The impact of sustainability-linked bond announcements on wealth creation

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EXECUTIVE SUMMARY

Several new fixed-income products have been developed in recent years to finance the transition towards a carbon-neutral world. Even though sustainability-linked bonds (SLBs) only entered the market in late 2019, they have experienced exponential growth. This indicates that the instrument is seen as a viable transitional financing instrument that has macro-economic significance. In this study, we examine whether the sustainability-linked label of debt issuance is a driver of cumulative abnormal stock returns, using an event study methodology on a sample of 122 issuers of SLBs. First, we show that public SLBs are, until now, most prevalent in Europe and mostly issued by issuers from "transition" sectors (e.g. utility and materials). Furthermore, the majority of the SLBs have at least one key performance indicator related to greenhouse gas emissions, where the default is a 25bps coupon step-up. When looking into stock market reactions to the announcement of an SLB issuance, we find a small positive, but statistically insignificant abnormal return in the two-day event window surrounding the SLB announcements. Overall, these findings conclude that we cannot significantly prove that shareholders benefit from an SLB issuance. Due to the infancy stage of the market, there is a lack of consistency and alignment in targets and coupon step-ups, resulting in a large divergence in SLB structuring. The results point towards a call for increased scrutiny and harmonization of sustainability-linked bond key performance indicators and targets, which can help the robustness of these bond structures.

Keywords*:* sustainable finance, ESG investing, sustainability-linked bonds, shareholder wealth, event study, announcement effect

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LIST OF ABBREVIATIONS

AAR	average abnormal return
AR	abnormal return
CAAR	cumulative average abnormal return
CAR	cumulative abnormal return
CBI	Climate Bonds Initiative
EBA	European Banking Authority
ECB	European Central Bank
ESG	environmental, social and governance
EUR	euro
GHG	greenhouse gas
GSS	green, social and sustainability(-linked)
HY	high yield
ICMA	International Capital Markets Association
IG	investment grade
KPI	key performance indicator
MREL	minimum requirement for own funds and eligible liabilities
OECD	Organization for Economic Co-operation and Development
OLS	ordinary least squares
ROA	return on assets
SBG	Sustainability Bond Guidelines
SBP	Social Bond Principles
SBTi	Science Based Targets initiative
SDG	Sustainable Development Goals
SLB	sustainability-linked bond
SLBP	Sustainability-Linked Bond Principles
SPO	second party opinion
SPT	sustainability performance target
USD	US dollars

1. INTRODUCTION

The OECD reported in 2017 that, collectively, the world must pay USD 6.9 trillion per year to reach climate goals as defined in the Paris Agreement in 2015, pursuing efforts to limit global warming to 1.5°C (OECD, 2017). Subsequently, the European Commission published in 2018 the EU Sustainable Finance Action Plan[1], putting sustainable finance high on the EU legislative agenda (Busch et al., 2021). Over the last years, the need for investments on an excessive scale and the increasing environmental, social and governance (ESG) awareness have caused a growing demand for sustainable finance products. Furthermore, Schoenmaker and Schramade (2018) explained that financial markets can play a leading role in the transition towards a low-carbon and circular economy and are in charge of allocating funds to their most efficient use. However, this can only be achieved if there is confidence in the sustainable finance market. Therefore, it is of high importance that the market for sustainable finance products matures.

One of today's most developed sustainable finance products is the green bond. In a few years, green bonds have emerged as a real driver of the sustainable finance market. This still relatively new debt instrument is designed to fund pre-specified climate-related projects. Flammer (2021) shows in a recent study that this fixed-income instrument has become increasingly popular among corporates, especially in industries where the environment is of high importance to the core operations of the firm, such as in the energy and the utility industry. More sustainable finance products followed after the success of the green bond. For example, social bonds were designed to (re-)finance projects that aim to address or mitigate specific social issues (ICMA SBP, 2021), and the sustainable bond is a combination of both, with its use of proceeds financing both green and social projects (ICMA SBG, 2021).

A more recent development in addition to these so-called "use of proceeds" bonds, is the origin of the sustainability-linked bond (SLB). SLBs are encouraging companies to contribute to a company-specific ESG objective. This so-called sustainability-linked or key performance indicator (KPI) instrument ties the interest rate of a bond to the issuer's ability to achieve a predetermined sustainability performance objective within a certain timespan

[1] Commission to the European Parliament, the European Council, the Council, the European Central Bank, The European Economic and Social Committee and the Committee of the regions (March 8, 2018). *Action Plan: Financing Sustainable Growth*, COM/2018/097 final.

(Giráldez & Fontana, 2022). This instrument is of particular interest for companies having a hard time collecting sufficient green or social capital expenditure to issue a sustainable use of proceeds bond. Most of the time this is due to the nature of their business (Liberadzki et al., 2021). In contrast to use of proceeds bonds, SLBs address the need to transition the entire business towards a specific target.

This rather new debt solution, first issued in 2019, has become increasingly popular over the last few years. Credit rating agency S&P highlights this rapid growth and expects growing attention towards this product as more firms step into the ESG debt market.[2] The Climate Bonds Initiative expressed in its recent Sustainable Debt Market Summary that SLBs represent over 10% of the total green, social and sustainability(-linked) (GSS) bond issuances at the end of Q3 2021 (CBI, 2021). Looking forward, SLBs are expected to become more important, in particular among non-financial corporates. This sector is expected to lead the issuance activities, as many corporates are setting net-zero commitments within their strategy.

This promising instrument is a highly desired development in the transition towards a carbon-neutral world. Moreover, the COVID-19 pandemic has addressed the urgency to tackle several social issues. However, while the issuances of sustainability-linked bonds are expanding increasingly, little is known about this instrument. Existing literature about SLBs is rare for both the demand and the supply side. It is of high interest to study this new instrument as several investors already require firms to set sustainability targets. Others even require their financing products to have a green, social or sustainability(-linked) label to be included in their funds. But what motives drive these companies to issue an SLB rather than a green or social use of proceeds bond? And what does this issuance imply for the company's financial performance? In addition to the rapid developments that are going on in the SLB market, there is also some criticism of this new concept. Some say that issuers are rushing to take advantage of the less stringent requirements in comparison with, for example, green or social bonds. Others say that companies are taking advantage of the excessive investor demand for ESG products. However, due to the infancy stage of the market, these arguments for so-called "greenwashing" (falsely pretending to be sustainable to obtain pricing advantages) have not

[2] See S&P Global Market Intelligence, "Sustainability-linked bonds in 'rapid growth' as more firms tap ESG debt market" (June 23, 2021).

yet been evidenced by empirical analysis. Through this research paper, we shed light on the pros and cons of the fairly new sustainability-linked bond product.

In this study, we focus on the stock market returns for companies that announce an SLB issuance. We explore whether the sustainability-linked label of debt issuance is a driver of cumulative abnormal stock returns. Previous studies have shown that shareholders profit from firms exhibiting eco-friendly behaviour, as stock markets respond positively to this behaviour (Klassen & McLaughlin, 1996; Flammer, 2013; Krüger, 2015). According to these theories, we would expect a positive effect on shareholder wealth if the market sees the issuance of an SLB as a positive contribution to the environment. The process of issuing an SLB for the first time can be costly and rather arduous, as it requires internal efforts and verification and it brings reporting commitments. Hence, it is important to investigate whether shareholders can benefit from SLB issuances. Results can be highly useful for the development of the SLB market. The research question stated in this paper is as follows:

Does the issuance of a sustainability-linked bond have a positive effect on shareholder wealth?

To empirically examine the evolution of the SLB market, we retrieve all sustainability-linked bonds issued up to and including February 2022 from the Bloomberg database. After compiling the dataset, we start our empirical analysis by providing a detailed description of the SLB market to get a clear picture of recent developments. We show that public SLBs are, until now, most prevalent in Europe and mostly issued by issuers from "transition" sectors (e.g. utility and materials). Furthermore, the majority of the SLBs have at least one key performance indicator related to greenhouse gas emissions, where the default is a 25bps coupon step-up. Hereafter, we use an event-study methodology to empirically examine whether stock markets respond to the issuance of an SLB, and if so, in which direction this will be. Within this methodology, the market model is used to estimate abnormal performance. We find a small positive, but statistically insignificant cumulative average abnormal return over the event window [0,1]. Overall, the findings conclude that, as of now, there is no proof of a real acknowledgement by the stock market of the announcement of an SLB.

This study contributes to the existing sustainable finance literature by providing initial insights into the sustainability-linked bond space. The up-and-coming SLB market has, to the best of our knowledge, not been studied as extensively as the data available is still relatively limited. However, since the market grows exponentially and more issuers will enter the SLB space, more data becomes available and more fundamental studies of this young market can be

conducted. Additionally, for issuers, it is of high importance to investigate what KPIs, penalties for failure of these targets (e.g. coupon step-up, coupon step-down, premium at maturity) and level of penalties are best received by the market. Lastly, this study helps regulators in identifying flaws in the market. Stricter frameworks for the use of SLBs and more credible targets, verified by the Science Based Targets initiative, may be a solution to this uncertainty in the market and provide more consistency among the SLBs. We expect further issuing volume and more standardisation of the product to mitigate the inconsistencies in the market.

The remainder of this paper is structured as follows. In Section 2, we provide an overview of the existing literature on the GSS bond market, with a focus on the recently booming SLB market. We furthermore outline the existing literature on cumulative abnormal returns to (GSS) debt issuances. In Section 3, we provide an overview of the data selection process and extensively outline the descriptive statistics of the public SLB market. Hereafter, in Section 4, we describe the methodology used in this research, followed by the results in Section 5. In Section 6, we address the conclusion of our research. Herein, we combine insights from existing literature with the empirical results from our event study. Finally, in Section 7 we provide suggestions for further research.

