, the decrease in SLBs issued by public firms has had a similar downward trend to all SLBs (as shown in Figure 1), especially regarding the issuance amount. Figure 2 shows the downward trend for the issuance amount to begin following Q1/2022, with a positive spike in Q1/2023, breaking the otherwise consistent downward trend.

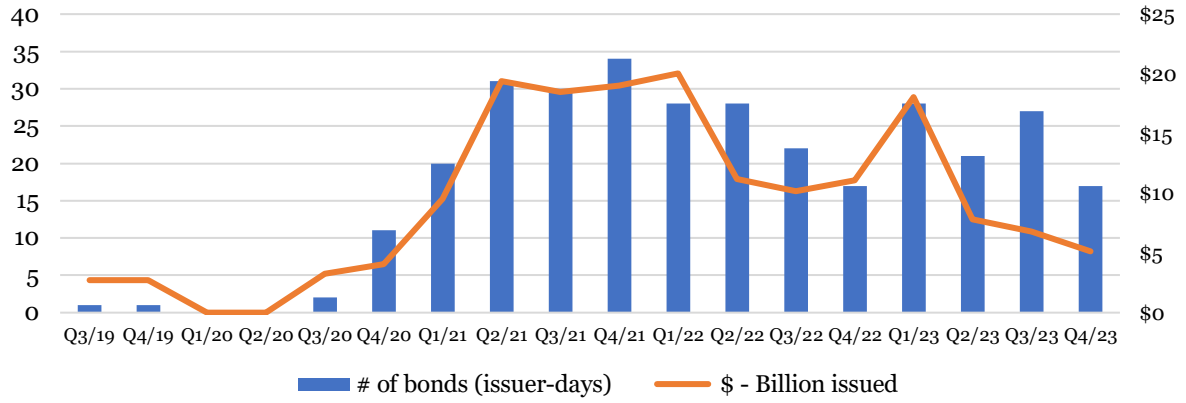
Table 1. SLB issuances by public firms

Year	# bonds (issuer-days)	$ amount (billion)
2019	2	4.2
2020	13	7.3
2021	115	66.4
2022	95	52.4
2023	93	37.8
Total	**318**	**168.2**

*This table shows the number and total issuance amount (in billion USD) of sustainability-linked bonds (issuer-days) used in the final sample.

[5] In case of different maturities and coupon rates, the information of the largest bond (in terms of issuance amount) was used.

Figure 2. SLB issuances by public firms



*This figure displays the number and total issuance amount (in billion USD) of sustainability-linked bonds (issuer-days) in each fiscal quarter.

Table 2 shows the number of bonds and total issuance amount (in billion USD) per Refinitiv's TRBC industry group (Panel A) and region (Panel B) for all bonds included in the final sample.

Panel A confirms findings by Hinsche and Klump (2023), as SLBs are more common in carbon-intensive industries (e.g. Electric Utilities, Oil & Gas, Metals & Mining). The number of SLBs issued by financial firms (8%) is significantly lower than for green bonds, with almost half of the green bonds in Flammer (2021) issued by financial firms. Berrada et al. (2022), whose SLB sample period ends in February 2022, reported similar figures, with 15% of bonds issued by financial firms.[6]

Panel B presents a breakdown by region and identifies the ten countries with the highest issuance amount. Most issues have come from Western countries. Other countries with high issuance amounts include China and Israel; however, the latter is due to 2 sizeable SLBs issued by Teva Pharmaceuticals. Most notably, SLB issuances are more common in European countries, with 142 SLBs issued worth $97.5 billion. This represents over half of the total issuance amount of the bonds included in my sample. Berrada et al. (2022) reported similar figures, with 46% of bonds issued by European firms.

[6] Other sources have found a similar pattern, with S&P Global (2023) showing that less than 1% of SLBs were issued by financial companies in H1/2023, compared to 12% in FY2022.

Table 2. SLB issuances by industry and region

Panel A. SLB issuances by TRBC Industry Group		
Industry	# bonds	Amount ($B)
Carbon-intensive sectors	**197**	**110.9**
Electric Utilities & IPPs	35	36.7
Machinery, Tools & Heavy Vehicles	20	10.2
Oil & Gas Related Equipment and Services	13	9.1
Oil & Gas	11	8.3
Metals & Mining	15	6.2
Chemicals	14	6.2
Others	89	34.2
Non carbon-intensive sectors	**121**	**57.2**
Pharmaceuticals	4	10
Food & Drug Retailing	13	9.4
Telecommunications Services	14	7.2
Investment Banking & Investment Services	6	3.6
Residential & Commercial REITs	10	1.6
Banking services	9	1.6
Others	65	23.8
Total	**318**	**168.2**
Panel B. SLB issuances by region		
Region	# bonds	Amount ($B)
Europe	142	98
North America	25	20
Latin America	39	18.2
Asia	97	27.8
Australasia	9	3.8
Africa	6	0.3
Total	**318**	**168.2**
Top 10 countries		
Italy	25	38.6
France	39	23.7
United States	14	11.3
Mexico	17	9
Canada	11	8.7
Japan	43	7.8
Brazil	14	7.6
Israel	2	7.3
Germany	10	6.4
China	22	5.4
Total	**197**	**125.8**

*This table shows the number and total issuance amount (in billion USD) of sustainability-linked bonds (issuer-days). Panel A presents the data in terms of Refinitiv's TRBC Industry Group. Panel B reports the information per region and in the top 10 countries.

Table 3 presents the different themes of the Sustainability Performance Targets (SPTs) included in the SLBs of the final sample (Panel A). In addition, the individual KPI items are reported (Panel B), and the penalty mechanism applied for failing to meet the targets (Panel C).

Looking at Panel A, 86% of bonds in the sample include only environmental KPIs, while 95% of bonds include at least one KPI related to environmental targets. These findings align with Berrada et al. (2022), who found 89% of bonds with information to be concerned with environmental targets and 98% to include at least one environmental KPI.

Panel B presents all KPI items included in the SLB in the final sample. Scope 1 and 2 GHG emissions are the most common single KPI included. KPI items related to greenhouse gas emissions represent 56% of the KPI items with information available (53% of the total number). This number is similar to that of Berrada et al. (2022), who found 48% of KPIs to be related to GHG emissions.

Panel C presents the different penalty mechanisms included in the SLBs. Contrary to Berrada et al. (2022), who found 95% of the bonds with information to include a coupon step-up feature, only 68% of SLBs in my sample had a coupon step-up as the sole penalty mechanism. The final sample in this study resembles that of Feldhütter et al. (2023), who found 77% of SLBs to include coupon step-up or step-down features, while 10% had a one-time cash or redemption fee. The final sample in this study has a higher share of SLBs with a charity donation or purchase of carbon credits as its penalty compared to Feldhütter et al. (2023), who had a 5% share. That figure is likely due to the increased number of SLBs from Japan, who mostly feature either donations or carbon credit purchases as their penalty.

Table 3. Sustainability target themes, KPIs and penalty mechanisms

Panel A. KPI theme

Theme	# bonds	Percentage
Environmental	272	85.5 %
Social	7	2.2 %
Governance	8	2.5 %
E & S	20	6.3 %
E & G	9	2.8 %
E, S & G	1	0.3 %
No information	1	0.3 %
Total	**318**	**100 %**

Panel B. KPI items (multiple per SLB)		
KPI item	Count	Percentage
Greenhouse gas emissions	266	52.7 %
Renewable Energy	42	8.3 %
Energy Consumption/Efficiency	19	3.8 %
Increase in Women Board Members/Advisory Professionals	16	3.2 %
ESG Rating	12	2.4 %
Waste Management	11	2.2 %
Other	112	22.2 %
No information	27	5.3 %
Total	**505**	**100 %**
Panel C. Penalty mechanism		
Penalty mechanism	# bonds	Percentage
Coupon Step-up	215	67.6 %
Premium Redemption	37	11.6 %
Charity Donations/Carbon Credit	33	10.4 %
Other	22	6.9 %
Missing information	11	3.5 %
Total	**318**	**100 %**

*This table reports SLB characteristics for the bonds included in the final sample. Panel A describes the themes of the Sustainability Performance Targets (SPTs). Panel B displays the single KPI items included in the bonds, with some SLBs incuding several KPI items. Panel C presents the penalty mechanism for failing to meet the target.

Table 4 presents summary statistics of bond- and firm characteristics. The average maturity of the bonds included in the sample is 6.9 years, while the average coupon rate is 3.8%. These results resemble that of Berrada et al. (2022), who reported an average maturity of 7.6 years and an average coupon of 3.1% for SLBs. These figures are also similar to public green bonds reported in Flammer (2021); however, the number of certified bonds differs. In Flammer (2021), 50% of the green bonds were certified by an independent third party, compared to 88% of the SLBs in my final sample. The summary statistics also show that 57% of the bonds in the final sample include a call option. This is slightly higher than the 45% reported for SLBs in Kölbel and Lambillon (2022). The mean of the issuer's total assets is $33.85 billion, clearly smaller than the green bond sample used by Baulkaran (2019), who reported a mean of $544.2 billion. Baulkaran (2019) reports that the firm size is highly skewed by large financial institutions. Due to the relatively lower share of financial firms issuing SLBs, the firm size of the final sample in this study is not skewed by major financial institutions.

Regarding financial ratios, the averages align with green bond issuers in Flammer (2021) and Baulkaran (2019). However, SLBs have lower average Refinitiv Environmental and Social pillar scores than Flammer (2021), while the Governance score remains similar. The amount issued, which has a mean of $523 million, is slightly lower than that of Baulkaran (2019), who reports an average issue size of $872 million.

The average total cumulative penalty for failing to reach all KPIs included in the SLBs is 0.75%. Although the median one-time penalty fee is 0.25% and the mean 0.30%, the total penalty is increased due to the several coupon payments affected by missing the target. This number is similar to that reported by Berrada et al. (2022), who found a cumulative total penalty of 0.88%.

Overall, the summary statistics do not show significant irregularities with the SLB sample included in Berrada et al. (2022). Also, in terms of green bonds, the main difference with SLBs is the smaller size of the issuer, both in terms of total assets and market capitalisation.

Table 4. Bond- and firm-level summary statistics

	N	Mean	Std. dev.	Min	Max
Panel A. Firm characteristics					
Total assets $B	219	33.85	50.99	0.71	236.02
Market cap. $B	219	17.14	25.25	0.06	132.65
Return on assets (%)	219	0.06	0.06	-0.07	0.36
Leverage ratio (%)	219	0.38	0.16	0.00	0.87
Cash flow ratio (%)	219	0.07	0.06	-0.09	0.25
Tobin's Q (%)	219	1.37	0.73	0.55	4.78
Environmental score	201	65.36	19.21	7.40	97.00
Social score	201	67.99	20.71	8.57	97.78
Governance score	201	62.10	20.74	10.00	99.00
Panel B. Bond characteristics					
Maturity (years)	318	6.89	2.82	1.00	15.00
Coupon (%)	318	3.80	2.81	0.00	10.62
Callable	318	0.57	0.50	0.00	1.00
SPO-ceritified	318	0.88	0.33	0.00	1.00
Amount issued. $m	318	523.32	586.45	26.77	3500.00
Total penalty (%)	297	0.75	0.53	0.01	2.25

*This table presents firm (at first issuance) and bond (issuer-day) characteristics for the final sample. Return on assets equals EBIT/total assets. Leverage ratio is total debt/total assets. Cash flow ratio is equaled to the operating cash flow/total assets. Tobin's Q is calculated as the market value of assets (market value of equity + (total assets – book value of equity) divided by total assets. Callable equals 1 if the bond includes a call option and 0 otherwise. Total penalty is the highest total cumulative penalty for failing to meet the sustainability performance targets outlined in the SLB.

4. Methodology

This section presents the methodologies employed in this study. First, the event study designed to examine whether SLBs generate abnormal announcement returns is presented, along with several robustness tests. Next, a regression analysis conducted to investigate whether certain firm- and bond-specific characteristics impact the returns is introduced, with the motivation behind the choice of variables discussed. Finally, a difference-in-difference analysis used to assess changes in ESG performance and institutional ownership post-SLB issuance is outlined while detailing the matching procedure and dependent variables utilised.

4.1. Event study methodology

This study uses an event study methodology to study the effect of the stock price reaction on sustainability-linked bond announcements. Event studies are used to analyse fluctuations in stock prices of companies around corporate events and have been used in previous research on different security offerings (e.g., Eckbo, 1986) and ESG bond announcements (e.g., Flammer, 2021). Event studies are useful because the size of the abnormal returns offers a measure of the value of the event placed by investors. The high signal-to-noise ratio of stock returns compared to the less updated accounting measures also increases the likelihood of capturing the effect of the SLB announcement instead of other events during the year (Krüger, 2015). As mentioned, given findings on an insignificant reaction following conventional bond issuances (e.g. Eckbo, 1986), I assume that the announcement returns are driven by the additional sustainability commitment within the bond (Flammer, 2021)

The variable of interest in the event study is the abnormal return during an event window, with the event date (t=0) being the announcement date of the SLB issuance. In line with Flammer (2021) and Tang and Zhang (2020), I will use a 16-day event window, or [-5, 10], to capture the effect of the SLB announcement. The reasoning behind the use of multi-day event windows stems from the fact that there is a chance that information regarding the issuance could have been revealed before the official announcement date as well as to account for a staggered response (Flammer, 2021; Krüger, 2015). In addition to the information leakage and staggered response motivation proposed by other studies, the differing bond announcement dates in the

Refinitiv and Bloomberg databases (discussed in Section 3) suggest that a wider time frame is more appropriate in this study setting to ensure that the announcement is included in the event window. Following Flammer (2021), time intervals prior to and after the event windows, [−20, −11], [−10, −6] and [11, 20] are also analysed to identify a potential run-up in stock prices.

To identify the normal returns around each event, I use the market model, which is the most commonly used method in event studies (Ahern, 2009). In a meta-study covering 400 event studies, Holler (2014) found that almost 80% of the studies used the market model.

The estimation period for normal returns varies between the type of study, with Holler (2014) indicating a range between 30 and 750 days. In the examined studies on ESG-related events (Baulkaran, 2019; Flammer, 2021; Krüger, 2015; Tang & Zhang, 2020), the estimation period varies between 200 and 250 days. Although increasing the estimation period may improve the precision of the beta and alpha estimates, it can also lead to them becoming outdated. Nevertheless, Armitage (1995) suggests that results are often unaffected by minor deviations in the estimation period. As such, the 230-day estimation period employed in this study [-250, -21] is not expected to impact findings.

Each firm's main domestic equity index is used as the market index. Campbell et al. (2010) show that using the domestic market index and home currency returns is sufficient in multi-country event studies. Armitage (1995) also suggests that event studies examining abnormal returns are generally robust to the choice of the market index. Nevertheless, the MSCI All Country World Equity Index in USD, hereafter the global index, is also included as a robustness check, with returns of all stocks converted to USD.

Following Campbell et al. (1997), I regress the returns from the estimation period of each firm (i) on the market model. Normal returns for the event window are then determined by using the obtained estimations according to Equation (1):

$$\hat{R}_{it} = \hat{\alpha}_i + \hat{\beta}_i \times R_{mt} \tag{1}$$

For t = (-250, -21)

Abnormal returns are calculated by taking the actual stock return on a given event day minus the estimated normal returns according to Equation (2):

$$AR_{it} = R_{it} - \hat{R}_{it}$$

(2)

To obtain the overall effect on the stock returns following SLB announcements, the average abnormal return (AAR) of all analysed SLB announcements (i) for the individual days (t) within the event window is calculated using Equation (3):

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it}$$

(3)

The formulas used to calculate the cumulative abnormal returns (CAR) for single observations and the cumulative average abnormal returns (CAAR) for all observations are specified in Equation (4) and Equation (5), respectively. Here, t_1 is the first day of the event window and t_2 represents the last day of the event window:

$$CAR_{i[t_1,t_2]} = \sum_{t=t_1}^{t_2} AR_{it}$$

(4)

Moreover, for all SLB announcements included in the analysis:

$$CAAR_{[t_1,t_2]} = \frac{1}{N}\sum_{i=1}^{N} CAR_{i[t_1,t_2]}$$

(5)

The cross-sectional t-test is the primary test to determine whether the CAAR is statistically different from zero. The test statistic is specified in Equation (6) according to Müller (2023):

$$t(CAAR_{[t_1,t_2]}) = \frac{CAAR_{[t_1,t_2]}}{S_{CAAR_{[t_1,t_2]}}}$$

(6)

Where:

$$S^2_{CAAR_{[t_1,t_2]}} = \frac{1}{N-1}\sum_{i=1}^{N}(CAR_{i[t_1,t_2]} - CAAR_{[t_1,t_2]})^2$$

(7)

In Equation (6), $CAAR_{[t_1,t_2]}$ represents the cumulative (average) abnormal returns for all observations obtained in Equation (5), with $S_{CAAR_{[t_1,t_2]}}$ being the standard deviation obtained by taking the square of $S^2_{CAAR_{[t_1,t_2]}}$ in Equation (7). Here, $CAR_{i[t_1,t_2]_i}$ is the cumulative abnormal return for a single firm (i) obtained using Equation (4).

The cross-sectional test and other parametric tests specifically designed for event studies are the most widely used significance tests in event studies covering multiple days (Kolari & Pynnönen, 2011). Event studies on green bonds (e.g., Baulkaran, 2019; Tang & Zhang, 2020) have primarily relied on the t-test to determine the significance of cumulative abnormal returns. Therefore, the t-test is also used in this study as the primary significance test to increase comparability.

In addition to looking at the total sample of all SLB announcements, I investigate certain sub-samples to gain insights into the propositions highlighted in Section 2.7.1. As such, I investigate the CAARs for first-time and subsequent issues, bonds issued in Europe and outside Europe and SLBs issued before and after 2022. I also investigate whether the stock market reaction is different for carbon-intensive industries. A carbon-intensity industry classification by Wilson and Caldecott (2023) is used to segment carbon-intensive industries using Refintiv's TRBC industry code.[7]

In a study on sustainability bonds, Mocanu et al. (2021) included a matched sample of conventional bond issuances, determining the significance of the market reaction of sustainability bonds by examining the significance of the difference with conventional bonds. This study opted for the more traditional methodology employed in the majority of related studies (e.g., Baulkaran, 2019; Flammer, 2021; Tang & Zhang, 2020), as Borusyak and Jaravel (2018) report that control groups are more appropriate for studies where the event date is consistent between the treated and control firms, which is difficult to obtain with a matched sample of bond announcements.

[7] The difference in reactions between financial and nonfinancial firms as well as SPO-certified bonds is also of interest. Flammer (2021) found that only SPO-certified green bonds garner a significantly positive reaction, while Tang and Zhang (2020) report a similar result for nonfinancial green bond issuers. With 88% of SLBs included in the final sample of this study being ceritfied by SPOs and 90% issued by nonfinancials, the group sizes differ significantly and only the larger sample is presented as a robustness check to confirm that the results are not driven by either group.

4.1.1 Robustness tests

Event studies often include alternative significance tests and abnormal return estimation models to verify the results of their main models (e.g., Flammer, 2021; Krüger, 2015; Tang & Zhang, 2020). This provides robustness while also addressing the inherent joint-test problem in event studies. The joint-test problem arises because the results depend on whether the abnormal return significantly differs from zero and on the accuracy of the expected returns model (Kothari & Warner, 2007). Therefore, this study includes several robustness tests for significance testing and expected returns estimation to validate the primary analysis results.

4.1.1.1 Significance tests

A primary reason for parametric tests' popularity is that nonparametric tests' efficacy deteriorates in multiple-day event studies (Kolari & Pynnönen, 2011). However, stock prices are not normally distributed, often exhibiting high skewness and kurtosis (Ahern, 2009; Brown & Warner, 1985). Therefore, the assumption of normally distributed abnormal returns in parametric tests is violated. Non-parametric tests, by contrast, are more suitable for daily stock returns as they do not make assumptions about the distribution of returns (Ahern, 2009). Kolari and Pynnönen (2010) support this view, arguing that nonparametric tests should be used in event studies investigating abnormal returns. Consequently, event studies often apply nonparametric tests to verify the robustness of parametric test statistics and ensure that findings are not influenced by non-normal returns or outliers (Kolari & Pynnönen, 2011).

Concerning multi-country event studies, Campbell et al. (2010) found that the nonparametric rank test (Corrado, 1989) and the generalised sign test (Cowan, 1992), were more powerful than parametric tests, particularly in event windows covering multiple days. Parametric tests were notably prone to error in samples with country clustering and when firm-specific events influenced the domestic market index. Given that this study examines global sustainability-linked issuances, utilising the domestic market index for normal return estimation, the rank test (Corrado, 1989) is incorporated as a robustness check. The equation of the test statistic is presented in the Appendix (A2).

Despite Campbell et al.'s (2010) findings, Kolari and Pynnönen (2010) suggest that nonparametric tests may become misspecified for longer event windows or if the

event's effect occurs randomly during one day in the window. Given varied announcement dates from Bloomberg and Refinitiv and a 16-day event window, these concerns may apply to this study. Kolari and Pynnönen (2010) constructed an adjusted form of the parametric test of Boehmer et al. (1991), hereby called the adjusted BMP test, to help mitigate this issue. In addition to adjusting for event-induced variance included in the original BMP (Boehmer et al., 1991) test[8], the test also corrects for cross-sectional correlation in the case of clustered event days. Looking at Figure 2, the SLB announcement dates included in the final sample are relatively evenly spread across the sample period. Given the distribution of the SLB issuances, cross-sectional correlation due to event-date clustering is assumed not to affect the results as much as event studies focusing on widespread events such as disasters or new regulations. Nevertheless, as even a low correlation may lead to the over-rejection of the null hypothesis of no abnormal returns (Kolari & Pynnönen, 2010), the adjusted BMP test is included as an additional robustness check. The equation of the test statistic is presented in the Appendix (A2).

4.1.1.2 Fama-French three-factor model

Following Flammer (2021), I implement the global 3-factor model (Fama & French, 1993) as a robustness check. While only a small fraction (4%) of the 400 event studies reviewed by Holler (2014) applied multi-factor models, the use of the FF3 model helps address concerns that abnormal returns in the event window may stem from other known risk factors, such as size and value (Flammer, 2021). Due to the limited availability of domestic factors, I utilise the global market index as the market factor (R_m), alongside the daily developed size and value factors (SMB and HML) from the Kenneth R. French Data Library. These factors incorporate USD returns from stocks across 23 developed countries, representing 71% of the SLBs in the final sample. As such, the Fama-French model estimates daily normal returns (converted to USD) using Equation (8) (Ahern, 2009):

$$\hat{R}_{it} = \hat{\alpha}_i + \hat{\beta}_{1,i} \times R_{m,t} + \hat{\beta}_{2,i} \times SMB_t + \hat{\beta}_{3,i} \times HML_t \quad (8)$$

For t = (-250, -21)

[8] Boehmer et al. (1991) found that the use of historical returns potentially underestimates the variance due to the event impacting the returns and therefore the variance around the event.

Abnormal returns are again calculated based on Equation (2).

4.1.1.3 Market-adjusted return model

In addition to the previously proposed models, the market-adjusted return or market-adjusted model is employed as a robustness test. Holler (2014) reported that the market-adjusted model was utilised in 13% of the 400 event studies reviewed, making it the second most commonly used model. In the market-adjusted model, normal returns are assumed to be the market return of the domestic index. Consequently, abnormal returns are obtained by subtracting the return of the designated domestic market index on a given day in the event window from the actual stock return as specified in Equation (9) (Ahern, 2009):

$$AR_{it} = R_{it} - R_{mt} \tag{9}$$

The market-adjusted model is, in essence, a market model with restrictions, where β_i is constrained to 1 and α_i to 0 (Campbell et al., 1997). Campbell et al. (1997) argue that biases arise if the restrictions are false and should only be used in case of missing data. Despite its limitations, the market-adjusted model addresses concerns regarding the validity of beta and alpha estimates based on past returns (Welch, 2019; Pettengil & Clark, 2001), as no predicted return estimations are performed.

4.1.1.4 Adjusted-beta market model

For illustrative purposes, this paper explores an alternative method for estimating beta. Welch (2019) argued that in contexts that aim to predict future returns, beta estimates obtained by regressing historical stock returns on the market (hereafter referred to as OLS betas) may not effectively minimise variance in the out-of-sample period. Blume (1975) documented that betas tend to be mean-reverting, meaning that the beta moves towards the market value of 1. Therefore, the OLS beta, estimated using historical data, is a biased estimate of the future value. Practitioners often employ a simplified version of Blume's (1975) beta, called the Bloomberg beta, applying a shrinkage of 2/3 to the OLS beta (Welch, 2019). In line with the illustrative nature of this robustness check, this study adopts a similar approach. Following Carrol & Fok (1995), normal returns are estimated similarly to the market model, but with a

constant shrinkage term $\kappa = \frac{2}{3}$ applied to the OLS beta, along with an additional fixed constant of $\frac{1}{3}$ as shown in Equation (10):

$$\hat{R}_{it} = \hat{\alpha}_i + (\frac{2}{3}\,\hat{\beta}_i + \frac{1}{3}) \times R_{mt} \tag{10}$$

For t = (-250, -21)

Abnormal returns are again calculated based on Equation (2).

Carroll and Fok (1995) utilised the Blume (1975) and Bloomberg beta in their study on the impact of adjusted betas on dividend announcement event studies, suggesting that adjustments may be beneficial when results are influenced by the mean-reverting nature of betas. Still, given the limited use of the Blume/Bloomberg betas in event studies, no conclusions are drawn based on the results. [9]

4.1.1.5 Alpha-excluding market model

There has been little focus in event study literature on the effect of biased alphas on results, with most studies primarily focusing on beta estimation (Pettengil & Clark, 2001). However, Pettengil and Clark (2001) argue that alphas may significantly influence results in event studies involving multiple momentum stocks or multi-day event windows, as higher alphas would lead to inflated normal returns beyond what is justified by beta risk. Furthermore, the transferability of alpha from the estimation period using past returns may introduce bias, as returns are not stationary and alpha is not a constant parameter (Pénasse, 2022). Therefore, this study also incorporates a model to demonstrate the effect of the alpha estimate on abnormal returns. Pettengil and Clark (2001) proposed that biased estimates are avoided by estimating abnormal returns by excluding the alpha estimate as depicted in Equation (11):

$$AR_{it} = R_{it} - \hat{\beta}_i \times R_{mt} \tag{11}$$

For t = (-250, -21)

Similar to the adjusted-beta model, results are only included for illustrative purposes to explore the effect of the alpha estimate on outcomes.

[9] Alternative beta estimation techniques are not uncommon in event studies, with the Scholes-Williams (1977) and Dimson (1979) betas being the most prevalent. Event studies on bond announcements applying Blume (1975) betas include, e.g. Ashhari et al. (2009).

4.2. Firm- and bond-level regressions

Moving on to the identification of announcement return drivers, I follow Baulkaran (2019) and look at how bond (BC) and firm (FC) characteristics influence cumulative abnormal returns using Equation (12):

$$CAR_{i[-5,10]} = \alpha + \gamma' BC + \theta' FC + \epsilon_i \quad (12)$$

Where $CAR_{i[-5,10]}$ are the cumulative abnormal returns obtained from Equation (4) for the market model explained in Section 4.1. Separate analyses are conducted using both the total sample and only first-time issuances. Vector BC encompasses various bond characteristics, such as maturity and coupon rate, which are elaborated upon in the next section. Vector FC controls for several firm characteristics, including size and profitability, further discussed in Section 4.2.2.