2. THEORETICAL REVIEW

In this section, we first provide a brief overview of the evolution and key characteristics of the green, social and sustainability(-linked) (GSS) bond market. Moreover, we describe the development of the fairly new and unexplored sustainability-linked bond instrument. Next, we present the current state of research on stock market reactions to conventional and GSS bond issuances. Using this theoretical review, we examine prior work and propose our methods for studying the impact of SLB announcements on wealth creation.

2.1 Evolution of the green, social and sustainability bond market

Green, social and sustainability bonds are, similar to traditional fixed income products, a way for companies to raise capital. The main difference between the regular and sustainable instruments is the ESG angle. In 2007, the European Investment Bank issued an original fixed-income product with a climate-related goal, under the designation of a "climate awareness bond". In 2008 it was the World Bank that issued the first official "labelled" green bond. In 2013 there was a turning point in the green bond market, as corporates started to issue green bonds and the market grew enormously. Green bonds add value in raising debt for specific projects with environmental or climate-related benefits (e.g. renewable energy, green buildings, clean transportation, sustainable water). In addition, they can help the issuer broaden its investor base. However, prior research is ambiguous in terms of the pricing advantage for green bonds over non-green bonds. Both Larcker & Watts (2020) for municipal bonds, and Flammer (2021) for corporate bonds, find no pricing difference (i.e. a "greenium" of zero). Contrary to these findings are the findings of Baker et al. (2018) and Zerbib (2019), who find that green bonds, compared to conventional bonds issued by the same issuer, trade at a premium. These findings imply that there is a so-called "greenium" on green bonds.

From 2015 on, different kinds of sustainable fixed-income products started to emerge. Social bonds started to rise in popularity since the first publication of the Social Bond Principles by the ICMA in 2017[3]. More recently, the growth of this market was accelerated by the outbreak of the COVID-19 pandemic, resulting in a growing demand for new ways of funding the abrupt social and economic interruptions (Peeters et al., 2020). In addition to this social label, a combination of both arose. This instrument, also referred to as a sustainability bond,

[3] See the updated version of the ICMA Social Bond Principles (June, 2021).

intends to raise debt with its use of proceeds financing both green and social projects (ICMA SBG, 2021). Showing its rapid pick-up, the Climate Bonds Initiative reported that all labelled bonds combined (i.e. green, social, sustainability(-linked) and transition bonds) accounted for USD 779bn of new issuances in the first three quarters of 2021, showing a year-on-year growth of 54.8% (CBI, 2021). This exponential growth is shown in *Appendix A.*

2.2 The changing sustainable finance landscape: sustainability-linked bonds

A recent development in the field of sustainable finance is the issuance of sustainability-linked bonds. Within the GSS bond space, the share of sustainability-linked bonds gained solid ground in 2020, with a spectacular increase of corporates joining the SLB market in 2021 (CBI, 2021). The concept emerged from its equivalent in the loan market (i.e. the sustainability-linked loan) and can be seen as a "general purpose" instrument, rather than a "use of proceeds" instrument. This means that instead of funding pre-specified projects, the debt is used to finance the entire company. However, in an SLB a certain sustainability performance target (SPT) at the entity level is defined and linked to the cost of capital. An example of such an SPT is the reduction of scope 1, 2 and 3 greenhouse gas (GHG) emissions, covering emissions from the entire value chain of the company. Addressing the need for the entire business to change is, according to Liberadzki et al. (2021), the merit of this product over the traditional project-level "use of proceeds" bonds. As of this writing, the targets have been mostly related to decarbonisation. However, due to the COVID-19 pandemic, the focus of these targets has shifted more and more towards social issues. Hence, SLBs are starting to see social KPIs embedded in their bonds. The cornerstone of this new instrument is the financial impact involving trigger events. The most common example is the potential step-up or step-down of the coupon linked to failure or success to meet its SPT (ICMA, 2020). Lastly, SLBs can be aggregated under the collective definition of transition finance, according to the definition set by Caldecott (2020). His definition reads: "Transition Finance is the provision and use of financial products and services to support counterparties, such as companies, sovereigns, and individuals, realise alignment with environmental and social sustainability" (p. 3).

SLBs were first issued in September 2019 by the Italian utility Enel, issuing a public USD 1.5bn SDG-linked bond.[4] In this bond, the company was able to link the sustainability

[4] See Enel Group, "Enel launches the world's first 'general purpose SDG linked bond', successfully placing a 1.5 billion U.S. dollar bond on the U.S. market" (September 6, 2019).

strategy to the terms of general corporate purpose debt. Hereafter, the growth was boosted as more market guidelines came into place. In June 2020, the Sustainability-Linked Bond Principles (SLBP) were published by the ICMA[5], after which the European Central Bank (ECB) decided to accept this instrument as collateral for new loans (Gibbs et al., 2022). The instrument became a frequent feature of the sustainable debt market. Non-financials continued to dominate this market as more and more corporates are incorporating net-zero commitments in their strategy. Furthermore, the sustainability-linked structure has so far turned out to be complicated for financial institutions. In April 2021, it was Berlin Hyp that issued the first SLB by a bank. This EUR 500m 10-year SLB involved a coupon step-up of 25bps should its SPT not be met. Nevertheless, the European Banking Authority's (EBA) position towards ESG-inked capital instruments has constrained further supply.[6] The regulator sees coupon step-ups, or similar compensatory mechanisms, as potential incentives to call the bond. This is preventing their use as loss-absorbing instruments contributing towards MREL requirements. This can undermine the viability of SLBs for banks. On the other hand, according to Giráldez and Fontana (2022), sovereigns are well-positioned to issue SLBs in their future sustainable debt offerings. The reason is that sovereigns sometimes have a more significant and broader impact with their actions than corporates. The instrument is an attractive alternative for sovereigns as it can combine the benefits of a GSS bond issuance with certain flexibility on the use of proceeds. Very recently, in March 2022, the first sovereign SLB was issued by the government of Chile. With a 12.5bps coupon step-up to each of its two targets and the first potential step-up occurring after 12 years, the total accrued interest penalty for the bond is 200bps over the subsequent 8 years. This penalty set by Chile sends a strong message to the SLB market regarding the level of ambition of the targets and the materiality of the penalties used in the bond. This could potentially act as a baseline for future issuances.

Recently, there also has been some debate about the level of ambition of the set KPIs, especially concerning companies undertaking major acquisitions that make meeting their KPIs easier. Some investors argue that standardization on SLBs should also include KPI resets for these companies. Furthermore, there has been debate about the penalties linked to the bond. In a recent paper by Reznick and Usson (2022), they show that penalties for missing the SPTs are

[5] See ICMA Sustainability-Linked Bond Principles (June, 2020).

[6] See EBA, "EBA updates on monitoring of Additional Tier 1 instruments and issues recommendations for ESG-linked capital issuances" (June 24, 2021).

consolidating around a step-up of 25bps, regardless of the coupon size or the credit quality or scale of the issuing company. In this report, they argue that the materiality of a fixed step-up of 25pbs as an incentive is inconsistent across companies, and thus undermines the credibility of the market. For some, it could be quite an incentive to hit the targets, while for others the materiality of the penalty is limited.

2.3 Stock market reaction to conventional and sustainable bond announcements

Previous literature regarding the announcement effect of conventional bond issuances shows that stock prices do not significantly react to regular bond issues. A traditional theory from Myers and Majluf (1984) shows evidence for this concept, showing that companies first tend to rely on internal financing sources, but when it needs to rely on external financing, debt is preferred over equity.

Financial markets are characterized by the fact that they frequently react strongly to information announcements. These could be environmental announcements, but also macro-economic or political announcements. Several studies have shown a significant increase in stock price for firms improving their (environmental) corporate social responsibility (CSR) (Flammer, 2013; Krüger, 2015). As the SLB instrument evidences the ESG ambitions set by the company, issuance of this instrument could potentially induce the same effect in the stock market. Additionally, Flammer (2013) shows that companies behaving irresponsibly are facing a significant stock price decrease. This means that companies could face lower stock prices after falling short on their sustainability performance targets linked to the SLB, as this can be interpreted as environmentally irresponsible behaviour.

As the sustainable finance market has been growing now for almost 15 years, a body of work on stock price reactions to the announcement of green bond issuances has developed. Baulkaran (2019) contributed to the literature in this field and showed that green bonds issued by publicly traded companies, on average, yield positive and statistically significant cumulative abnormal returns. Tang and Zhang (2020) and Flammer (2021) both focus on a dataset of global corporate green bonds, showing that the announcement of a green bond yields a short-term increase in equity value. Flammer (2021) finds a cumulative average abnormal return (CAAR) of 0.49% in the 16-day event window [-5,10] surrounding the SLB announcement, compared to a CAAR of 1.04% over the same event window in the study of Tang and Zhang (2020). Both studies imply that shareholders benefit from green bond issuances, with a stronger reaction for inaugural issuers. Flammer (2021) also finds a stronger response for certified green bonds. The

literature on positive stock price reactions to eco-friendly behaviour and green bond issuances forms a solid base to expect a similar reaction to appear for the issuance of sustainability-linked bonds. To test this theory, we hypothesise the following:

H1: Stock prices react positively to the announcement of sustainability-linked bond issuance.

H2: The announcement of sustainability-linked bond issuance results in significantly higher cumulative abnormal returns compared to the announcement of regular bond issuance.

2.4 Potential rationales for issuing a sustainability-linked bond

2.4.1 Cost of capital

For a company to raise the optimal capital structure and maximise firm value, it has to determine how much and what type of equity and debt it should issue (Ashhari, Chun & Nassir, 2009). Taking into consideration that cheaper cost of capital might be received positively by the stock market. Very recently, the first paper addressing the pricing of SLBs was published by Kölbel and Lambillon (2022). Their main findings imply that issuers, on average, can benefit from a sustainability premium. For the issuers who can issue their SLB with a sustainability premium, this benefit in the cost of capital can represent one rationale for issuing this product. However, they also show broad differences between issuers. Their results show that this premium is larger for bonds that link higher coupon step-ups to their bond structure. Moreover, the premium is found to be larger for callable bonds. Overall, we can say that investors are willing to accept lower pricing on an SLB, but only depending on the structure of this instrument. Köbel and Lambillon (2022) also find that some issuers can get a so-called "free lunch" by issuing an SLB. Results of their cost-benefit analysis imply that, for some issuers, the average coupon step-up it needs to pay to the bondholder is lower than the premium benefit on the SLB issuance. Moreover, most SLBs including a high coupon step-up also have a call option embedded in the structure of the bond. This allows the issuer to redeem the bond earlier than maturity, and thus lower the potential penalty. We would label this rationale for issuing an SLB as greenwashing. However, most SLBs issued have not yet reached their target observation date, hence we cannot predict whether these issuers will call their SLBs.

2.4.2 Signaling

From an investor perspective, it can be hard to assess a company's environmental commitment, as there might be information asymmetry between the investor and the company. A company can take several actions to reduce this information asymmetry and credibly show

its commitment to the environment. One way to signal this commitment is by issuing a bond linked to certain relevant and material ESG company targets. This signal is even more credible if the objectives are validated by the Science Based Targets initiatives (SBTi).[7] In this way, the issuer shows in two ways its discipline to change its entire business towards a specific ESG target; i) the issuer needs to set out clear ESG objectives, and ii) the issuer sets a direct financial incentive for the failure of meeting these sustainability targets. In addition to that, issuing an SLB for the first time can be rather costly and requires resources and internal efforts. Hence, by making this commitment, the issuer signals its discipline to change its entire business towards a specific ESG target and brings transparency to the market. A sustainability-linked bond announcement contains, contrary to conventional bonds, two pieces of information (Flammer, 2021). First, it announces the issuance of a bond, and second, it signals the company's environmental commitment. The unresponsive stock market to conventional bond issuances, a theory explained in Section 2.3, supports the theory that firms issuing an SLB signal their environmental commitment to the market. Furthermore, existing literature shows positive acknowledgement by the stock market to environmental commitments by a company (Klassen & McLaughlin, 1996; Flammer, 2013; Krüger, 2015).

Several event studies on green bond announcements distinguish between first time-issuers and sequential (seasoned) issuers. Both Zang and Zhang (2020) and Flammer (2021) find statistically insignificant stock price changes for seasoned green bond issues, in comparison to inaugural issues. These studies show that the media attention for inaugural green bond issues is higher than for sequential issues, as with the latter the market is already aware of the company's environmental targets. Hence, inaugural issues are rewarded with statistically significant higher stock market returns. Separating our analysis for first-time and sequential issues allows us to analyse the economic value of corporate environmental news. According to the media attention argument, we expect this same signalling theory to hold for sustainability-linked bond issuers. The hypothesis is stated as follows:

H3: The announcement of an inaugural sustainability-linked bond issuance results in significantly higher cumulative abnormal returns compared to the announcement of a seasoned sustainability-linked bond issuance.

[7] SBTi drives ambitious corporate climate action by setting science-based emission reduction targets.

2.5 Key performance indicator setting

The level of ambition, exhibited by the sustainability performance targets linked to the bonds, can vary extensively. As defined by the ICMA Sustainability-Linked Bond Principles, KPIs need to be material to the issuer's business model and they need to address relevant ESG challenges faced in the industry sector. Calibrating appropriate and credible KPIs is a joint effort among the issuer, the sustainability advisors and the second party opinion (SPO) provider, and is key to the success of this instrument. The KPIs selected can take a wide range of environmental targets like GHG emissions or renewable installed capacity as well as social objectives such as the construction of affordable housing or any diversity targets (Gibbs et al., 2022). They find that the majority of the SLBs have one or more KPIs related to GHG emissions reductions linked to their bond. For example, the Tesco SLBs are linked to the ability of the firm to reduce its scope 1 and 2 GHG emissions by at least 60% by the end of 2025, against a 2015 baseline.[8] Scope 1 and 2 emissions refer to the direct emissions from owned and controlled sources (scope 1) as well as indirect emissions arising from the purchase of directly consumed electricity, heating and cooling systems (scope 2). However, for most companies scope 3 emissions, defined as the GHG emissions along their supply chains (both upstream as well as downstream), tend to be a significant part of their total footprint. As of now, only a relatively small number of SLBs include scope 3 as part of their KPIs, even though scope 3 seems to be the majority of GHG emissions. The problem lies in the fact that not all corporates have so far been able to fully map their scope 3 footprint. Furthermore, definitions may vary widely for scope 3 emissions used in SLBs and not all scope 3 emissions are calculated in a similar way. Some SLBs only include certain categories of Scope 3, while other issues include all scope 3 categories. Data by MSCI shows that, in mid-2020, only 18% of all companies under their rating universe reported on scope 3 emissions. However, according to the estimations of MSCI, on average scope 3 represents three times the scope 1 and 2 combined emissions of corporates.

A more recent paper by the ECB describes how a firm's credit risk, defined as the risk that a lender does not receive the principal and interest on time, is influenced by the need to transition to a low-carbon economy (Carbone et al., 2021). The paper concludes that higher GHG emissions are likely to be associated with higher credit risk. Furthermore, the authors

[8] See "Tesco launches first sustainability-linked bond of €750m" (January 20, 2021).

concluded that i) disclosing GHG emissions increases the likelihood of firms having lower credit risk by approximately 5%, ii) making a forward-looking commitment related to emissions reduction has a 10% impact on lowering credit risk, and iii) firms that disclose scope 3 GHG emissions have lower credit risk by ca. 30% (although the latter result shows modest statistical significance). They conclude that both the percentage and the speed of GHG emissions targeted tend to be higher for more ambitious targets.

Overall, this paper highlights the value of corporates having forward-looking transition plans and disclosing their level of GHG emissions. The issuance of an SLB is one example of linking firm targets while raising money for the company. Moreover, lower credit risk, in the end, enables firms to attract new debt with a lower cost of capital, as this reduces the possibility of not fulfilling the debt obligations to the investor (i.e. not paying back the loan to the investor). These findings would suggest that shareholders benefit more if they are invested in firms setting forward-looking GHG emissions targets linked to their SLB issuance, than in firms that issue SLBs without GHG emissions targets. These GHG emissions targets are seen by the stock market as more credible in terms of ESG commitment. Furthermore, it is interesting to examine whether companies including scope 3 as part of their KPIs are rewarded with a higher stock return. Even though there are only a few companies to date that have mapped out these scope 3 emissions, it is a good incentive for issuers to know that getting started with mapping scope 3 emissions is valued by the market. The following hypotheses arise:

H4: The announcement of an SLB issuance with at least one KPI linked to GHG emissions reduction results in significantly higher cumulative abnormal returns compared to the announcement of an SLB issuance without a KPI linked to GHG emissions reduction.

H5: The announcement of an SLB issuance including scope 3 GHG emissions reduction as part of its KPIs results in significantly higher cumulative abnormal returns compared to the announcement of an SLB issuance including only scope 1 and 2 GHG emissions reduction as part of its KPIs.

3. DATA

In this section, we describe the data selection process, after which we provide a comprehensive description of the new SLB landscape.

3.1 Data selection

3.1.1 Bond data

Throughout the research and data selection process, we use Bloomberg to obtain data on both sustainability-linked and conventional bonds, as this database has the largest SLB coverage. For example, the Environmental Finance database does not cover all SLBs issued by private firms or SLBs issued by firms from the Asia-Pacific region. We retrieve our fixed-income data for the period 01.09.2019 until 28.02.2022. Within this period, all bonds labelled with the indicator "Sustainability Linked Bond / Loan" in Bloomberg are extracted and will be defined in the remainder of this study as "sustainability-linked bonds". Furthermore, we consolidate duplicate bonds (REGS, 144A and STRIPs) to prevent double-counting of bonds. For this study, we exclude all SLBs that are labelled by Bloomberg as "Schuldschein", as these instruments are classified as privately placed debt obligations and all have a coupon of 0.00%. Including these instruments may give a distorted picture of the SLB landscape and the event study results, as the announcement of these instruments may release other information than public SLBs. Private Placements which have an ISIN code are included. Lastly, we exclude convertible bonds, as their prices are sensitive to the price of the underlying stock, and hybrid bonds, as they contain different characteristics than regular SLBs and lack a maturity date. These criteria reduce the sample to 264 SLBs. Via Bloomberg, we are able to retrieve announcement dates for all issues, which is a prerequisite to performing an event study. Moreover, information is extracted from Bloomberg regarding the issuer name, ISIN, corresponding equity ticker, pricing date, issue date, maturity date, amount issued, currency, coupon, bond type, country of domicile of the issuer and the S&P, Moody's and BBG composite (bond level) ratings. Other data regarding the SLBs (i.e. the number and type of KPIs, SPTs, target observation dates, the type and level of penalties and if the issuer has a framework and second party opinion) are manually retrieved from the Environmental Finance database, Bloomberg news, official press releases and publicly available Sustainability-Linked Bond Frameworks of the issuer. The issued SLBs vary in currency and to compare them, all figures are converted into US dollars (USD) using the exchange rate at the issue date of the bond.