Additionally, following the approach of Hagendorff et al. (2013), I incorporate country and year effects into the analysis. This ensures that the findings are not driven by specific country or year characteristics. For instance, differences in coupon rates may be influenced not only by the issuing firm's interest rate risk but also by the country's interest rates.

4.2.1 Bond characteristics

Baulkaran (2019) used the bond coupon as a proxy for the cost of debt, given that the yield to maturity is commonly unavailable for most bonds. The study found the coupon rate to be negatively related to cumulative abnormal returns following green bond announcements and is therefore included in this study. In bonds with floating coupon rates, the rate at issuance is employed.

The bond's maturity is also included as a variable, as it is related to the measurement period of the SPTs included in the sustainability-linked bonds (Berrada et al., 2022). Hinsche and Klump (2023) argued that market participants prefer shorter-term targets over long-term targets, linking it to investor concerns surrounding the materiality and ambitiousness of the targets included in SLBs. As such, longer-maturity SLBs may face a lower stock market reaction.

Callability is included as another bond characteristic. Ul Haq and Doumbia (2021) raised concerns over the use of call options in SLBs to minimise penalties. Therefore, it could be assumed that the market views call options negatively.

Berrada et al. (2022) argued that the relative size of the sustainability-linked bond issue should positively impact announcement returns if the bond is mispriced due to a wealth transfer from bond- to shareholders. Therefore, the relative issue size, the issuance amount divided by the market capitalisation, is included as a variable in the regression.

Berrada et al. (2022) report that a higher penalty indicates a stronger commitment to meeting sustainability targets, as the cost of missing these targets is more severe. This follows from signalling theory (Spence, 1978), which argues that the strength of a signal increases with its cost. Therefore, this study also includes the total penalty as a percentage of the amount issued as a bond characteristic. The total penalty variable is constructed by calculating the highest possible penalty for missing all KPIs in the bond, making it comparable across SLBs with a varying number of KPIs. Given that the SLBs in the final sample have different penalty mechanisms (see Table 3), I standardise the penalties for comparison. Specifically, I calculate the total cost over the bond's lifetime for SLBs with multiple payments (e.g., coupon step-ups). This was done using the coupon frequency, payment effective date of the coupon step-up, step-up amount, and maturity date. For instance, an SLB with a 0.25% coupon step-up affecting three payment dates has a total penalty of 0.75%. This is, in essence, a simplified measure to that used by Berrada et al. (2022), who construct a cumulative discounted penalty variable, thereby accounting for time.

4.2.2 Firm characteristics

Serafeim and Yoon (2023) found a smaller stock price reaction following ESG news for companies with high ESG ratings. On the other hand, Berrada et al. (2022) suggested that bond investors may interpret a high ESG score as a signal for a higher probability of reaching the sustainability target. Given the evidence of a potential impact, I include individual ESG pillar scores as a firm characteristic in the regression.

I follow previous literature (Hagendorff et al., 2013; Baulkaran, 2019) and include firm size, profitability and leverage as additional firm characteristics.

Firm size, measured as the natural logarithm of total assets, may positively impact SLB announcement returns. Aouadi and Marsat (2018) argue that large firms may

receive more attention from investors and, therefore, a higher market reaction following ESG news. In addition, Baulkaran (2019) found firm size to be positively related to cumulative abnormal returns following green bond announcements.

Leverage is measured by dividing the total debt by the total assets and is included to account for a firm's exposure to financial distress (Hagendorff et al., 2013).

Mocanu et al. (2021) found that return on assets positively affects the announcement return of sustainability bonds. Therefore, I divide operating income by total assets (return on assets) to proxy for profitability.

Strong operating cash flows have been linked to agency problems, as managers may misuse or take advantage of excess cash (Tang & Zhang, 2020). Baulkaran (2019) found that the cash flow ratio was negatively related to cumulative abnormal returns following green bond issues. Therefore, the cash flow ratio, defined by the operating cash flow divided by total assets, will be included as a variable.

Finally, Tobin's Q will be used as a proxy for value, as investors may associate a high Tobin's Q with better growth opportunities and the likelihood that the firm will invest in value-enhancing projects. Baulkaran (2019) found Tobin's Q to be positively related to cumulative abnormal returns following green bond announcements. The variable is defined as (market value of equity+(total assets minus book value of equity)) divided by total assets.

4.3. SLBs and firm-level outcomes

This section describes the methodology used to analyse the development of firm-level outcomes after SLB issuances. The two main dependent variables, ESG performance and institutional ownership, are first introduced before the matching approach is described to find a counterfactual on how the dependent variables would change without an SLB issuance. Lastly, the estimated difference-in-difference specification used to determine the effect of SLB issuances on ESG performance and institutional ownership is explained.

4.3.1 Dependent variables

4.3.1.1 ESG performance

To avoid a penalty, SLB issuers have a monetary incentive to improve their performance regarding the sustainability performance target (SPT) included in the

bond. Due to potential greenwashing concerns discussed in Section 2.6, investigating several sustainability measures can help distinguish whether firms only focus on the SPTs included in the bond or incorporate a more holistic approach, where reducing the overall environmental impact is truly a firm's objective.

The first sustainability measure to be used is Refinitiv's ESG score, which is an aggregation of individual Environmental (E), Social (S) and Governance (G) scores. In addition, I include the E, S and G pillar scores as separate dependent variables. The pillar scores are calculated based on a firm's performance across several themes relevant to the individual categories. The Environmental pillar score is of specific interest, as 95% of the SLBs issued in my sample include at least one environmental KPI (Table 3). As 56% of these concern greenhouse gas (GHG) emissions, I also include Refinitiv's emission score, which measures a firm's effectiveness and commitment to reducing emissions.

Cregan et al. (2023) found evidence that emission scores do not successfully incorporate total CO2 emissions and intensity, adding that a substantial divergence across providers exists. Therefore, this study also looks at the effect on CO2 emission intensity, measured in total Scope 1 and 2 emissions (in metric tons) divided by a firm's revenue (million USD). The use of CO2 emission intensity captures each firm's carbon emission reduction efforts while controlling for changes to the amount of its operations (Busch et al., 2023). As such, including the emission intensity as a dependent variable provides a more objective measure of performance than Refinitiv ESG scores. In addition, changes in CO2 emissions are also easier to interpret than ESG scores, as emissions do not include several dimensions of environmental behaviour (Flammer, 2021).[10] Jalonen (2023) did not include actual emission data in his analysis of ESG performance, which increases the novel knowledge obtained from this study.

To distinguish the effect of the SLB issuance, I retain the value of the dependent variables at the time of the bond announcement for each firm and require at least one firm-year observation both before and after the issuance.

[10] Scope 3 scores would undeniably provide interesting implications on the performance outside of the KPIs, as most KPIs concern Scope 1 & 2 emissions. However, due to limited data availability and quality, Scope 3 emissions will not be used as a sole dependent variable

4.3.1.2 Institutional ownership

As my study aims to identify how SLBs are perceived from an investor's perspective, an increase in institutional ownership can provide information on whether SLBs are seen to improve the prospective fundamental or sustainability performance of the issuing firm. In addition, it may provide more background on the potential stock market reaction following SLB issuances, as stock prices can respond quickly to changes in demand (Koijen & Yogo, 2019).

As mentioned in Section 3.1, this study uses FactSet institutional ownership data to measure the effect of SLB issuances on institutional ownership. The study follows Tang and Zhang (2020) and uses both total institutional ownership in percentage of market capitalisation as well as the natural logarithm of total institutional ownership (USD) as dependent variables. In addition, the same variables are also used for domestic and foreign institutional investors.

4.3.2 Matching approach

To mitigate endogeneity concerns, this paper uses a similar matching methodology as Flammer (2021) to provide a counterfactual on how the firm-level outcomes would evolve without an SLB issue. More specifically, nearest neighbour matching without replacement is utilised, meaning that each SLB issuer is matched with only one control unit. Given that the matching approach is designed to find a control group that resembles the treated group as closely as possible, I follow Flammer (2021) and use the same matching characteristics for the ESG performance and institutional ownership analysis.

There may be omitted variables that could impact a firm's decision to issue bonds and subsequently improve their future ESG scores or attract a wider investor base. As such, I follow Flammer (2021) and Tang and Zhang (2020) and only match SLB issuers each year with firms that have issued a conventional bond in the same year to distinguish the effect of the SLB.

Previous findings show that firms issuing green bonds improve their environmental performance (Flammer, 2021) and see an increase in institutional ownership (Tang & Zhang, 2020). Therefore, I exclude issuers of other ESG bonds from the initial matching pool. To control for country and industry characteristics and certify that the firms face similar business conditions, I also insist that the

conventional bond issuer is in the same domicile and operates within the same sector regarding Refinitiv's two-digit TRBC industry classification code.

Nearest neighbour matching with Mahalanobis distance is then used to find a pair from the remaining potential control firms based on firm-level variables. This study uses the same matching variables as Flammer (2021). These include firm size (natural logarithm of total assets), Tobin's Q, return on assets, leverage ratio and E, S and G scores at t-1 and the change from t-2 to t-1. Using lags establishes that the SLB and conventional bond issuers have followed a parallel trend before the issuance and confirm that they are as comparable as possible. Due to the limited availability of ESG scores for some firms, I only include the change from t-2 and t-1, as the change from t-3 and t-2 would exclude several firms from the analysis.

The motivation behind including firm size comes from findings showing that size positively correlates with higher ESG Scores (Drempetic et al., 2020). Hong and Kacperczyk (2009), on the other hand, find that firms with lower ESG performance have higher leverage ratios. Using past ESG scores is also essential, as Busch et al. (2023) argue that ESG scores likely do not follow a linear trend, with firms with already high ESG scores requiring more effort to achieve further improvements. Return on assets and Tobin's Q warrant that potential changes in future ESG performance are not due to better growth opportunities prior to the issuance (Flammer, 2021). These characteristics are also relevant in terms of institutional ownership, as they may impact the attractiveness of the firm.

4.3.2.1 Matched sample for ESG performance analysis

The final sample for the previously introduced analyses included 219 unique issuer firms. As the primary dependent variable for determining ESG performance is Refinitiv's ESG scores, which are reported for each financial year, only SLBs issued before 2023 are included. This is because, as of February 2023, ESG scores for the latest financial year were unavailable for most firms. Therefore, the initial pool consists of 166 unique SLB issuers between 2019 and 2022.

Eighteen firms were excluded due to a lack of Refinitiv's ESG coverage or insufficient data, leaving 148 firms before matching. Of these 148 firms, 105 are matched with a conventional bond issuer from the same year, domicile, and industry. Most unmatched firms did not find a comparable firm due to the strict requirements

of being in the same sector and country, having available ESG scores, and having issued a conventional bond in the same year.

Table 5. Matched sample used in ESG performance analysis

		Obs.	Mean	Std. dev.	p-value (diff. In means)
Panel A: Matching characteristics					
Size	SLB issuer	105	16.523	1.650	0.721
	Matched CB issuer	105	16.443	1.609	
Return on Assets	SLB issuer	105	0.062	0.051	0.080*
	Matched CB issuer	105	0.048	0.063	
Tobin's Q	SLB issuer	105	1.662	1.549	0.131
	Matched CB issuer	105	1.408	0.738	
Leverage ratio	SLB issuer	105	0.353	0.137	0.114
	Matched CB issuer	105	0.387	0.166	
Environmental score	SLB issuer	105	66.501	20.004	0.014**
	Matched CB issuer	105	58.836	24.698	
Social score	SLB issuer	105	68.399	21.720	0.008***
	Matched CB issuer	105	60.163	22.564	
Governance score	SLB issuer	105	61.423	21.214	0.104
	Matched CB issuer	105	56.578	21.724	
Δ Size	SLB issuer	105	0.117	0.688	0.956
	Matched CB issuer	105	0.112	0.684	
Δ Return on Assets	SLB issuer	105	0.001	0.036	0.310
	Matched CB issuer	105	-0.005	0.043	
Δ Tobin's Q	SLB issuer	105	0.071	0.717	0.337
	Matched CB issuer	105	-0.001	0.264	
Δ Leverage ratio	SLB issuer	105	0.010	0.056	0.435
	Matched CB issuer	105	0.017	0.070	
Δ Environmental score	SLB issuer	105	1.241	6.419	0.284
	Matched CB issuer	105	2.271	7.427	
Δ Social score	SLB issuer	105	1.462	7.099	0.753
	Matched CB issuer	105	1.745	5.857	
Δ Governance score	SLB issuer	105	2.665	12.353	0.829
	Matched CB issuer	105	2.297	12.270	
Panel B: Other characteristics					
ESG score	SLB issuer	105	66.145	16.843	0.006***
	Matched CB issuer	105	59.202	19.358	
Emissions score	SLB issuer	105	73.323	21.640	0.004***
	Matched CB issuer	105	63.136	28.350	
Institutional ownership (%)	SLB issuer	105	35.623	24.960	0.952
	Matched CB issuer	105	35.834	25.368	
Δ ESG score	SLB issuer	105	1.784	6.173	0.576
	Matched CB issuer	105	2.210	6.105	
Δ Emissions score	SLB issuer	105	2.695	11.019	0.436
	Matched CB issuer	105	1.556	10.103	
Δ Institutional ownership (%)	SLB issuer	105	-0.360	4.653	0.576
	Matched CB issuer	105	-0.003	4.623	

*This table presents the descriptive statistics of the matched treatment and control firms used in the ESG perfromance difference-in-difference analysis. The table presents both the statistics in the year preceding the issuance as well as the change between t-2 and t-1 (marked with a Δ). Panel A includes variables used in the matching procedure, while Panel B presents other relevant characteristics. The last column reports the p-value of a difference-in-means test. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 5 presents descriptive statistics for the sample of SLB issuers and the matched control group of conventional bond issuers used in the ESG performance analysis. Panel A includes matching variables, while Panel B reports statistics for other relevant variables. The table presents the statistics in the year before the issuance and the change between t-2 and t-1 (marked with a Δ).