In *Table 1*, we provide descriptive statistics of the global sustainability-linked bonds retrieved from Bloomberg. A split is made between SLBs issued by private firms (*Column 2*) and public firms (*Column 3*). Due to the infancy stage of the market, the sample of SLBs is not yet as sizeable as in peer studies conducted on green bonds. Of the 264 SLBs issued, 83 SLBs are issued by private firms and 181 by public firms, corresponding to 63 and 122 unique issuers, respectively. In total, the 122 public firms correspond to 101 inaugural and 21 sequential issuers, issuing on 151 single issuer-days[9]. Unsurprisingly, public firms issue on average larger bonds, with a larger tenor. Furthermore, public firms pay, on average, a lower coupon on their SLBs than private firms. This could be due to the fact that private firms are, on average, smaller and riskier and need to pay more to investors to raise debt. The median credit rating is also higher for public firms (a BBG composite rating of BBB-) than for private firms (a BBG composite rating of B), corresponding to the creditworthiness of the bond. Lastly, we observe a share of 44% high yield (HY) bonds in the total sample (*Column 1)*, relative to 56% investment grade (IG) bonds. This share corresponds to 79% HY bonds in the private sample against 33% HY bonds in the public sample.

Table 1. Descriptive statistics of the global sustainability-linked bond market

This table provides descriptive statistics of the overall SLB market *(1)*, the market for private issuers *(2)*, and the market for public issuers *(3)*. *# Sustainability-linked bond issuer-days* represents the unique issue days by the issuer for all issuers together. *# Sustainability-linked bond issuers* represents the unique issuers within the sample. The *Maturity* in years, *Coupon* in percentage and a dummy for *Callable bond*, being (1) for a callable bond and (0) otherwise, are expressed in average numbers. Below the average, we show within brackets the standard deviations of the samples. The *S&P, Moody's and BBG composite rating* refer to the bond ratings, expressed as the median in the sample. The BBG composite rating comprises an average rating per bond issue using multiple providers.

	All *(1)*	*Private* *(2)*	*Public* *(3)*
# Sustainability-linked bonds	264	83	181
# Sustainability-linked bond issuer-days	218	67	151
# Sustainability-linked bond issuers	185	63	122
Amount (USDm)	488.51	359.05	547.87
	(388.27)	(283.27)	(405.33)
Maturity (years)	7.31	6.31	7.77
	(3.22)	(3.36)	(3.06)
Coupon (%)	2.93	3.97	2.46
	(2.03)	(2.11)	(1.81)
Callable (1/0)	0.61	0.48	0.67
	(0.49)	(0.50)	(0.47)
S&P rating (median)	BBB-	B	BBB
Moody's rating (median)	Baa3	B2	Baa2
BBG composite rating (median)	BB+	B	BBB-

[9] Multiple transactions on the same day, with the same announcement date, issued by one issuer are seen as one "issuer-day".

To conduct the event study, the sample in the remainder of this paper is reduced to the 181 SLBs issued by 122 public firms[10], since stock market data is required for the analysis. For SLBs issued by private companies, it holds that, if the bond is issued by a direct subsidiary of a publicly traded firm, the deal is included in the sample and the announcement corresponds to the parent company's publicly traded stock. This is in line with Tang and Zhang (2020). Bloomberg is used to classifying the issuers as public or private.

In addition to the sustainability-linked bond data, we extract all conventional bonds issued by the public companies in the sample within the same period. For these conventional bonds, the same bond-specific data is retrieved. Conventional bonds are defined as issued by the same company that issued the sustainability-linked bond, but not labelled as sustainability-linked or green by Bloomberg. In this way, we control for firm-specific factors that might affect stock market reactions to the announcement of a bond. The same criteria regarding the exclusion of convertible and hybrid bonds are applied. Furthermore, conventional bonds issued on the same day as an SLB are removed from the sample. We obtain a sample of 313 conventional bonds after these criteria. Again, all quantities are converted to USD.

3.1.2 Stock market data

Stock market data is obtained from Bloomberg. The equity tickers corresponding to the publicly listed companies issuing the SLBs are used to retrieve adjusted daily stock prices (P_t). These stock prices are adjusted for normal and abnormal cash dividends, stock dividends, spin-offs and stock splits. These corrections adequately reflect the corporate actions of the company, all having an impact on the true value of the stock (Campbell, Cowan & Salotti, 2010).

3.1.3 Index data

In line with Flammer (2021), country-specific index data is retrieved from Bloomberg and will serve as a proxy for the market return in this study. For each country, we use the leading stock market index. Furthermore, a global stock market index (i.e. the MSCI All Country World Index), including both emerging and developed world markets, is used as a robustness check. The indices used in the analysis are listed in *Appendix B*.

[10] Public firms are defined as publicly listed companies traded on a stock exchange.

3.1.4 Firm-level data

Finally, firm-specific data on SLB issuers are retrieved from Bloomberg. Firm-level data are used as control variables in the regression analysis. For each SLB, we retrieve accounting data at the date of the announcement of the bond issuance. Based on prior event study literature on green bonds, the most relevant variables are selected (Baulkaran, 2019; Lebelle, Lajili Jarjir, & Sassi, 2020; Flammer, 2021).

To calculate the size of the issuing firm on the announcement date of the bond, we first retrieve the total assets of the firm, defined as the total of all short and long-term assets as reported on the balance sheet. In line with Baulkaran (2019), Lebelle et al. (2020) and Flammer (2021), the size of the issuing firm *i* is calculated by the natural logarithm of the total assets. This method is used to minimize the impact of outliers in the distribution of firm size. The firm's size is retrieved as follows:

$$Firm\ size_i = \ln\left(Total\ Assets_i\right) \tag{1}$$

Second, the return on assets (ROA) is retrieved from Bloomberg, calculated by a firm's net income divided by its total assets. This variable indicates how profitable a company is relative to its total assets. Return on assets gives an idea of how efficient management is at using assets to generate earnings. The ROA is derived through *Equation 2*:

$$ROA_i = \frac{Net\ income\ before\ depreciation_i}{Total\ Assets_i} \tag{2}$$

Lastly, an indication of the level of debt in the firm is presented by the variable leverage. This variable, expressed in percentages, is calculated by the sum of short and long term debt over the firm's total assets. The ratio is derived by the following equation:

$$Leverage_i = \frac{(Short\ term\ debt_i + Long\ term\ debt_i)}{Total\ Assets_i} \tag{3}$$

Again, as with the bond-specific data, we convert all quantities to USD.

3.2 Descriptive statistics of the public sustainability-linked bond market

In this section, we provide a detailed description of the public SLB market. As the market is still in its infancy stage and, to the best of our knowledge, only a few studies have been conducted in this area, it is important to get a clear picture of how the market develops, what its characteristics are and what type of issuers are coming to the market.

3.2.1 Bond and firm-level descriptive statistics

In *Table 2*, we show the descriptive statistics regarding the sustainability-linked bonds (*Panel A*) and conventional bonds (*Panel B*) issued by the public companies in the sample. When comparing the two, we observe a significantly larger average amount issued (USD 548m versus USD 334m) and a longer maturity for SLBs. The p-values for the difference-in-means test between the sustainability-linked and the conventional bond sample are significant at the 1% level for the variables amount, maturity and callable. This implies that, for these variables, the difference between the means of both samples is significantly different from zero. Thus, SLBs are more regularly issued with a call option, which is mainly a feature of the HY versions of the product. Furthermore, the average coupon for the SLB sample is 2.46%, which is lower than for their conventional peers, paying on average 2.60% on their coupons. However, the difference is not statistically significant at the 10% level. Finally, in *Panel C*, we describe the firm characteristics of the public SLB issuers at the time of the SLB issuance. The total of 181 SLB issuances corresponds to 151 unique issuer-day observations. Looking at the mean and median of the variables being close to each other, the distribution of the variables looks symmetrical around the mean.

Table 2. Descriptive statistics of the sample of public sustainability-linked bond issuers

Panel A describes the bond characteristics of the public SLBs in the sample. *Panel B* describes the bond characteristics of the conventional bonds issued by the same SLB issuers. *Panel C* describes the firm characteristics of the SLB issuers on the 151 unique SLB issuer-days. The *Amount* is expressed in USD million, *Maturity* in years, *Coupon* in percentage and a dummy for *Callable*, being (1) for a callable bond and (0) otherwise. The *p-value* relates to the difference-in-means test, comparing the difference in means between the SLB sample and the conventional bond sample.

	Panel A. Sustainability-linked bond characteristics						
Variable	*N*	*Mean*	*Median*	*SD*	*Min*	*Max*	*P-value (diff in means)*
Amount (USDm)	181	547.87	500.00	405.33	28.16	2,161.04	0.000***
Maturity (years)	181	7.77	7.03	3.06	1.49	20.00	0.000***
Coupon (%)	181	2.46	2.29	1.81	0.00	10.75	0.413
Callable (1/0)	181	0.67	1	0.47	0	1	0.000***
	Panel B. Conventional bond characteristics						
	N	*Mean*	*Median*	*SD*	*Min*	*Max*	
Amount (USDm)	313	334.11	232.97	312.24	11.23	2,500.00	
Maturity (years)	313	6.18	6.00	6.03	0.09	30.17	
Coupon (%)	313	2.60	2.80	2.12	-0.16	12.61	
Callable (1/0)	313	0.27	0	0.44	0	1	
	Panel C. Firm characteristics						
	N	*Mean*	*Median*	*SD*	*Min*	*Max*	
Size	151	9.61	9.60	1.54	6.50	15.32	
Leverage (%)	151	0.40	0.37	0.16	0.03	0.82	
Return on assets (%)	151	0.03	0.03	0.07	-0.26	0.37	

, ** and * indicate statistical significance at the 10%, 5% and 1% confidence level, respectively.*

3.2.2 Overview of the public sustainability-linked bond market

Figures 1.1 and *1.2* show the evolution of the sustainability-linked bond market. *Figure 1.1* shows the exponential growth of the public SLB market, especially since 2021. Within this year, a volume of USD 80bn is issued in sustainability-linked format. *Figure 1.2* shows that corporates are dominating the SLB market (in monetary terms). However, this figure also shows that the percentage of volume issued by financials has increased over time: from 0% in 2019 to 3%, 7% and 18% in 2020, 2021 and the first two months of 2022, respectively. In terms of the number of deals, in 2020 there were only 13 SLBs issued, in comparison to 149 SLBs in 2021. Note that the first quarter of 2022 only refers to the first two months of 2022. Nevertheless, these months experience slightly lower issuances due to market volatility, caused by looming uncertainty and political tension around the situation between Russia and Ukraine.

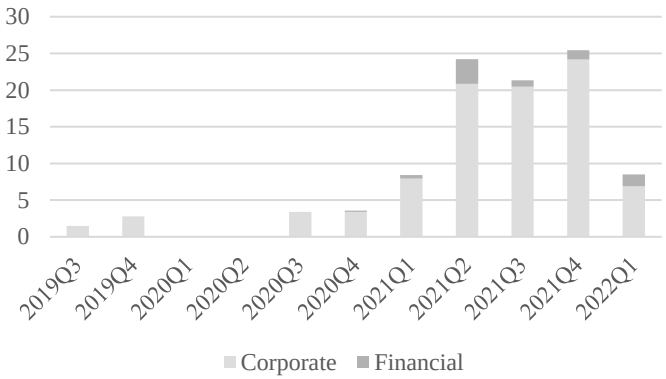

Figure 1.1 Volume of sustainability-linked bonds issued per quarter (USDbn)

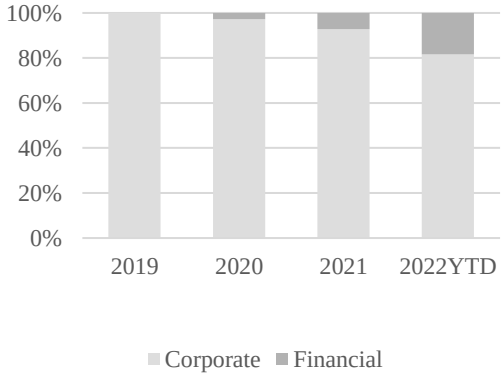

Figure 1.2 Corporate-financial split of the sustainability-linked bond volumes issued (%)

* Figures up to and including Feb 2022

Figure 2 shows that the strong pick-up of the SLB market has been mainly due to a boom of issuances from European issuers, accounting for 57% of the SLB volume issued.[11] In terms of countries of origin, issuers from the Netherlands are leading with an issued volume of USD 21.5bn, followed by France (USD 9.4bn).[12] Looking at the total amount issued by currency, we find that euro issuances are the most dominant with a share of 52%, followed by issuances in US dollars (36%)[13]. Furthermore, the SLB instrument has so far mostly been used by issuers from "transitional" sectors, such as the utility and materials sector. Both in monetary terms and in the number of deals they are leading the SLB market. A consensus is emerging

[11] See Figure C.1 in Appendix C for a region split of the public SLB market.
[12] See Table C in Appendix C for a country split of the public SLB market.
[13] See Figure C.2 in Appendix C for a currency split of the public SLB market.

that SLBs are well-suited to finance the green transition. They can either be issued by companies lacking appropriate assets for a use of proceeds bond or when the company's activities cannot yet be clearly defined as appropriate for either a green or a social bond. A detailed sector split can be found in *Appendix D* of this study.

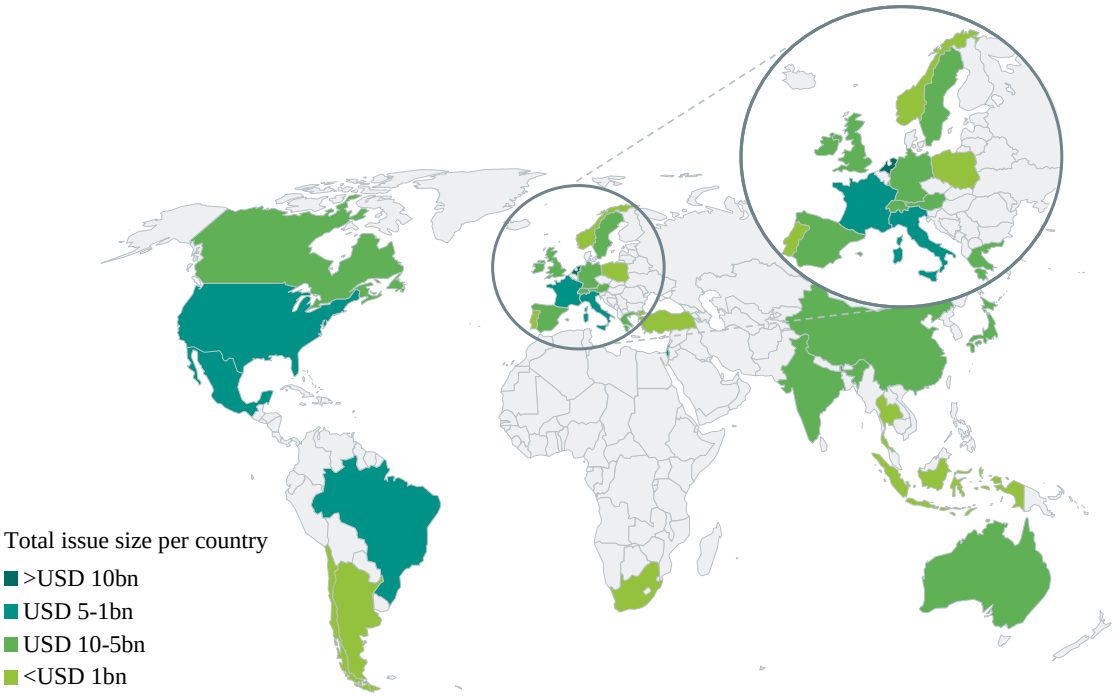

Figure 2. Geographic market overview of sustainability-linked bond issuances, Sept 2019 – Feb 2022

* All figures relate to issuance volumes in monetary terms

3.2.3 Sustainability-linked bond framework and second party opinion

Issuers can show their credibility and bring transparency to the market by issuing a sustainability-linked bond based on a published Sustainability-Linked Bond Framework (framework). This framework is more credible to investors when obtaining a second party opinion (SPO) from an independent ESG research company or an environmental assessment expert. All SPO providers use their own assessment method and verification parameters to assess the credibility of the SLB. Nevertheless, most SPO providers build on the Sustainability-Linked Bond Principles, as administered by ICMA. These principles lay down five core components of SLBs, including the selection of KPIs, the calibration of SPTs, and bond characteristics. Data on 118 public SLB issuers with information on the issuer's framework and SPO shows that 105 issuers have an SLB framework. Moreover, 103 of these issuers obtained an assessment by an independent SPO provider on their framework. Sustainalytics is the leader in the SPO market with a market share of 36%, followed by ISS ESG (22%). In *Figure 3*, we show a split of SPO providers in the market.

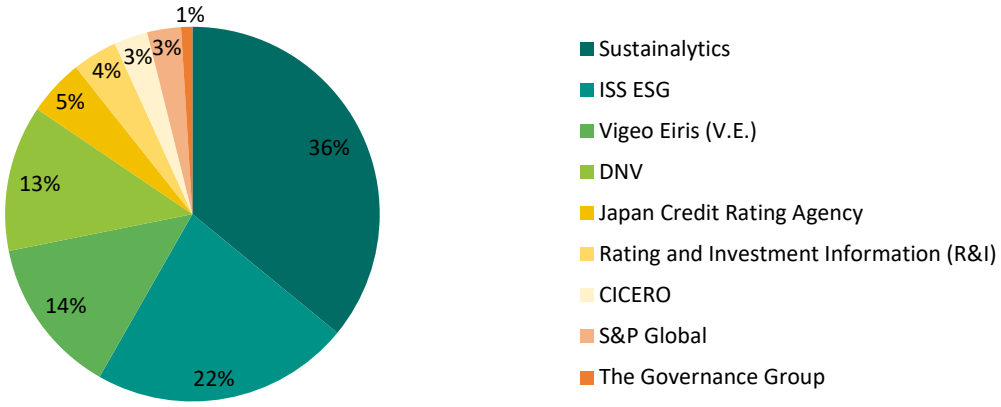

Figure 3. Split of second party opinion provides in the public sustainability-linked bond market (%)

3.2.4 Sustainability-linked bond characteristics

Data on 167 SLBs with information on the trigger events show that, thus far, coupon step-ups have been the most commonly used feature that is triggered by an issuer failing to meet its SPT (75% of the SLBs), but other structures have been floated (*Table 3*). The other most used financial impact is a cash premium to be paid at maturity (13%), with the remainder referring to either a combined coupon step-up and step-down or any sort of alternative structure (e.g. the purchase of green certificates). Other investors say that they are not that keen on profiting from failure and would rather see a donation or a commitment to invest an amount in remediation activities to get the company back on the right track in terms of sustainability. Despite the increasingly wide variety of issuers and KPIs across the market, the level of step-up typically lies around 25bps. However, levels are ranging from 12.5bps to 75bps per KPI, depending on the number of KPIs linked to the bond. In terms of cash premium paid at maturity, the most common amongst issuers is to pay 75bps as a penalty once the bond matures.