Regarding accounting variables, only return on assets is significantly different between the treatment and control group (10% level), suggesting that the control firms provide a reliable counterfactual for the SLBs in terms of accounting performance. Other considerable differences, although insignificant, come from the treated group having a slightly higher Tobin's Q and a lower leverage ratio. As mentioned earlier, previous findings suggest that the treated group would have a slight advantage, as profitability and firm value are associated with high ESG scores, while leverage is associated with lower ESG performance. The differences are all statistically insignificant regarding changes from t-2 and t-1. However, the matched group decreased their return on assets and Tobin's Q.

In terms of ESG performance, the results are different. The treated firms have significantly higher Environmental and Social scores, which may affect results, as firms with already high ESG scores might require more effort to increase them further (Busch et al., 2023). SLB issuers also have a higher Governance pillar score; however, the difference is insignificant. Regarding the pre-trend, the matched group has a slightly higher improvement in Environmental and Social pillar scores, while SLB issuers have increased their Governance score more. These differences, however, remain insignificant, which increases the comparability of the two groups due to similar pre-trends.[11]

4.3.2.2 Matched sample for institutional ownership analysis

As mentioned, institutional ownership and ESG performance analysis follow the same matching approach. However, all 219 unique issuers are now included in the initial matching pool, as data on institutional ownership at the end of 2023 was available for all firms. However, in my initial sample of 219 unique SLB issuers, 18 firms were not included in Refinitiv's ESG coverage, while another 8 bonds did not have sufficient

[11] Although not reported, of the 105 SLBs used in the ESG performance analysis, 81% only included environmental KPIs. In addition, of the SLBs with information on the specific KPIs, 62% had carbon reduction targets.

data. Therefore, these firms are excluded from the matching procedure, leaving 193 firms. Out of these 193 firms, 140 were matched using nearest-neighbour matching based on the aforementioned variables. Most unmatched SLB issuers (53) could not find a match for the same reasons highlighted in the previous section.

Table 6. Matched sample used in institutional ownership analysis

		Obs.	Mean	Std. dev.	p-value (diff. In means)
Panel A: Matching characteristics					
Size	SLB issuer	140	16.476	1.625	0.592
	Matched CB issuer	140	16.585	1.773	
Return on assets	SLB issuer	140	0.059	0.048	0.122
	Matched CB issuer	140	0.049	0.061	
Tobin's Q	SLB issuer	140	1.533	1.374	0.556
	Matched CB issuer	140	1.429	1.561	
Leverage ratio	SLB issuer	140	0.350	0.150	0.540
	Matched CB issuer	140	0.361	0.168	
Environmental score	SLB issuer	140	65.834	19.317	0.073*
	Matched CB issuer	140	61.271	22.972	
Social score	SLB issuer	140	67.726	21.198	0.046**
	Matched CB issuer	140	62.521	22.219	
Governance score	SLB issuer	140	61.703	20.698	0.097*
	Matched CB issuer	140	57.518	21.402	
Δ Size	SLB issuer	140	0.087	0.598	0.771
	Matched CB issuer	140	0.108	0.609	
Δ Return on assets	SLB issuer	140	0.000	0.035	0.490
	Matched CB issuer	140	-0.003	0.047	
Δ Tobin's Q	SLB issuer	140	-0.017	0.719	0.869
	Matched CB issuer	140	-0.028	0.400	
Δ Leverage ratio	SLB issuer	140	0.009	0.053	0.213
	Matched CB issuer	140	0.018	0.070	
Δ Environmental score	SLB issuer	140	1.450	5.947	0.465
	Matched CB issuer	140	2.035	7.363	
Δ Social score	SLB issuer	140	1.467	21.198	0.465
	Matched CB issuer	140	1.227	6.175	
Δ Governance score	SLB issuer	140	2.295	12.302	0.390
	Matched CB issuer	140	1.029	12.310	
Panel B: Other characteristics					
ESG score	SLB issuer	140	65.711	16.069	0.026**
	Matched CB issuer	140	61.050	18.617	
Emissions score	SLB issuer	140	74.030	21.469	0.016**
	Matched CB issuer	140	67.274	25.193	
Institutional ownership (%)	SLB issuer	140	34.845	23.946	0.958
	Matched CB issuer	140	34.690	24.616	
Δ ESG score	SLB issuer	140	1.825	6.017	0.635
	Matched CB issuer	140	1.481	6.089	
Δ Emissions score	SLB issuer	140	2.582	10.546	0.780
	Matched CB issuer	140	2.233	6.089	
Δ Institutional ownership (%)	SLB issuer	140	-0.345	4.367	0.742
	Matched CB issuer	140	-0.174	4.272	

*This table presents the descriptive statistics of the matched treatment and control firms used in the institutional ownership difference-in-difference analysis. The table presents both the statistics in the year preceding the issuance as well as the change between t-2 and t-1 (marked with a Δ). Panel A includes variables used in the matching procedure, while Panel B presents other relevant characteristics. The last column reports the p-value of a difference-in-means test. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 6 presents summary statistics for the matching variables (Panel A) and other relevant characteristics (Panel B) for the sample used in the institutional ownership analysis. The matching shows results similar to those in Table 6. However, the difference between the treatment and control group is smaller when looking at return on assets and ESG scores, with the overall ESG, Social pillar and emission scores now only significantly different at the 5% level and the Environmental and Governance pillar scores at the 10% level. In terms of institutional ownership, there are no notable differences in the year preceding the issuance or in the pre-trend, which increases the likelihood that the matched conventional bond sample is a fitting counterfactual for the SLBs for the institutional ownership analysis.

4.3.3 Difference-in-Differences specification

To determine the change in firm-level outcomes following SLB issuances, I perform a difference-in-difference (DiD) analysis by estimating the following panel regression on issuer-year observations of SLB issuers and matched conventional bond issuers:

$$y_{it} = \alpha + \beta_1 \times Post_{it} \times SLB_i + \beta_2 \times Post_{it} + \beta_3 \times SLB_i + Firm\ FE + Country \times Year\ FE + Industry \times Year\ FE + \epsilon_{it} \quad (13)$$

y_{it} is the different ESG performance measures and institutional ownership variables used as the dependent variables. $Post_{it}$ is a dummy variable equaling 1 for years after the issuance and 0 otherwise. SLB_{it} is a dummy variable equalling 1 if the firm is an SLB issuer and 0 otherwise. β_1 captures a difference-in-differences estimator on whether SLB issuers experience a change in the dependent variable after issuing SLBs compared to the matched control firms. I also follow Flammer (2021) and Dursun-de Neef et al. (2023) by including firm, country-by-year and industry-by-year fixed effects. Once included, the SLB_{it} variable will be colinear with the firm fixed effects and, therefore, dropped from the analysis.

Firm fixed effects are used to account for unobserved firm characteristics that do not change over time. In contrast, country-by-year and industry-by-year fixed effects are included to control for common shocks (e.g., macroeconomic shocks, policy changes or industry-specific events) or capture any time trend affecting all entities

within a country or industry in a given year. For example, there may be notable variations in environmental impact, disclosure requirements and regulations between different countries and industries that may impact ESG performance (Lys et al., 2015). In addition, I follow Busch et al. (2023) and include firm-clustered standard errors to account for correlated error terms.

5. Results

This section details the empirical results from the models explained in Section 4, following a similar structure to the rest of the paper. First, the event study results are present, followed by the firm- and bond-level regressions. Subsequently, the difference-in-difference analysis results are shown, starting with the ESG performance following SLB issuances and then moving on to the changes in institutional ownership.

5.1. Event study

Table 7 presents the average abnormal returns (AARs) for individual days for the main event window [-5, 10]. The sample used in the analysis includes all 318 issuer-day observations from the final sample. The results show a largely positive trend. However, the announcement date (0) is noticeably insignificant. The only significant AAR can be found eight days after the announcement date when the daily average abnormal return is 0.23%. It is worth noting that due to the deviations of announcement dates between the databases (discussed in Section 3.1) and potential information leakage, it is more informative to look at multi-day event windows, as the actual announcement date may not happen when the event day equals 0.

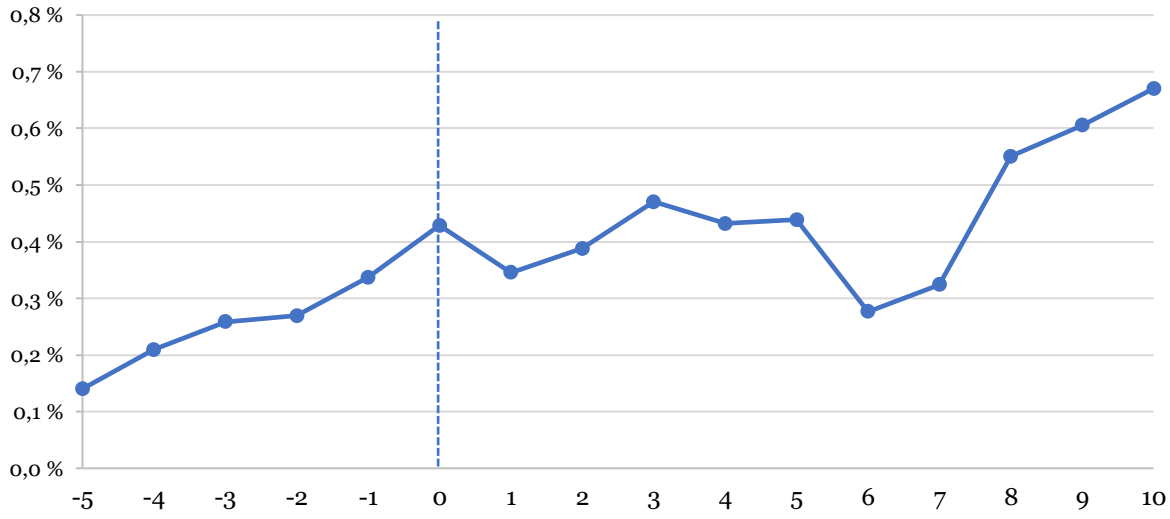
Figure 3 shows the cumulative (average) abnormal returns to all SLB issuances around a 16-day event window [-5, 10]. The plot shows an overall upward trend over the event window. However, there is a drop due to a negative average abnormal return on day 6 of 0.16%, following which the CAAR begins to rise again to the end value of 0.67%.

Table 7. Average abnormal returns around the event window

Event day	AAR (%)	t-stat	Adj-BMP test	Rank test
-5	0.140	1.321	1.006	1.605
-4	0.069	0.652	0.580	1.065
-3	0.049	0.462	0.681	0.250
-2	0.011	0.104	0.333	0.577
-1	0.068	0.638	1.150	1.534
0	0.092	0.863	0.716	0.547
1	-0.083	-0.786	-0.535	-0.514
2	0.042	0.399	0.935	0.778
3	0.083	0.781	0.659	0.089
4	-0.039	-0.365	-0.230	-0.378
5	0.007	0.065	0.339	0.114
6	-0.162	-1.526	-1.277	-1.232
7	0.047	0.446	0.527	0.493
8	0.227	2.135**	2.499**	2.269**
9	0.055	0.514	0.262	0.618
10	0.065	0.613	1.339	1.487

*This table reports the average abnormal returns (AAR) following SLB issuances for each event day included in the main event window [-5, 10]. T-stat is the t-statistic from a cross sectional test. Adj-BMP test is the adjusted t-statistic by (Kolari & Pynnönen, 2010) and Rank test is the z-statistic from the Corrado (1989) rank test. The sample includes all SLB issuer-day observations (N = 318). *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Figure 3. CAAR development over the event window



*This figure displays the cumulative (average) abnormal returns (CAAR) of the event study covering the total sample (N = 318). The figure illustrates results from the main event study presented in Table 8, meaning that the market model using the domestic indexes are used. The y-axis displays the percentage value of the CAAR, while the x-axis shows the days surrounding the SLB announcement date (0).

The results from the total sample event study are displayed in Table 8. The table reports the average cumulative (average) abnormal returns (CAAR) for the main event window and time windows around the announcement. As mentioned in Section 4.1, the cross-sectional t-test is used as the primary test to assess significance. The nonparametric Corrado (1989) rank test and the parametric adjusted-BMP test (Kolari & Pynnönen, 2010) are reported to assess the validity.

Table 8. Stock market reaction following all SLB issuances

Event time	CAAR (%)	t-stat	Adj-BMP test	Rank test
[-20, -11]	-0.123	-0.365	-0.377	-0.197
[-10, -6]	-0.310	-1.307	-1.416	-0.400
[−5, 10]	**0.670**	**1.562**	**2.470****	**2.337****
[11, 20]	-0.450	-1.338	-1.491	-1.826*

*This table reports the cumulative (average) abnormal returns (CAAR) for different time windows around the SLB issuance. T-stat is the t-statistic from a t-test assuming cross-sectional independence. Adj-BMP test is the adjusted t-statistic by (Kolari & Pynnönen, 2010) and Rank test is the z-statistic from the Corrado (1989) rank test. The sample includes all SLB issuer-day observations (N = 318). *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

The main event window [-5, 10] shows a positive average CAAR of 0.67%, but the result is insignificant using the t-test. However, the rank and adjusted BMP tests are significant at the 5% level, indicating some evidence of a significantly positive abnormal reaction. The direction predicted in Hypothesis 1, which anticipated a positive abnormal reaction to SLB issuances, is correct, and the alternative significance tests support rejecting the null hypothesis.

Nevertheless, Campbell et al. (2010) argued that using both nonparametric and parametric tests can lead to different conclusions, and nonparametric tests cannot be assumed to be well-specified without evidence of data non-normality or violations of parametric test assumptions. Therefore, I cannot reject the null hypothesis of no significant stock market reaction following SLB issuances.