Table 3. Overview of financial impact features used in the sustainability-linked bond structure

Penalty	*# of bonds with penalty structure*	*% of the public SLBs*
Coupon step-up	126	75%
Cash premium at maturity	21	13%
Coupon step-up & Coupon step-down	8	5%
Coupon step-down	4	2%
Purchase of certificates	4	2%
Donation	4	2%

3.2.5 Key performance indicators

For the 181 SLBs in the sample, we were able to retrieve data on KPIs for 175 of the bonds. The most common approach amongst SLB issuers is to include 1 or maximum 2 KPIs per transaction. Most of these SLBs (105 SLBs corresponding to 60%) have one KPI linked to the bond. This leaves 24% with two KPIs and only 16% with three or more KPIs linked to the

bond. As KPIs need to be material to the issuer's business model (as defined by the ICMA SLBP), we assume that issuers prefer to use a limited number of 'very material' KPIs, rather than including several ones which might not be so relevant to their strategy. For the 175 SLBs with KPI data, we identified a total of 267 KPIs. Our analysis indicates that the reduction of greenhouse gas (GHG) emissions thus far has been the main focus of the SLB market, with 73% of the deals having at least one KPI focussing on GHG emissions. However, it may also be the case that more than one KPI linked to the bond structure regards the reduction of GHG emissions (e.g. one KPI on scope 1&2 and one KPI on scope 3 GHG emissions). The second most used KPI is linked to renewable energy (*Table 4*).

Table 4. Key performance indicators linked to the sustainability-linked bonds used in the sample

KPI category	*Category*	*# of times KPI used in an SLB*
GHG emissions (scope 1, 2 and 3)	Green	141
Renewable energy	Green	28
Circular economy	Green	15
Healthcare	Social	12
Gender equality	Social	9
Water	Green/social	8
Global ESG assessment	ESG	8
ESG Index listing	ESG	6
Sustainable sourcing	Green	5
Biodiversity	Green	4
Clean transportation	Green	4
Diversity	Social	3
Green buildings	Green	3
Other		*23*

Looking at the GHG emissions targets, we notice that a small share of the issuers has scope 3 (i.e. indirect) included in their GHG emissions KPI. This means that the vast majority of issuers still rely exclusively on scope 1 and 2 (i.e. direct) emissions as targets under their SLB transactions. However, for most companies, scope 3 emissions are a significant part of their global footprint as these include the emissions from the entire value chain (e.g. the use of purchased goods and services, transportation and distribution, etc). We assume that the preference by issuers to use scope 1 and 2 as KPIs relies on the fact that not all corporates have so far been able to fully map their scope 3 footprint. For our fourth and fifth hypotheses, information on scope 1, 2 and 3 GHG emissions is required. We study the effect of having a GHG emissions reduction target in place on stock market reactions. Furthermore, we examine the difference between only relying on scope 1 and 2 emissions or including scope 3 emissions as well. As shown in *Table 5*, from the 127 SLBs with at least one GHG emissions reduction target (*Column 1*), there are 31 bonds with a target linked to scope 3 GHG emissions, corresponding to 26 unique issuers (*Column 3*).

Table 5. Sustainability-linked bond sample with at least one KPI linked to greenhouse gas emissions

This table describes all sustainability-linked bonds (SLBs) with at least one key performance indicator (KPI) related to greenhouse gas (GHG) emissions reduction linked to the bond. *Column (1)* describes the sample in which all SLBs include at least one KPI related to scope 1, 2 or 3 GHG emissions. *Column (2)* describes the SLB sample in which the KPIs only relate to scope 1 or 2 GHG emissions (or both). *Column (3)* describes the sample in which the SLBs include at least one KPI linked to scope 3 GHG emissions. *# Sustainability-linked bond issuer-days* represents the unique issue days by the issuer for all issuers together. *# Sustainability-linked bond issuers* represents the unique issuers within the sample.

	All GHG	*Scope 1-2*	*Scope 3*
	(1)	*(2)*	*(3)*
# Sustainability-linked bonds	127	96	31
# Sustainability-linked bond issuer-days	105	76	29
# Sustainability-linked bond issuers	84	58	26

4. METHODOLOGY

In this section, we describe the event study method used in this study. Furthermore, we describe the cross-sectional regression analysis used to investigate potential drivers of the cumulative abnormal returns. This method is used as a robustness check for the event study.

4.1 Event study

Employing this event study, we examine the impact of a sustainability-linked bond announcement on the issuer's stock price. If there is a positive impact of the SLB announcement on shareholder wealth, this will be reflected in abnormal stock returns. Potential stock price reactions to the announcement of an SLB issuance are measured around the announcement date, rather than around the issue date, as no new information is disclosed to the market by the actual issuance of the bond (Flammer, 2021). Hence, the announcement date is used as the event date and will therefore be day zero (T=0). As explained in the study of McWilliams and Siegel (1997), the event window must not be too long, to avoid confounding effects, but must on the other hand be long enough to capture the potential effects of the event. With this in mind, we take the window [0,1] as our main event window, examining a 2-day window centred around the announcement date. This is in line with the event study of Lebelle, Lajili Jarjir and Sassi (2020), who examined the announcement effect on shareholder wealth of green bonds. Furthermore, the alternative event windows [0] and [-1,0] are included as a robustness check. To check for run-ups in stock prices preceding and after the event, we also consider time intervals [-5,-2] before and [2,5] after the event window. By including the event window [-5,-2], and as described by Krüger (2015), we take into account that some information about the event may have been disclosed or leaked before the announcement date. Furthermore, as suggested by MacKinlay (1997), a time window after the event enables us to check for a continual increase in stock prices. Moreover, for comparison, we include the announcements of conventional bonds in our analysis. These results allow us to answer hypothesis 2, as formulated in Section 2.3.

4.1.1 Returns

Before conducting the event study, we calculate daily stock returns (R_t) from the adjusted daily stock prices (P_t). For the calculation of these daily stock returns we use the simple return method (*Equation 4*):

$$R_t = \frac{P_t}{P_{t-1}} - 1 \qquad (4)$$

However, problems in estimating predicted returns and measuring abnormal returns arise when a stock does not trade daily. To handle the non-trading days of stocks we use the trade-to-trade method, as used in Maynes and Rumsey (1993) and Campbell et al. (2010). Within this method, the daily stock return is determined from the last day with a non-missing stock price to the current day. Furthermore, to reduce the impact of missing stock prices and thin trading, events with missing stock prices in the event window are excluded from the analysis (Maynes & Rumsey, 1993).

4.1.2 Abnormal returns

In this study, the market model (MM) is used to estimate abnormal performance. This is in line with the method used in Campbell et al. (2010) and Flammer (2021). With this pricing model, we first calculate the abnormal returns and subsequently the cumulative abnormal returns. The market model estimation is expressed by *Equation 5*:

$$R_{it} = \alpha_i + \beta_i * R_{mt} + \varepsilon_{it} \tag{5}$$

$$E(\varepsilon_{it} = 0) \qquad Var(\varepsilon_{it}) = \sigma_{\varepsilon_i}^2$$

where R_{it} is the return on the company's stock *i* at time *t*. Furthermore, R_{mt} represents the daily market return, served by the country-specific indices, and ε_{it} represents the error term. For the error term, it holds that it has an expected value of zero and a variance of $\sigma_{\varepsilon_i}^2$.

The parameters of the market model, α_i and β_i, are estimated using an ordinary least squares (OLS) regression. Both company and market components may vary over time and between countries, and thus requires the market model estimation of α_i and β_i for each sustainability-linked bond announcement. In line with Flammer (2021), an estimation window of 200 trading days with daily stock returns is used to estimate the parameters α_i and β_i (i.e. an estimation window of [-220,-21] trading days). These 200 trading days are used to make an estimation of the normal performance of the issuers' stock, in case there was no bond issued on that day. The estimated daily return on the stock of company *i* is presented by *Equation 6*:

$$\hat{R}_{it} = \hat{\alpha}_i + \hat{\beta}_{mt} * R_{mt} \tag{6}$$

The abnormal daily returns (AR) for a company's stock *i* on day *t* are calculated by the difference between the actual returns and the estimated daily returns, as shown in *Equation 7*:

$$AR_{it} = R_{it} - \hat{R}_{it} \tag{7}$$

Cumulative abnormal returns (CAR) are calculated by aggregating the abnormal returns over the selected event window [T_1, T_2]. This is expressed in *Equation 8*:

$$CAR_i(T_1, T_2) = \sum_{T_1}^{T_2} AR_{it} \tag{8}$$

Average abnormal returns (AAR) are computed by *Equation 9*, and present the average abnormal returns for the aggregated stocks *i* on day *t*. Furthermore, *N* denotes the number of events in the sample.