This decision is further supported by alternative event windows reported in Table A1 in the Appendix, which show lower CAARs and inferior statistical significance. However, the negative and insignificant CAARs for the periods before and after the main event window in Table 8 suggest that the main event window captures the potential run-up and lagged response of the SLB issuance. Therefore, the alternative event windows reported in Table A1 in the Appendix may exclude essential effects. Interestingly, the alternative significance tests do not consistently reject the

null hypothesis at the 5% level in the alternative windows in Table A1, suggesting that these tests may not reject the null hypothesis too often.

Looking further at Table 8, the positive CAAR of the main event window seems to be mitigated by the time windows preceding and succeeding the SLB issuance. A negative reaction in the succeeding event windows could result from the market price correcting itself from a potentially irrational positive announcement effect. The effect is, however, insignificant.

Table 9. Stock market reaction of different sub-samples

	CAAR [-5, 10]	t-stat	Adj-BMP test	Rank test
Panel A: First vs. subsequent issues				
First-time SLB issue (N = 219)	0.891	1.687*	3.381***	2.420**
Subsequent SLB issue (N = 99)	0.219	0.297	0.232	0.825
Panel B: Europe vs. Rest of the world				
European issue (N = 142)	0.169	0.259	0.133	0.402
Rest of the world issue (N = 176)	1.089	1.912*	3.677***	2.776***
Panel C: Carbon-intensive industries				
Carbon-intensive industry (N = 196)	0.343	0.604	1.012	0.804
Other industries (N = 122)	1.226	1.885*	3.218***	2.860***
Panel C: Before vs. After January 2022				
Before January 2022 (N = 130)	0.357	0.486	0.713	0.242
After January 2022 (N = 188)	0.905	1.742*	2.778***	2.755***

*This table reports the cumulative (average) abnormal returns (CAAR) for different sub-samples of SLB issues. T-stat is the t-statistic from a cross sectional test. Adj-BMP test is the adjusted t-statistic by (Kolari & Pynnönen, 2010) and Rank test is the z-statistic from the Corrado (1989) rank test. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 9 presents the results for different sub-samples to determine if certain groups drive the announcement returns.

Panel A shows findings for first-time SLB issuances versus subsequent issuances by the same firm. The reaction is larger for first-time issues (0.89%) than for subsequent issues (0.22%). Unlike the full sample results, the CAAR for first-time issues is significant at the 10% level using the t-test. Additionally, the adjusted BMP test is significant at the 1% level and the rank test at the 5% level.

Panel B reports the CAAR for issuances in Europe versus the rest of the world. The CAAR is positive (1.09%) and significant at the 10% level for issuances outside Europe, while the reaction is smaller (0.17%) for issuances in Europe. Using the alternative significance tests, this finding is significant at the 1% level.

Panel C indicates that the market responds more positively to SLB announcements from non-carbon-intensive industries. The result is significant at the 10% level using the t-test and at the 1% level using the alternative significance tests.

Panel D reports the reaction to SLB issuances before and after January 2022. The results show a larger CAAR for issuances after January 2022, with significance at the 10% level using the t-test and at the 1% level using the alternative significance tests.

Table 10. Event study robustness checks

	CAAR [-5, 10]	t-stat	Adj-BMP test	Rank test
1. Global market model (N = 318)	0.714	1.437	2.001**	1.772*
2. FF3 Global Factor model (N = 318)	0.763	1.598	2.347**	1.684*
3. Market Adjusted Return (N = 318)	1.016	2.266**	3.203***	2.304**
4. Adj-beta market model (N = 318)	0.690	1.645	2.584**	2.226**
5. Alpha excl. market model (N = 318)	0.942	2.192**	3.133***	2.321**
6. Excluding Financials (N = 294)	0.699	1.578	2.630***	2.272**
7. SPO-certified bonds (N = 280)	0.674	1.491	2.005**	2.046**
8. SLB as first ESG bond (N = 164)	0.863	1.371	3.263***	2.439**

*This table reports the cumulative average abnormal returns (CAAR) for robustness checks around a 16-day event window [-5, 10]. T-stat is the t-statistic from a cross sectional test. Adj-BMP test is the adjusted t-statistic by (Kolari & Pynnönen, 2010) and Rank test is the z-statistic from the Corrado (1989) rank test. ∗, ∗∗, and ∗∗∗ denotes significance at the 10%, 5%, and 1% level, respectively.

Table 10 presents additional robustness checks for the event study. Replacing the domestic market indexes with the global index results in a slightly higher CAAR of 0.71%, but it remains insignificant. The rank test statistic is significant only at the 10% level, compared to 5% with domestic indexes, further supporting the null hypothesis of no significant stock price reaction. Using the FF3 model, which controls for additional risk factors, the CAAR increases slightly to 0.76%, but the significance tests yield similar results to the global market model. Excluding non-financial firms and non-SPO-certified bonds does not change the results from the total sample using the market model, as expected, given the relatively low number of bonds in these groups.

The market-adjusted return model finds a higher CAAR of 1.0%, which is significant at the 5% level using the t-test and rank test and at the 1% level with the adjusted BMP test. Although this does not alter the overall conclusions, it highlights the borderline significance of the positive market reaction, with t-statistics for the total sample across different models ranging between 1.44 and 2.27.

The adjusted beta model produces results similar to the market model, suggesting that the OLS betas do not significantly alter the findings compared to alternative estimation methods. However, the t-statistic approximates the 10% significance level, with a value of 1.645.

Excluding the estimated alpha from the market model yields results similar to the market-adjusted return model. The CAAR is 0.94%, which is significant at the 5% level using the t-test and rank test and at the 1% level with the adjusted BMP test. The market-adjusted return model assumes an alpha of 0 and a beta of 1, while the average beta for the total sample during the estimation period was 0.835, explaining the similar results. The lower average beta would technically suggest higher CAAR due to lower predicted normal returns, but this does not account for the variation of the estimated betas across firms.

To assess whether the higher positive abnormal return for first-time issuers in Panel A of Table 9 is influenced by prior green, social or sustainable bond issuances, a sub-sample of firms issuing their first ESG bond was analysed. The CAAR remains at 0.86% but becomes insignificant using the t-test. This indicates that a prior ESG bond issuance does not significantly lower the market reaction.

5.2. Firm- and bond-level regression analysis

Table 11 presents the results when regressing the 16-day CARs obtained from the main event study on several firm and bond-level characteristics. In column 1, the result for the whole sample is reported. In contrast, column 2 presents the results for observations with available Refinitiv ESG scores and the relevant information to calculate the total possible penalty for missing the targets included in the SLBs. Columns 3 and 4 report similar results but only include CARs for the first SLB issuance of a firm. Similarly to other studies using CAR as a dependent variable in regressions (e.g. Kruger, 2015), the adjusted R-squared is low across all columns, indicating that the model explains little of the variation in the cumulative abnormal returns.

Looking at Column 1, the direction of the coefficients for most bond- and firm-level characteristics aligns with the literature, with callability, maturity, coupon rate, and leverage ratio loading negatively on cumulative abnormal returns. Unexpectedly, the coefficient for Tobin's Q is negative, while the cash flow ratio is positive. Nevertheless, the coefficients are insignificant across all models.

Table 11. Firm- and bond-level regression analysis

	All firms	All firms	First-issue	First-issue
	(1)	(2)	(3)	(4)
Callability	-0.012	0.001	-0.024	-0.010
	(0.129)	(0.015)	(0.015)	(0.019)
Maturity	-0.003*	-0.005*	-0.003	-0.004
	(0.002)	(0.003)	(0.002)	(0.003)
Coupon (%)	-0.002	-0.002	-0.004	-0.004
	(0.002)	(0.002)	(0.003)	(0.003)
Cash flow ratio	0.051	0.084	0.129	0.168
	(0.095)	(0.105)	(0.107)	(0.125)
Firm size	0.010**	0.013**	0.009*	0.013*
	(0.004)	(0.006)	(0.005)	(0.007)
Leverage ratio	-0.003	0.005	0.014	0.011
	(0.034)	(0.040)	(0.045)	(0.052)
Return on Assets	0.103	0.140	-0.067	-0.018
	(0.116)	(0.113)	(0.137)	(0.154)
Tobin's Q	-0.002	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.003)
Relative issue size	0.061	0.069	0.064	0.075
	(0.050)	(0.056)	(0.073)	(0.080)
Environmental score		0.0008*		0.0009*
		(0.0004)		(0.0005)
Social score		-0.0005		-0.0006
		(0.0004)		(0.0004)
Governance score		-0.0005**		-0.0006*
		(0.0003)		(0.0003)
Total penalty (%)		0.005		0.005
		(0.010)		(0.015)
Constant	-0.221**	-0.257**	-0.216	-0.265*
	(0.093)	(0.104)	(0.133)	(0.157)
Year effects	Yes	Yes	Yes	Yes
Country effects	Yes	Yes	Yes	Yes
Observations	318	279	219	189
Adj-R2	0.032	0.035	0.022	0.010

*This table reports regressions of cumulative (average) abnormal retuns on bond and firm characteristics. The dependent variable is the cumulative abnormal returns (CAR) of a 16-day even window. Callability is a dummy varibale equal to 1 if the SLB includes a call option. Maturity is SLBs maturity in years. Coupon is the coupon rate. Cash flow ratio is the operating cash flow/total assets. Leverage ratio equals total debt/total assets. Firm size is the natural logarithm total assets. Return on assets = operating income/total assets. Tobin's Q = (equity market value + (total assets – equity book value)) divided by total assets. Relative issue size is the amount issued/market capitalisation. Environmental, Social and Governance score are Refintiv's E, S and G pillar scores. Total penalty is the highest possible penalty incurred for failing to meet the targets in the SLB, which is measured in percentage. *, ** and *** denote statistical significance at the 10%, 5% and 1% level based on robust standard errors.

Only maturity is significant at the 10% level among the variables with negative coefficients. For variables with positive coefficients, firm size is significant at the 5% level, suggesting that larger firms experience a higher abnormal stock price reaction following SLB issuances.

In Column 2, which includes ESG pillar scores and the total penalty as independent variables, maturity and size remain significant at the 10% and 5% levels, respectively. The Environmental pillar score has a positive loading and is significant at the 10% level, while the Social pillar score is negative and insignificant. The Governance score is negative and significant at the 10% level, and the total penalty for failing to meet sustainability performance targets is found to be insignificant.

Columns 3 and 4 focus on the first SLB issuance of a firm. In Column 3, which includes all first-time issues, only firm size remains significant, though at the 10% significance level. This result holds when firms with ESG pillar and penalty data are included in Column 4, where the Environmental and Governance pillar scores are also found to be slightly significant (at the 10% level) predictors for cumulative abnormal returns for first-time issuances.

Overall, these results suggest that no firm or bond characteristic consistently explains cumulative abnormal returns following SLB issuances. This is confirmed in Table A3 in the Appendix, where excluding year and country effects causes most variables to lose significance. It is worth noting that the negative and significant coefficient of the intercept in the regressions only holds when country and year effects are included.

5.3. ESG performance

To determine whether SLBs indicate a credible commitment to future sustainability improvements, the post-issuance ESG performance is analysed. Table 12 presents the results from a difference-in-differences panel regression using issuer-year observations from a matched sample of SLB and conventional bond issuers. Refinitiv's ESG scores, emission scores, and CO2 emission intensity are the dependent variables. Columns 1, 3 and 5 exclude firm fixed effects, while columns 2, 4 and 6 include all fixed effects (firm, country-year and industry-year). The primary variable of interest is the interaction variable SLB*Post, which is a difference-in-differences estimator on

whether SLB issuers experience a change in the dependent variable after issuing SLBs compared to the matched control firms.

Table 12. ESG performance difference-in-difference analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ESG Score	ESG Score	Emission Score	Emission Score	CO2 Intensity	CO2 Intensity
SLB	7.793***		8.810***		49.753	
	(2.231)		(3.274)		(129.129)	
Post	7.798***	0.882	8.644**	0.512	233.108	97.459
	(2.722)	(1.348)	(4.154)	(2.263)	(189.157)	(73.357)
SLB*Post	**-1.469**	**-2.442***	**-0.910**	**-4.328***	**-176.273**	**-241.98***
	(1.572)	**(1.326)**	**(2.517)**	**(2.271)**	**(150.459)**	**(128.052)**
Firm FE	No	Yes	No	Yes	No	Yes
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,732	1,732	1,732	1,732	1,236	1,236
R-squared	0.462	0.909	0.403	0.860	0.652	0.960

*This table presents the results of the difference-in-difference specification shown in Section 4.3.3. SLB is a dummy variable equal to 1 for firms that have issued an SLB. Post is a dummy equal to 1 for the issuance year and years following. SLB*Post is the difference-in-difference estimator which is equal to one for SLB issuers for years following the SLB issuance. ESG score is the overall Refinitiv ESG score. Emission Score is the Refinitiv Emission Score. CO2 is total Scope 1 & 2 emission per $m in revenue. The sample consists of available firm-year observations of matched firms in 2014-2023. Standard errors (reported in parentheses) are clustered at the firm level. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Similar to the matching results, the difference in ESG and emission scores between SLB and conventional bond issuers is evident from the positive and significant SLB coefficient in columns 1 and 3. This suggests that SLB issuers have, on average, 7.8 points higher ESG scores and 8.8 points higher emission scores when data from multiple years are considered. Both columns also show a positive and significant post-issuance coefficient, while the SLB*Post difference-in-differences (DiD) estimator is negative but insignificant in both cases.

When firm fixed effects are included in columns 2 and 4, which omit the SLB variable due to collinearity, the post-issuance coefficient becomes insignificant. However, the interaction variable SLB*Post becomes statistically significant at the 10% level. These results suggest that ESG and emission performance decreases following SLB issuances. The magnitude of the decline compared to conventional bond issuers is 2.4 points in ESG scores and 4.3 points in Emission scores. This decrease represents almost a third of the pre-issuance difference in ESG scores and nearly half in emission scores.

Columns 5 and 6 present results using the amount of Scope 1 and 2 emissions per million in revenue (USD). Unlike columns 1-4, which include 105 bond issuer pairs and 1,723 firm-year observations, columns 5 and 6 only include 80 pairs (1,236 firm-year observations) of SLB and conventional bond issuers with the required CO2 data.

Interestingly, SLB issuers have higher CO2 intensity (though insignificant) compared to their matched conventional bond issuers. When firm fixed effects are included, the SLB*Post coefficient is negative and significant at the 10% level, indicating that SLB issuers reduce their CO2 intensity compared to conventional bond issuers. The magnitude is almost five times the initial difference between SLB and conventional bond issuers, suggesting an economically significant impact.

Table 13. ESG pillar score difference-in-difference analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	E Score	E Score	S Score	S Score	G Score	G Score
SLB	8.861***		9.731***		4.276	
	(2.982)		(2.387)		(2.713)	
Post	5.505	0.548	12.498***	2.092	4.795	0.142
	(3.482)	(1.775)	(2.976)	(1.636)	(3.563)	(2.109)
SLB*Post	**-3.137**	**-5.093*** **	**-2.368**	**-3.557** **	**1.066**	**1.326**
	(2.112)	**(1.888)**	**(1.829)**	**(1.541)**	**(2.462)**	**(2.095)**
Firm FE	No	Yes	No	Yes	No	Yes
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,732	1,732	1,732	1,732	1,732	1,732
R-squared	0.401	0.877	0.534	0.914	0.316	0.827

*This table presents the results of the difference-in-difference specification shown in Section 4.3.3. SLB is a dummy variable equal to 1 for firms that have issued an SLB Post is 1 for the issuance year and years following. SLB*Post is the difference-in-difference estimator which is equal to one for SLB issuers for years following the SLB issuance. E, S and G scores are Refintiv's Environmental, Social and Governance Pillar Scores. The sample consists of available firm-year observations of matched firms in 2014-2023. Standard errors (reported in parentheses) are clustered at the firm level. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

I examine the development of individual ESG pillar scores in Table 13. The SLB coefficient in Columns 1, 3, and 5 shows the differences in the pillar scores between SLB issuers and conventional bond issuers. Consistent with overall ESG and emission scores, SLB issuers have higher scores across all pillars. The differences are significant at the 1% level for the Environmental and Social scores, while the difference in Governance scores is insignificant.

The post-issuance coefficient is positive and significant for the Social score (column 3) but becomes insignificant when firm-fixed effects are included. Similarly,

the interaction variable SLB*Post becomes significant at the 1% level for the Environmental and Social scores in Columns 2 and 4, indicating that SLB issuers decrease their environmental and social performance post-issuance. The magnitude of the decline compared to conventional bond issuers is 5.1 points for Environmental scores and 3.6 points for Social scores.

The Governance score results differ, with the DiD coefficient being positive but insignificant. These findings suggest that the decrease in the ESG score observed in Table 12 is primarily driven by reduced performance in the Environmental and Social pillars. In contrast, a slight increase in Governance scores mitigates the overall decrease in ESG scores.

5.4. Institutional ownership

To expand the knowledge on how SLB isssuances are perceived by investors, I examine their impact on institutional ownership. Table 14 presents results from a similar difference-in-differences panel regression employed in the ESG performance analysis according to Equation (13) in Section 4.3.3. This time, issuer-year observations on institutional ownership from a matched sample of 140 SLB and conventional bond issuers are used. Columns 1 and 3 of the table display results excluding firm fixed effects, while columns 2 and 4 include all fixed effects.

In columns 1 and 3, the SLB coefficient confirms findings from the matching procedure (Table 6), indicating that SLB issuers exhibit slightly higher institutional ownership, albeit not statistically significant.

Turning attention to the analysis of percentage ownership in columns 1 and 2, the coefficient for SLB*Post is negative but statistically insignificant, suggesting no significant change in institutional ownership following SLB issuances. This result remains consistent whether firm fixed effects are incorporated or not.

In columns 3 and 4, where the natural logarithm of the total market value owned by institutional investors is used as the dependent variable, the SLB*Post variable remains insignificant. Notably, when firm fixed effects are included in column 4, the difference-in-differences estimator changes sign to positive. This could suggest that the previously observed negative sign concerning percentage ownership might stem from portfolio rebalancing actions, particularly if the stock constitutes a significant portion of the portfolio. However, given the consistent lack of statistical

significance across the results, the null hypothesis of no change in institutional ownership following SLB issuances cannot be rejected.

Table 14. Institutional ownership difference-in-difference analysis

	(1)	(2)	(3)	(4)
Dependent variable	IO (%)	IO (%)	Log(IO_USD)	Log(IO_USD)
SLB	0.020		0.272	
	(0.014)		(0.181)	
Post	0.029	0.004	0.561**	-0.095
	(0.018)	(0.009)	(0.222)	(0.088)
SLB*Post	**-0.019**	**-0.007**	**-0.012**	**0.087**
	(0.012)	**(0.008)**	**(0.128)**	**(0.091)**
Firm fixed effects	No	Yes	No	Yes
Country-year fixed effects	Yes	Yes	Yes	Yes
Industry-year fixed effects	Yes	Yes	Yes	Yes
Observations	2,709	2,709	2,709	2,709
R-squared	0.750	0.961	0.464	0.900

*This table presents the results of the difference-in-difference specification shown in Section 4.3.3. SLB is a dummy variable equal to 1 for firms that have issued an SLB. Post is a dummy variable equal to 1 for the issuance year and years following. SLB*Post is the difference-in-difference estimator which is equal to one for SLB issuers for years following the issuance. IO (%) is the percentage of shares held by institutional investors. Log (IO_USD) is the log of the total amount in ($m) owned by insitutional investors. The sample consists of available firm-year observations of matched firms in 2014-2023. Robust standard errors (reported in parentheses) are clustered at the firm level. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table 15 reports changes in ownership by domestic and foreign institutions after SLB issuances, measured both in percentage and as the natural logarithm of total ownership. All columns incorporate firm, country-year and industry-year fixed effects, with results excluding firm fixed effects presented in Table A2 in the Appendix.

Results from column 1 suggest that domestic institutions decrease their equity ownership in SLB issuers, with the interaction variable SLB*Post being negative and significant at a 10% level. According to this, domestic institutional ownership decreases by 1.0% after SLB issuances. The post-issuance coefficient, which is of similar magnitude but positive and significant at the 5% level, indicates that while institutional ownership decreases relative to conventional bond issuers, there is not an overall decline in ownership.

When the log of total ownership is analysed in column 2, the results differ. Here, the SLB*Post coefficient becomes positive and insignificant, while the post-issuance coefficient is negative and significant. Therefore, no conclusions can be drawn from

the results in column 1, as the decrease in ownership percentage is inconsistent with total ownership changes.

Examining foreign ownership in columns 3 and 4 reveals insignificance both in terms of percentage and log of total ownership. Notably, the SLB*Post coefficient is positive in both instances, indicating that any negative change in institutional ownership is likely driven by domestic investors. This argument is supported by the results excluding firm-fixed effects in Table A2 in the Appendix. In column 1 (Table A2), the DiD coefficient is negative and statistically significant at a 5% level regarding the percentage owned by domestic investors, with the sign remaining negative when the natural logarithm of ownership is employed.

Table 15. Institutional ownership: Foreign vs. domestic investors

	(1)	(2)	(3)	(4)
Dependent variable	IO_dom (%)	IO_dom (log_USD)	IO_for (%)	IO_for (log_USD)
Post	0.013**	-0.241**	-0.008	-0.192
	(0.006)	(0.121)	(0.006)	(0.125)
SLB*Post	**-0.010***	**0.123**	**0.004**	**0.145**
	(0.005)	**(0.131)**	**(0.006)**	**(0.138)**
Firm fixed effects	Yes	Yes	Yes	Yes
Country-year fixed effects	Yes	Yes	Yes	Yes
Industry-year fixed effects	Yes	Yes	Yes	Yes
Observations	2,700	2,700	2,700	2,700
R-squared	0.970	0.917	0.946	0.872

*This table presents the results of the difference-in-difference specification shown in Section 4.3.3. SLB is a dummy variable equal to 1 for firms that have issued an SLB. Post is a dummy = 1 for the issuance year and years following. SLB*Post is the difference-in-difference estimator which is equal to one for SLB issuers for years following the issuance. IO_dom (%) and IO_for (%) is the percentage of shares held by domestic and foreign institutional investors, respectively. IO_dom (log_USD) and IO_for (log_USD) is the log of the total amount in ($m) owned by domestic and foreign insitutional investors respectively. The sample consists of available firm-year observations of matched firms in 2014-2023. Standard errors (reported in parentheses) are clustered at the firm level. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

6. Discussion

This study aimed to analyse sustainability-linked bonds (SLBs) from a shareholder's perspective and offer insights into whether issuers' and investors' views are aligned. This section summarises and discusses the findings. It also addresses the implications of the results for existing literature. Finally, the limitations of this study and future research directions in the area of sustainability-linked bonds are considered.

6.1. Announcement returns

To answer the first research question of whether investors view SLBs as a credible signal of a firm's future sustainability improvements, the stock price reaction following SLB announcements was analysed. An event study was conducted on a sample of 318 global SLB announcements by public firms, with the sample period ranging from September 2019 until the end of 2023.

In summary, the results suggest that, on average, there is a positive but statistically insignificant abnormal return following SLB issuances. However, certain sub-samples do exhibit statistically significant abnormal returns. This study offers the first extensive look at the announcement returns following SLB issuances, adding to the tentative results of Lahtinen (2022), who also found a positive but insignificant reaction for 32 SLB issuances.

The event study was first conducted on the total sample of 318 SLB issuances, which showed positive but insignificant cumulative (average) abnormal returns around a 16-day event window. This finding held for several robustness tests. Nevertheless, the consistently high t-statistics and significant alternative test statistics suggest market optimism and borderline statistical significance. This suggestion is concurred by the results from the market-adjusted return model and an alpha-excluding market model, which found a positive and significant CAAR at a 5% level for all significance tests. Still, the statistical insignificance measured by the t-test in other models means there is no concrete evidence for hypothesis 1, which expected a positive and significant stock price reaction following SLB issuances.

While the positive reaction indicates that the market welcomes sustainability-linked bond issuances, the lack of statistical significance contradicts previous research on green bonds (Flammer, 2021; Tang & Zhang, 2020), which have consistently found positive and significant abnormal returns. The magnitude of the reaction (CAAR = 0.67%, t = 1.562) is similar to Flammer (2021), who finds CAARs of 0.49% for the total sample of 384 green bond issuances and 0.80% for first-time issues. Nevertheless, the differing significance levels suggest that the factors influencing market perceptions of SLBs and green bonds may vary.

The results for various sub-samples offer deeper insights into the market's perception of SLB issuances and the factors influencing the stock market reaction. Drawing from event studies on green bonds (Flammer, 2021; Tang & Zhang, 2020), it

was hypothesised that the market gains awareness of a firm's sustainability commitments following the first SLB issuance, suggesting that subsequent issuances may not elicit a similar reaction. The results confirm this as first-time issuances show positive and largely significant CAARs, whereas the reaction for subsequent issues is statistically insignificant. This also suggests that the stock price reaction is mainly driven by the additional utility for environmentally conscious investors rather than by increased growth prospects. This claim stems from the argument that subsequent issuances should also generate a similar reaction if the issuance is viewed to increase sustainable investments with a positive impact on fundamental performance (Tang & Zhang, 2020).

Given the varying market standards and investor preferences for ESG investing, the difference in market reactions between European and non-European SLB issuances was examined. The event study results reveal that European SLB announcements receive modest and statistically insignificant reactions, whereas issuances outside Europe had a positive and significant CAAR. This finding relates to de Vincentiis (2023), who suggested that European investors only react to negative ESG news. A potential explanation for this was drawn from previous literature suggesting that if European firms are already expected to behave sustainably, the SLB issuance may provide less additional information to the market (Serafeim & Yoon, 2023). Similarly, the faster growth in ESG investing in other geographies (GSIA, 2022) might imply that domestic investors place increasingly more value on sustainability improvements. Nevertheless, the potential channel remains unknown, with further research required to complement the findings of de Vincentiis (2023) on geographical differences in stock price reactions following ESG news.

Several studies have highlighted the vital role of SLBs in incentivising the decarbonisation of carbon-intensive firms (Hinsche & Klump, 2023; Vulturius et al., 2022). The results from this study show that the market is wary of issuances by firms from these industries, as the market reaction is only significant for SLB issuances for firms in industries which are not labelled as carbon-intensive. This finding indicates that SLB issuances do not remove exclusionary screens for firms in emission-heavy industries (Bolton & Kacperczyk, 2021).

Figure 1 highlighted a relative decrease in SLB issuances compared to green bonds since 2022, raising concerns about whether greenwashing speculation had led the industry to begin abandoning the instrument (Binnie, 2023). My results show that

issuances after January 2022 have faced positive and significant cumulative abnormal returns, while SLBs prior showed no statistical significance. This finding implies that the greenwashing speculation is not widely adopted by the market. It also indicates that the maturity of the SLB market positively correlates with the credibility of the sustainability signal, with Mocanu et al. (2021) also finding sustainability bond announcement returns to increase over time. CBI (2024) highlighted that while the early market showed several SLBs lacking quality, the share of SLBs aligned with voluntary guidelines has increased rapidly. This quality improvement could have translated into higher abnormal returns following the SLB announcement.

It is worth mentioning that the t-statistic was only significant at a 10% level for the sub-sample groups. However, the consistently significant test statistics from the Corrado (1989) rank test and the adjusted-BMP test by Kolari and Pynnönen (2010), along with the insignificance of the results for the comparison groups in each analysis, collectively provide sufficient evidence of a positive and abnormal stock price reaction.