$$AAR_t = \frac{1}{N} \sum_{i=1}^{N} AR_{it} \tag{9}$$

Lastly, cumulative average abnormal returns (CAAR) in the event window [T_1, T_2] are calculated by the following equation:

$$CAAR(T_1, T_2) = \frac{1}{N} \sum_{T_1}^{T_2} AAR_t \tag{10}$$

4.1.3 Significance test

After computing the estimated CAARs using the event study methodology, we compute a standardized cross-sectional test to draw the statistical inference. This parametric significance test[14], as proposed by Boehmer et al. (1991), combines the Patell (1976) test with the traditional cross-sectional test. According to Kolari and Pynnönen (2010), the standardized test is more robust than its traditional peer, as the first considers both information on the estimation window and the event window. Furthermore, it accounts for serial correlation and event-induced volatility. Employing this test, we check for each day whether the average abnormal returns are statistically different from zero (Campbell, 2010). Our H_0 is as follows:

$$H_0 : E(AAR) = 0$$

The cross-sectional test for testing the null hypothesis is given by *Equation 11*:

$$z_{AAR_t} = \sqrt{N} \frac{AAR_t}{SD_{AAR_t}} \tag{11}$$

where SD_{AAR_t} denotes the standard deviation across firms on day *t* and *N* denotes the number of events in the sample The standard deviation of the AAR on day *t* is calculated by the following equation (*Equation 12*):

[14] A parametric test assumes that abnormal returns are normally distributed (MacKinlay, 1997).

$$SD_{AAR_t} = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(AR_{it} - AAR_t)^2} \quad (12)$$

In addition to the average abnormal returns for each day in the event window, we test for the significance of the cumulative average abnormal returns in the sample. For this, we perform a regression on the CAAR. The p-value on the constant derived by this regression shows the significance level of the abnormal returns across all issuers in the sample in the event window [T_1, T_2]. This test is preferable to a t-test because it allows for robust standard errors.

4.1.4 Robustness check

As a robustness check, we analyse whether similar results are achieved when taking the MSCI All Country World Index as the market return instead of the country-specific indices. Results are shown in Section 5.1.3.

4.2 Cross-sectional regression analysis

Following prior event studies performed on green bond announcements, the variation of the CAR is now examined in the cross-section (Baulkaran, 2019; Lebelle, Lajili Jarjir, & Sassi, 2020). With this analysis, we can control for both firm-specific and bond-specific variables that may affect stock market reactions to the announcement of an SLB issuance. An OLS regression model is estimated through *Equation 13*, with the cumulative abnormal return acting as the dependent variable. The firm and bond-specific control variables firm size, return on assets (ROA), leverage, bond size, coupon, maturity and callable act as independent variables in the regression analysis. The calculation and rationale of the added firm-specific variables are explained in Section 3.1.4. Moreover, previous empirical studies show that bond characteristics also may impact the stock market reaction to the announcement of bond issuances (Baulkaran, 2019). In particular, the issue size, coupon rate and maturity of the bond have been considered in the regression analysis. Therefore, we add these three bond-specific variables to the cross-sectional test. Bond size is calculated as the natural logarithm of the amount issued, coupon is the coupon paid on the bond in percentages, maturity is the number of years to maturity of the bond and callable is a dummy variable for the bond being callable before maturity. This variable is equal to 1 for a callable bond, and 0 otherwise. This leads to the following regression:

$$CAR_{it} = \alpha_i + \beta_1 * Firm\ size_{it} + \beta_2 * ROA_{it} + \beta_3 * Leverage_{it} + \beta_4 * Bond\ size_{it} + \beta_5 * Coupon_{it} + \beta_6 * Maturity_{it} + \beta_6 * Callable_{it} + \varepsilon_{it} \quad (13)$$

$$E(\varepsilon_{it} = 0) \qquad Var(\varepsilon_{it}) = \sigma_{\varepsilon_i}^2$$

For the error term ε_{it} in *Equation 13*, it holds that it has an expected value of zero and a variance of $\sigma_{\varepsilon_i}^2$. Furthermore, the main event window of interest for the cross-sectional regression is the window [0,1] surrounding the announcement date. This is in line with Lebelle et al. (2020).

We first perform a regression with the above-explained control variables. Hereafter, we perform four more regression analyses, in which we implement a different dummy variable each time. First, we investigate whether a corporate issuer (dummy is 1) compared to a financial issuer (dummy is 0), could be a potential driver of the CARs. Second, we add Europe as a dummy variable to the regression analysis (dummy being equal to 1 for a European issuer and zero otherwise). The third element we control for is first-time issue by adding a dummy that is 1 for a first-time issuance and 0 for a seasoned issuance. Lastly, we add a dummy for scope 1&2 GHG emissions and a dummy for scope 3 GHG emissions to *Equation 13*. If both dummies are equal to zero, the bond has an other related KPI linked to the SLB.

5. EMPIRICAL RESULTS

In this section, we present the empirical results of the event study conducted in this paper. The primary interval [0,1] represents the event window of the announcement date plus the day after the announcement date. For this interval, we first check for any outliers in the estimated abnormal returns (AR) and cumulative abnormal returns (CAR). The distribution of the two can be found in *Appendix E*. Both show a normal distribution, implying no real outliers in the sample.

5.1 Event study results

5.1.1 Stock market reaction to sustainability-linked bond announcements

The main results are reported in *Table 6*. This table shows the cumulative average abnormal returns over different time windows surrounding the announcement of the sustainability-linked bond issuance. The SLB sample includes 151 unique issuer-day observations. We find an estimated CAAR of 0.182% in the primary time window [0,1]. This CAAR implies that stock prices react in a small but positive direction to the announcement of the SLB issuance. However, the standard error is more than 1.5 times the CAAR, and hence the CAAR is not significant at the 10% level. Looking at the t-statistics and the corresponding p-values, none of the CAARs in the other event windows is significant at the 10% confidence level. Overall, the results in *Table 6* show that it cannot be proven that sustainability-linked bond announcements lead to significant positive cumulative average abnormal returns. These non-significant results could have several reasons. First, these results could imply that the null hypothesis is not rejected, meaning that there are indeed no cumulative average abnormal returns. However, the results may also indicate that the available data is at this point in time too limited to come to conclusions. With only one year worth of data on SLB issuances, as shown in *Figure 1.1*, we realize the SLB market is still young. For hypothesis 1, we cannot reject the null hypothesis.

Table 6. Cumulative average abnormal returns for different intervals around the announcement date

The sample consists of 151 sustainability-linked bonds, all issued on a unique issuer-day. The *event time* represents the event window surrounding the announcement date [0]. Furthermore, the *standard error* shows the amount of variation in the cumulative abnormal returns.

Event time	*CAAR*	*Standard Error*	*t-statistic*	*p-value*
[-5,-2]	0.093	0.341	0.27	0.786
[-1,0]	0.187	0.290	0.61	0.540
[0]	0.251	0.249	1.01	0.316
[0,1]	0.182	0.286	0.67	0.505
[2,5]	0.140	0.319	0.44	0.662

, ** and * indicate statistical significance at the 10%, 5% and 1% confidence level, respectively.*

To check for run-ups before and after the event, we examine the daily average abnormal returns in the event window [-5,5] surrounding the announcement date. We use the standardised cross-sectional test (Z_t), as expressed in *Equation 11*, to test whether the daily AARs are significantly different from zero. Information leakage before the announcement of the SLB issuance does not seem to be an issue in the sample. As shown in *Table 7*, the AARs on day 4 and day 3 before the announcement of the SLB are statistically significant at the 10% and 5% confidence levels, with corresponding Z-scores of 1.935 and 2.469, respectively. However, both days assign a different direction of market reaction (i.e. an AAR of 0.331% on day 4 prior to the announcement and an AAR of -0.373% on day 3 prior to the announcement), giving an ambiguous signal. Moreover, the AAR on day 0 (the announcement date) indicates a positive but statistically insignificant average abnormal return of 0.251%. Overall, we do not find significant evidence of a run-up in stock prices leading up to or after the announcement date.

Table 7. Daily average abnormal returns for time interval [-5,5], including significance level (Z_t)

The sample consists of 151 sustainability-linked bonds. For every day, from 5 days preceding the announcement date until 5 days after the announcement date, we computed the average abnormal returns (AAR). *SD* represents the standard deviation of the AAR. The standardized cross-sectional test (Z_t) is used to test if the daily average abnormal returns are significantly different from zero.

Day	*[-5]*	*[-4]*	*[-3]*	*[-2]*	*[-1]*	*[0]*	*[1]*	*[2]*	*[3]*	*[4]*	*[5]*
AAR	0.161	0.331	-0.373	-0.034	-0.064	0.251	-0.069	-0.084	0.278	-0.170	0.116
SD	0.216	0.171	0.151	0.122	0.140	0.249	0.147	0.140	0.209	0.163	0.169
Z_t	(0.744)	(1.935)*	(2.469)**	(0.281)	(0.456)	(1.007)	(0.469)	(0.597)	(1.326)	(1.041)	(0.689)
Obs.	151	151	151	151	151	151	151	151	151	151	151

, ** and * indicate statistical significance at the 10%, 5% and 1% confidence level for a two-tailed test, respectively.*

To test hypothesis 2, the results in *Table 8* distinguish between sustainability-linked and conventional bond announcements. This comparison is made to control for firm-specific factors that might affect stock market reactions to the announcement of a bond. The SLB sample includes 151 unique issuer-day observations, whereas the conventional bond sample includes 237 unique issuer-day observations. For the main event window [0,1] we find a CAAR of 0.182% in the SLB sample, compared to a CAAR of 0.011% in the conventional bond sample. Nevertheless, both samples show no significant results. Our results are in line with previous literature regarding stock price reactions to conventional bond issuances, showing that there is no significant stock price reaction to regular bond issues. Still, to examine whether the means in the SLB sample and the conventional bond sample significantly differ from each other, we conduct a difference-in-means test. However, the p-values are not significant at the 10% confidence level for all event windows and this implies that there is no evidence for the difference between the means of both samples to be significantly different from zero.