To conclude the stock price reaction results, it seems that only certain issuances are able to generate positive and significant announcement returns. The divergence suggests that the market perceives certain SLB issuances to provide additional information on a firm's sustainability performance. In contrast, others lack new information or only include information that does not offer additional value to investors. The exact group characteristics may not drive the differences in reactions for sub-samples; however, they provide a general indication of the direction and the borderline statistical significance of all issuances.

Regarding the negative criticism surrounding SLBs, the results mitigate concerns that investors see SLB issuances as a greenwashing tool, as the reaction is generally positive. Nevertheless, the insignificance and variation in responses suggest that firms cannot reliably anticipate significant positive returns following SLB announcements. This could contribute to the credibility of the SLB market, as issuers with ulterior motives may be reluctant to issue SLBs, leaving the market open for issuers with a genuine will to increase their ESG performance.

6.2. Bond- and firm-level regressions

This study regressed the CARs on specific bond- and firm characteristics to uncover whether they can explain variations in announcement returns.

The results mainly suggest that firm- and bond characteristics cannot consistently predict announcement returns. The firm's size measured in the natural logarithm of total assets was the only consistently significant variable, predicting higher cumulative abnormal announcement returns in the whole sample analysis with a 5% significance level and 10% when first-time issues were analysed. This finding relates to that of Baulkaran (2019), who found the firm size to be a significant predictor of green bond announcement returns. One potential explanation is proposed by Aouadi and Marsat (2018), who suggest that larger firms receive more attention from investors and, thereby, a more substantial market reaction. Similarly, larger firms are likely to have a higher environmental impact, which could translate to higher announcement returns if investors consider the total impact (Flammer, 2021). However, this should hold for carbon-intensive firms, which did not receive higher abnormal returns. Therefore, the visibility argument is more likely to drive the results.

Another variable with modest statistical significance (10% level) in the whole sample was the bond maturity, which had a negative coefficient. In a working paper, Hinsche and Klump (2023) identified that SLB market participants prefer short-term targets promising short-term transition results, as it lowers concerns about ambiguous sustainability targets. As the bond's maturity is related to the sustainability performance target period, this suggests that investors would agree with the findings from Hinsche and Klump (2023). The result, however, was insignificant for first-time issuances, suggesting a vague relationship between the maturity of the SLB and cumulative abnormal returns.

When individual ESG pillar scores were added to the analysis, the regression found the coefficients of Environmental and Governance pillar scores to be significant at a 10% level. However, the direction of the coefficient differed, with the Governance score predicting lower abnormal returns, while the Environmental score had a positive sign. The different direction for the pillar scores challenges the inferences drawn from the result. Serafeim and Yoon (2023) found the positive market reaction following ESG news to be lower for high ESG-rated firms, which relates to the negative sign for the Governance pillar score. On the other hand, Berrada et al. (2022) found ESG scores, particularly the Governance score, to be positively related to SLB mispricing, arguing that bond investors view highly rated firms as having a more credible sustainability signal. Given the modest statistical significance and the contradictory signs and arguments favouring both directions, no conclusions can be drawn on the relationship.

Interestingly, the regression results did not find any evidence that a higher cumulative total penalty would increase SLB announcement returns. Berrada et al. (2022) argued that the size of the penalty increases the incentive to reach sustainability targets included in the SLBs, which would suggest that the strength of the signal shown to the market is stronger. However, the reasons behind the insignificant result are manifold. First, the size of individual coupon step-ups concentrated around 0.25%, while the total penalty size was also relatively stable across firms operating in the same domicile. This suggests that there may not be enough variation in the penalty size to determine the credibility of the issuance. Second, the strength of the sustainability signal in SLBs does not only depend on the penalty for failing to reach the sustainability target but also on the ambitiousness of the target (Vulturius et al., 2022) and the probability of achieving it (Kölbel & Lambillon, 2022). The calculated total penalty variable represents a worst-case scenario where none of the KPIs are met. Feldhütter et al. (2023) found the average probability of reaching the sustainability target in their sample to be 73%, employing a technique that assumes future ESG improvements to be similar to historical improvements. Therefore, a high penalty may not impact announcement returns if it accompanies a non-ambitious target that is likely to be met.

The coefficient for a dummy variable indicating callability was negative but insignificant. This finding aligns with Erlandsson and Korangi (2023), who found limited evidence of an excess proportion of callable SLBs, thereby mitigating concerns set by Ul Haq and Doumbia (2021) on issuers using call options to avoid penalties.

The low r-squared values of the regressions and the lack of statistically significant variables explaining the variation in CARs showcase the complexity of explaining announcement returns. Therefore, the results indicate that unaccounted variables or market characteristics likely drive announcement returns. For example, Naughton et al. (2019) found that the market response depends on the valuation premium on ESG performance at the time of the announcement.

6.3. ESG performance

The second research question sought to identify whether SLB issuers improve their ESG performance post-issuance. This study performed a difference-in-difference (DiD) analysis on a matched sample of 105 SLB and conventional bond issuers to

determine whether SLB issuers experience a change in ESG performance after issuing SLBs compared to the matched control firms.

The results raise alarms regarding greenwashing concerns, as the interaction variable was negative and significant at a 10% level when the firms' ESG and emission scores were used as the dependent variable. The results from individual pillar scores strengthen the greenwashing argument, as the DiD estimator coefficient was negative and significant for the Environmental (1%) and Social (5%) pillar scores, while the Governance score was positive and insignificant. Given that most sustainability targets included in the SLBs concern environmental performance and, most often, carbon emissions, the deteriorating Environmental and emission scores are especially concerning regarding the validity of the environmental commitment that firms aim to communicate. Therefore, these findings suggest that SLB issuers do not incorporate a holistic approach towards combatting climate change but instead focus on the specific KPIs. This is confirmed by the finding that SLB issuers seem to reduce their emission intensity following SLB issuances, with the interaction term negative and significant at the 10% level ($t = -1.89$). As such, the results do not support Hypothesis 2, which states that SLB issuers improve their ESG performance following bond announcements; instead, I primarily find contrary results.

Given the generally positive announcement results in the event study, the results on ESG performance indicate that the perspectives of shareholders and issuers are not aligned. The decrease in emission intensity implies that issuers focus solely on the KPIs included in the bonds. In contrast, shareholders seem unaware of the risk concerning the overall ESG performance. Feldhütter et al. (2023) argued that the design of SLBs is superior to that of sustainable use-of-proceeds bonds, as it ties the sustainability efforts to the company level instead of the project level. This study's findings suggest that SLBs do not reduce the likelihood that firms continue unsustainable practices following the issuance, as the overall ESG performance is not improved but decreases compared to conventional bond issuers.

The result contradicts empirical evidence on the sustainability performance following green bond issuances, which has found that the overall ESG performance of the company increases (e.g., Fatica & Panzica, 2021; Flammer, 2021). Instead, my results align with Jalonen (2023), who found SLB issuers in a smaller sample to decrease their ESG and individual E, S, and emissions scores. Therefore, the current

short-term evidence of a relative decrease in Refinitiv ESG scores compared to conventional bond issuers is robust.

This study adds novel information by showing that emission intensity is reduced post-issuance. This reduction in CO2 intensity can be viewed from two perspectives.

First, it suggests that firms only commit to the sustainability targets included in the SLBs, while overall ESG performance is disregarded. In theory, the firm only commits to achieving the KPIs included in the SLB, and the relative decrease in emission intensity suggests that issuers hold their promise to decrease emissions. However, given positive findings on green bonds, it could be assumed that investors expect SLB issuers to also perform in other sustainability metrics.

Second, it could indicate that the subjective nature of ESG measures impacts the finding of a deteriorating ESG performance (Berg et al., 2022). Cregan et al. (2023) found that emission scores do not capture absolute CO2 emissions and intensity levels and diverge significantly between providers. This indicates a risk that SLB issuers have not decreased their actual sustainability performance but only their Refinitiv ESG scores. Christensen et al. (2022) found that increased ESG disclosure results in higher ESG score disagreement. This could translate to SLB issuers if the increased disclosure and visibility generated by the SLB issuance result in Refinitiv's ESG analysts focusing more on these firms while having more subjective information on which to draw conclusions. In addition, given the higher pre-issuance ESG scores of SLB issuers compared to their matched convention bond issuers, the results may be impacted by the initial difference, as Busch et al. (2023) argued that higher ESG scores are more challenging to improve compared to lower ESG scores.

Nevertheless, given no concrete evidence of biased ESG metrics, the findings suggest that the greenwashing concerns raised by market participants are not in vain. It also implies that the current lack of regulation and standardisation grants issuers too much freedom, allowing for misleading sustainability signalling efforts. Besides the penalty set by the company itself, no additional regulations direct SLBs, which allow greenwashing efforts and misleading targets to remain unpunished (OECD, 2024). Daubanes et al. (2024) argue that firms' incentives to decarbonise are amplified by the interest of their managers in their stock prices. As such, the decision to issue an SLB may be incentivised by the potential stock price increase or lower cost of debt rather than to signal their commitment towards a net zero economy.

6.4. Institutional ownership

To add to the first research question on whether investors view the sustainability targets inherent in SLBs as value-adding, a similar difference-in-difference (DiD) analysis was performed to examine changes in institutional ownership following SLB issuances. Precisely, the DiD specification in Equation (13) was estimated against issuer-year observations of different institutional ownership measures from 140 pairs of SLB and conventional bond issuers.

In short, the analysis could not reject the null hypothesis of no difference in institutional ownership following SLB issuances. This implies that the additional information on the issuers' potential sustainability improvements is insufficient to increase institutional investors' demand for the underlying stock.

The interaction variable, which captures whether SLB issuers experience a change in institutional ownership compared to their matched counterpart, was negative and insignificant when percentage ownership was used as the dependent variable. In contrast, the coefficient turned positive when the natural logarithm of total institutional ownership was used as the dependent variable.

The results remained inconclusive when ownership by domestic and foreign institutional investors was examined separately. The results initially suggest that domestic investors decrease their ownership on average by 1% following SLB issuances, with a significance level of 10%. However, when total ownership was examined, the interaction variable turned positive and insignificant. These findings suggest that the initial adverse finding may be driven by portfolio rebalancing due to a relative increase in market capitalisation by SLB issuers. Regarding foreign institutional ownership, the coefficient was positive in terms of both the percentage of shares owned and total ownership, but it remained insignificant.

The findings imply that SLB issuances do not significantly increase or decrease institutional ownership. Boermans (2023) found that European mutual and pension funds invest more in sustainability-linked bonds than other bonds. This study is the first to investigate institutional ownership changes in the underlying stock of SLB issuers, complementing the findings of Boermans (2023) by showing that the institutional preference of the bond does not transfer to the issuer's equity. The result differs from green bonds, as Tang and Zhang (2020) found a significant increase in institutional ownership following green bond issuances. These findings also add

insights into the difference in the significance of the stock price reaction between sustainability-linked and green bonds, suggesting that the sustainability signal is less robust for SLBs.

The result differs from expectations set by papers finding a link between ESG performance and institutional ownership (e.g. Cao et al., 2023; Velte, 2020). Instead, it relates to findings that a positive E&S performance does not increase institutional ownership (Nofsinger et al., 2019), and the governance pillar score has a positive impact (Lopez-de-Silanes et al., 2022). As environmental targets are the most common KPIs, SLB issuances likely signal environmental developments while not providing additional information on governance improvements. Also, given the high share of SLB issuers in carbon-intensive industries, the institutional investor demand may differ from that of green bond issuers, as exclusionary screens may be applied for these firms (Bolton & Kacperczyk, 2021). Nonetheless, I find no support for hypothesis 3, which expected increased institutional ownership following SLB issuances.

6.5. Study limitations and future research

It is still early to draw inferences about the SLB market, with the first SLB issued only in September 2019. Additionally, the concentration of bonds issued between 2021 and 2023, which accounted for 95% of SLBs in the final sample, limits transferability to other periods.

The limited issuer-year observations also mean that the long-term impact of SLB issuances on ESG performance cannot be determined. ESG improvements require substantial investments and time to materialise. Although the findings in this study suggested a negative impact on ESG performance, the actual impact may only be evident in subsequent years. Therefore, future research should take an updated view of both the announcement returns and long-term ESG performance once the market has developed. This could also provide insights into whether the subjective nature of the measures or an actual decrease in ESG performance drives the relative decrease in ESG scores. To confirm this, ESG metrics from other ESG rating providers could be included in the analysis.

This study used Refinitiv as the primary source of data. However, the SLBs included in the Bloomberg Terminal were also used to determine inconsistencies. The cross-checking allowed this study to determine the correct amount of SLBs and to

identify the first announcement date between both databases. However, the inconsistencies between the announcement dates found in the databases raise concerns about whether undetectable differences were present in both databases that could impact results. Future research should be aware of the differences in announcement dates, as identifying the actual event date is critical for event studies (Armitage, 1995).

A similar consideration comes from the impact on announcement results due to the public release of sustainability-linked frameworks or Second Party Opinion (SPO) reviews. The sustainability-linked frameworks and SPO reviews are, in most cases, published before the announcement of the bond issuance and include information on the Sustainability Performance Targets, KPIs and SPO certification. Although it does not necessarily require the firm to issue an SLB and does not include pricing information, it may reduce the signalling strength at the actual bond announcement date. This study aimed to identify this by reporting CAARs for time windows up to 20 days before issuance. These results (Table 8) show a negative and insignificant reaction. Given the positive main event window CAAR, it suggests that the effect of the SLB issuance is, on average, captured in the main event window, which mitigates some of these concerns.

Another limitation regarding the event study relates to confounding events. Confounding events, such as equity issuances or quarterly earnings, with a positive or negative impact on stock returns, can significantly affect the announcement returns if they occur within the event window. Therefore, confounding events could be accounted for to avoid biased cumulative abnormal returns (Bowman, 1983). This could have been done by conducting a manual review of press releases and newspaper articles for firms around the SLB announcement. Due to the scope of this study, confounding events were not accounted for. Therefore, it is acknowledged that they may impact the results of this study.

The matching result for the ESG performance difference-in-difference analysis raises other mentionable limitations. The procedure resulted in a control group similar to the treatment group in accounting variables. However, the overall ESG, Environmental, Social and emission scores were significantly higher for SLB issuers. As mentioned, this finding may have impacted the results, as Busch et al. (2023) argue that ESG score development might not be linear. The differences were primarily due to the limited amount of firms that fit the strict matching criteria. As this study looked

at issuances globally, several smaller economies had a limited number of potential matching candidates. Despite the initial differences, the significant relative decrease in ESG metrics post-issuance is concerning regarding greenwashing concerns surrounding SLBs.

This study also excluded green bond issuers from the matching pool. However, other potential sustainability efforts and commitments (e.g., SBTi emission reduction targets) were not accounted for, which could impact the ESG performance of the matched control firms. However, regarding CO2 emissions, this does not seem to impact results, as SLB issuers significantly reduce their emission intensity compared to conventional bond issuers.

Additionally, despite the matching procedure's ability to reduce endogeneity concerns, it is inferior to a (quasi-) experiment setting in determining causality. Calls for further regulation (Vulturius et al., 2022) could provide a future market change in which companies issue SLBs more randomly, thus providing a more robust empirical setting.

This study found positive and insignificant announcement returns for the total sample, which differs from previous findings on green bonds (e.g. Flammer, 2021; Tang & Zhang, 2020). The differences in the impact on institutional investor demand compared to Tang and Zhang (2020) provided some insight that the sustainability signal might be stronger for green bonds. Nevertheless, it also advocates revisiting green bonds during a more recent period, with the sample period of the most recent comprehensive study by Flammer (2021) only ranging until 2018, before the first SLB was issued. In an unpublished paper, Bhagat and Yoon (2023) used a more recent sample of 1,560 corporate green bond announcements between January 2013 and January 2022, finding no significant announcement returns. Although not published in a reputable journal, this finding could indicate that the overall sustainable bond market dynamics may have changed. Thus, it encourages further research on the varying stock market reactions between different sustainable bonds and different time periods. It could also suggest that the overall sustainable bond market has matured and increased its transparency, thereby approaching market efficiency.

7. Conclusion

This study aimed to address the research gap on how sustainability-linked bonds (SLBs) are perceived by industry participants and their alignment with shareholder perceptions. Specifically, stock price reactions, ESG performance and institutional ownership were analysed to answer two main research questions: 1) Do investors view SLBs as a credible signal of a firm's future sustainability improvements. 2) Are SLB issuers committed to improving their overall sustainability performance.

To answer the first question, an event study uncovered positive but insignificant cumulative abnormal returns following SLB announcements. However, alternative significance tests and several sub-samples indicated statistical significance, thereby suggesting investor optimism surrounding SLBs. However, the lack of significance in the total sample indicates that this optimism may be impacted by uncertainties on the true sustainability impact of the instrument.

Second, the study highlighted a concerning trend in ESG performance, as SLB issuers significantly decreased their sustainability performance compared to a matched sample of conventional bond issuers. However, SLB issuers seem to focus on the targets set in their SLBs as the emission intensity is reduced. This finding raises questions about the efficacy of SLBs in driving genuine progress, as issuers may still engage in economic activities with a harmful environmental and social impact. Furthermore, the observed disparity between market reactions and ESG performance suggests a disconnect between investor perceptions and underlying realities.

To add to the first question, the study found that institutional ownership does not significantly increase following SLB issuances. This implies that the sustainability signal may not be material enough to attract substantial interest from institutional investors.

These findings stand in contrast to previous research on green bonds, which has found a positive stock price reaction following green bond announcements (Baulkaran, 2019; Flammer, 2021; Tang & Zhang, 2020), improving ESG performance (Flammer, 2021) and increased institutional ownership (Tang & Zhang, 2020). The disparity indicates that greenwashing concerns and lack of standardisation may impact the instrument's ability to foster companies' net-zero transitions.

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8. Appendix

A1. Definition of abbreviations and variables

Panel A. Abbreviations

SLB	Sustainability-linked bonds
SPT	Sustainability Performance Target
KPI	Key-Performance Indicator
SLBP	Sustainability-Linked Bond Principles (ICMA, 2023)
SPO	Second-Party Opinion
DiD	Difference-in-Difference analysis
CAR	Cumulative abnormal return (one firm)
CAAR	Cumulative average abnormal return (multiple firms)

Panel B. Variable definitions

Callability	Dummy variable equalling 1 if bond includes call option and 0 otherwise
Maturity	Bond maturity in years
Coupon (%)	Coupon rate in percentage
Cash flow (CF) ratio	Operating cash flow divided by total assets
Firm size	Natural logarithm of the firm's total assets
Leverage ratio	Total debt divided by total assets
Return on assets (ROA)	Operating income divided by total assets
Tobin's Q	Market value of assets (market value of equity + (total assets – book value of equity) divided by total assets
Relative issue size	Bond issuance amount divided by market capitalisation
ESG score	Refinitiv overall ESG score

Environmental score	Refinitiv Environmental pillar score
Social score	Refinitiv Social pillar score
Governance score	Refinitiv Governance pillar score
Emission score	Refinitiv emission score
CO2 intensity	Total Scope 1 and 2 emissions (in metric tons) divided by a firm's revenue (in million USD)
Total penalty (%)	Worst-case-scenario penalty for missing all KPIs included in the SLB in terms of percentage of issuance amount. For multiple payments (e.g. Coupon step-ups), the cumulative amount is calculated. For one-time payments (e.g. Premium redemption), the actual percentage is used
Institutional ownership (%) / IO (%)	The percentage share of market capitalisation owned by institutional investors
Log (IO_USD)	The natural logarithm of the total amount of market capitalisation ($m) owned by institutional investors
IO_dom	Ownership by domestic institutional investors
IO_for	Ownership by foreign institutional investors

A2. Alternative test statistics

The alternative significance tests include (1) the Corrado (1989) rank test adjusted to apply for multi-day CAARs and (2) the adjusted BMP test by Kolari and Pynnönen (2010). Both tests are calculated using the STATA module by Kaspereit (2022). Nevertheless, the equations for both test statistics are presented below.

1. Corrado (1989) rank test

Following (Wolf et al., 2014), the abnormal returns calculated for the respective market models (e.g. Eq. (2) for the market model) are ranked, where $1 \leq K\ (AR_{it}) \leq T$ is the rank of a firm (i) of the abnormal return for each day (t). Here, the lowest (or most negative) AR is assigned 1, while the highest AR is assigned the rank T (for the

combined event and estimation window). Then, for every firm (i) and day (t) the scaled ranks are calculated using Equation (14):

$$K_{it} = \frac{rank(AR_{it})}{1 + M_i + L_{2i}} \tag{14}$$

Where L_{2i} is the number of days in the event window and M_i is the number of non-missing returns observations during the estimation period for any given firm. Then for any t, the scaled ranks and variance equals:

$$\overline{K}_t = \frac{1}{N}\sum_{i=1}^{N} K_{it} \tag{15}$$

$$S_{\overline{K}}^2 = \frac{1}{L_1 + L_2}\sum_{t=t_0}^{t_2} (\overline{K}_t - 0.5)^2 \tag{16}$$

Where $L_1$is the number of days in the estimation period and, L_2 the days in the event window. t_0 represents the start of the estimation period. The test statistic for the $CAAR_{[t_1,t_2]}$ is calculated using Equation (17):

$$z = \sqrt{L_2}\left(\frac{\overline{K}_{t_{1+}1,t_2} - 0.5}{S_{\overline{K}}}\right) \tag{17}$$

Where $\overline{K}_{t_{1+}1,t_2}$equals:

$$\overline{K}_{t_{1+}1,t_2} = \frac{1}{L_2}\sum_{t=t_{1+1}}^{t_2} \overline{K}_t \tag{18}$$

2. Adjusted BMP test by Kolari and Pynnönen (2010)

Following (Wolf et al., 2014), the standardised cumulative abnormal returns for firm (i) is calculated:

$$SCAR_i = \frac{CAR_i}{S_{CAR_i}}$$

Where:

$$S^2_{CAR_i} = S^2_{AR_i}\left(L_2 + \frac{L_2}{M_i} + \frac{\sum_{t=t_1+1}^{t_2}(R_{mt} - \bar{\bar{R}}_m)^2}{\sum_{t=t_0}^{t_1}(R_{mt} - \bar{\bar{R}}_m)^2}\right)$$

Where $L_2$is the number of days in the event window and M_i the number of non-missing returns observed during the estimation period. t_0 represents the start of the estimation period, $t_1$is the start of the event window, and t_2 is the end of the event window. And $\bar{\bar{R}}_m = \frac{1}{L_1}\sum_{t=t_0}^{t_1} R_{mt}$

Then the BMP test statistic is calculated:

$$t = \sqrt{N}\frac{\overline{SCAR}}{S_{\overline{SCAR}}}$$

Where:

$$\overline{SCAR} = \frac{1}{N}\sum_{i=1}^{N} SCAR_i$$

And:

$$S^2_{\overline{SCAR}} = \frac{1}{N-1}\sum_{i=1}^{N}(SCAR_i - \overline{SCAR})^2$$

The adjusted BMP test statistic is then obtained by calculating:

$$t_{adj} = t * \sqrt{\frac{1-\bar{r}}{1+(N-1)\bar{r}}}$$

Here, $\bar{r}$ is the mean of the cross-correlations from abnormal returns for the sample's estimation period residuals.

A3. Additional results

Table A1. Stock market reaction for alternate event windows

Event time	CAAR (%)	t statistic	Adj-BMP test	Rank test
[-10, 10]	0.360	0.723	0.228	1.823*
[-5, 5]	0.439	1.242	2.073**	1.760*
[-2, 2]	0.129	0.544	1.105	1.361
[0]	0.092	0.863	0.716	0.547

*This table reports the cumulative average abnormal returns (CAAR) for different times windows around the SLB issuance. T-stat is the t-statistic from a t-test assuming cross-sectional independence. Adj-BMP test is the adjusted t-statistic by (Kolari & Pynnönen, 2010) and Rank test is the z-statistic from the Corrado (1989) rank test. The sample includes all SLB issuer-day observations (N = 318). *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table A2. Foreign and domestic ownership excl. firm fixed effects

	(1)	(2)	(3)	(4)
Dependent variable	IO_dom (%)	IO_dom (log_USD)	IO_for (%)	IO_for (log_USD)
SLB	-0.020*	-0.088	0.040***	0.482**
	(0.012)	(0.282)	(0.013)	(0.224)
Post	0.010	0.407	0.019	0.690**
	(0.014)	(0.309)	(0.014)	(0.269)
SLB*Post	**-0.019****	**-0.079**	**-0.0001**	**0.006**
	(0.008)	**(0.193)**	**(0.0088)**	**(0.172)**
Firm fixed effects	No	No	No	No
Country-year fixed effects	Yes	Yes	Yes	Yes
Industry-year fixed effects	Yes	Yes	Yes	Yes
Observations	2,700	2,700	2,700	2,700
R-squared	0.770	0.500	0.475	0.472

This table presents the results of the difference-in-difference specification shown in Section 4.3.3., however, firm-fixed effects are excluded. SLB is a dummy variable equal to 1 for SLB issuers. Post is a dummy = 1 for the issuance year and years following. SLB*Post is the difference-in-difference estimator which is equal to one for SLB issuers for years following the SLB issuance. IO_dom (%) and IO_for (%) is the percentage of shares held by domestic and foreign institutional investors, respectively. IO_dom (log_USD) and IO_for (log_USD) is the log of the total amount in ($m) owned by domestic and foreign insitutional investors respectively. The sample consists of available firm-year observations of matched firms in 2014-2023. Standard errors (reported in parentheses) are clustered at the firm level. *, ** and * denote statistical significance at the 10%, 5% and 1% level, respectively.

Table A3. Regression analysis excluding country- and year effects

	All firms	All firms	First-issue	First-issue
	(1)	(2)	(3)	(4)
Callability	-0.009	-0.005	-0.010	-0.003
	(0.009)	(0.010)	(0.012)	(0.014)
Maturity	-0.003*	-0.003*	-0.002	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Coupon (%)	-0.002*	-0.003	-0.003*	-0.003
	(0.001)	(0.002)	(0.002)	(0.002)
CF ratio	0.022	0.020	0.090	0.087
	(0.084)	(0.091)	(0.101)	(0.115)
Firm size	0.005*	0.005**	0.005	0.006
	(0.003)	(0.003)	(0.003)	(0.004)
Leverage ratio	-0.009	0.003	-0.006	0.004
	(0.029)	(0.034)	(0.030)	(0.036)
Return on Assets	0.148	0.166*	0.061	0.082
	(0.097)	(0.092)	(0.118)	(0.127)
Tobin's Q	-0.004**	-0.003	-0.004	-0.003
	(0.002)	(0.002)	(0.004)	(0.004)
Relative issue size	0.030	0.025	0.053	0.046
	(0.039)	(0.043)	(0.047)	(0.053)
Environmental score		0.0005		0.0006
		(0.0003)		(0.0004)
Social score		-0.0002		-0.0003
		(0.0003)		(0.0004)
Governance score		-0.0003		-0.0004*
		(0.0002)		(0.0003)
Total penalty (%)		0.003		0.001
		(0.008)		(0.012)
Constant	-0.043	-0.045	-0.049	-0.265*
	(0.058)	(0.062)	(0.076)	(0.157)
Year effects	No	No	No	No
Country effects	No	No	No	No
Observations	318	279	219	189
Adj-R2	0.016	0.006	0.008	0.001

*This table reports regressions of cumulative (average) abnormal retuns on bond and firm characteristics. The variable definitions are presented in the Appendix (A1). *, ** and *** denote statistical significance at the 10%, 5% and 1% level based on robust standard errors.