Table 8. Cumulative average abnormal returns in the sustainability-linked bond sample compared to cumulative average abnormal returns in the conventional bond sample

The sample consists of 151 sustainability-linked bonds and 237 conventional bonds, all issued on a unique issuer-day. The *event time* represents the event window surrounding the announcement date [0]. The *standard error* shows the amount of variation in the cumulative abnormal returns. The *p-value* relates to the difference-in-means test, comparing the means between the two samples.

	Sustainability-linked bonds		Conventional bonds		Diff in means
Event time	*CAAR*	*Standard Error*	*CAAR*	*Standard Error*	*P-value*
[-5,-2]	0.093	0.341	-0.201	0.217	0.468
[-1,0]	0.187	0.280	-0.070	0.173	0.435
[0]	0.251	0.249	-0.022	0.115	0.321
[0,1]	0.182	0.296	0.011	0.160	0.613
[2,5]	0.140	0.319	-0.084	0.243	0.579

, ** and * indicate statistical significance at the 10%, 5% and 1% confidence level, respectively.*

The daily average abnormal returns (AARs) for both the sustainability-linked and for the conventional bond sample are furthermore graphically illustrated in *Figure 3*.

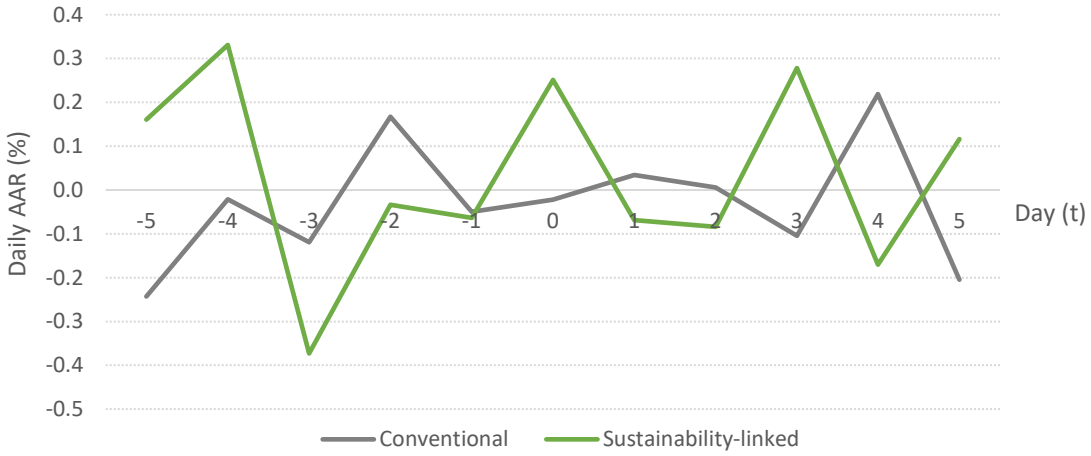

Figure 3. Daily average abnormal returns in the sustainability-linked bond and the conventional bond sample surrounding the announcement of the bond, over time window [-5,5]

5.1.2 Subsamples

To test hypotheses 3, 4, and 5, we also apply our analysis to several subsamples. For all of the subsamples, we still make use of the estimation window [-220,-21] and show results for the prime interval [0,1]. The results are shown in *Table 9*.

Firstly, we analyse how stock markets react to inaugural issuances compared to seasoned issuances. We observe a CAAR of 0.213% over the sample of inaugural issuances while observing a CAAR of 0.052% over the sample of seasoned issuers. However, both CAARs are statistically insignificant. The directions indicate that the stock market reacts small but positively for both subsamples. Also, the reaction seems to be larger for the sample of first-time issuers. However, looking at the p-value for the difference-in-means test (0.674), the CAARs do not significantly differ from each other.

Secondly, we analyse the sample of SLBs issued with at least one KPI related to the reduction of GHG emissions, compared to the sample of SLBs having other KPIs linked to the bond. The GHG emissions sample results in a CAAR of 0.022%, compared to a CAAR of 0.467% for the other KPI sample. However, the CAARs of both subsamples are statistically insignificant. The directions of the CAARs indicate that the stock market responds stronger to the announcements of SLBs issued with KPIs related to other objectives than the reduction of GHG emissions. This could be explained by the fact that most GHG emissions targets are related to the scope 1 and 2 emissions of the company, while the scope 3 emissions tend to be a quite significant part of the total footprint of the company. These targets can therefore be seen as less material to the issuer's core business. However, the p-value of the difference-in-means test (0.250) shows that both samples are not significantly different from zero.

Lastly, to examine hypothesis 5, we compare the subsample of SLBs including a scope 1 and 2 GHG emissions KPI with the subsample that includes scope 3 as part of their KPIs. The subsamples show a CAAR of -0.575% and 1.586%, respectively. These directions of abnormal returns strengthen the argument of including scope 3 in its KPIs leading to more shareholder wealth. Moreover, when testing the CAARs of both subsamples on a difference in means, we find a p-value of 0.009, implying that the difference between the CAARs in both subsamples is significantly different from zero. However, for the seasoned issuers, other KPI and scope 3 samples, we observe rather small subsamples. Such a small sample size may not have the statistical power to expose the effect of the sample. Furthermore, for the last subsample comparison, the CAARs are non-significant at the 10% level.

Table 9. Cumulative average abnormal returns in time window [0,1] for several subsamples

Sustainability-linked bond subsamples			
	Panel A. First-time vs. seasoned issue		
	First-time issue	*Seasoned issue*	*P-value (diff in means)*
CAAR	0.213	0.052	0.674
Standard Error	0.250	0.287	
N	122	29	
	Panel B. GHG emissions vs other KPI		
	GHG emissions KPI	*Other KPI*	*P-value (diff in means)*
CAAR	0.022	0.467	0.250
Standard Error	0.269	0.278	
N	105	40	
	Panel C. Scope 1&2 vs scope 3 KPI		
	Scope 1&2 KPI	*Scope 3 KPI*	*P-value (diff in means)*
CAAR	-0.575	1.586	0.009***
Standard Error	0.211	0.767	
N	76	29	

, ** and * indicate statistical significance at the 10%, 5% and 1% confidence level, respectively.*

To examine the direct effect of the subsamples we analysed so far, we also need to add these variables to the cross-sectional regression analysis in the remainder of this chapter. By including these dummy variables in the regression analysis, we can see these direct effects after controlling for other firm and bond-specific variables. The results are outlined in Section 5.2.

5.1.3 Robustness check

As a robustness check, we incorporate the MSCI All Country World Index in the event study as the benchmark return for all SLB issues in the sample. As shown in *Table 10*, when using the global index for estimating the CAARs, we observe a cumulative average abnormal return of 0.075% over the prime interval [0,1]. With the use of the country-specific indices as benchmark returns, we observed a CAAR of 0.182% over the same interval. However, regardless of the measure of CAAR, we observe no statistically significant results. Using the alternative world market index as a robustness test yields therefore very similar results.

Table 10. Cumulative average abnormal returns using country-specific indices compared to cumulative average abnormal returns using a world index

This table contains the cumulative average abnormal returns (*CAAR*) for different event windows surrounding the announcement date, using country-specific indices as well as a global index (MSCI all country world index). Both samples consist of 151 sustainability-linked bonds, issued on a unique issuer-day. The *standard error* shows the amount of variation in the cumulative abnormal returns.

	MSCI All Country World Index		Country-Specific Indices	
Event time	*CAAR*	*Standard Error*	*CAAR*	*Standard Error*
[-5,-2]	0.225	0.354	0.093	0.341
[-1,0]	0.113	0.300	0.187	0.280
[0]	0.241	0.258	0.251	0.249
[0,1]	0.075	0.307	0.182	0.296
[2,5]	0.276	0.358	0.140	0.319

, ** and * indicate statistical significance at the 10%, 5% and 1% confidence level, respectively.*

5.2 Cross-sectional regression results

We continue our analysis with regression results to control for firm and bond-specific variables. As there might be some independent variables in the regression that are correlated, we first check for multicollinearity using a correlation matrix. This matrix can be found in *Appendix F*. The degree of correlation between the control variables is low enough to say that multicollinearity does not appear to be a big issue in our regression models. In *Table 11*, we present the regression results for both the bond and the firm characteristics on the cumulative abnormal returns around the SLB announcements. First, in *Model 1*, we regress the base case scenario including all control variables outlined in *Equation 13*. In this regression, firm size, with a negative sign, is the only variable that is statistically significant at the 10% level. Thus, after controlling for other variables there are no significant cumulative abnormal returns that

can be observed. When adding the dummy variable 'corporate' to the regression analysis (*Model 2*), we observe this dummy to be negative and significant at the 1% level. After controlling for several variables, we observe a 2.632% decrease in CARs for corporate issuers. Moreover, firm size has become more significant, now at the 5% level. The significant negative coefficient for firm size implies that CARs are negatively related to firm size, suggesting that the issuance of an SLB triggers a more pronounced market reaction for smaller firms. This may be because smaller firms are more capable of mapping their total scope 3 footprint and linking a target to these emissions. Apart from this, none of the variables is statistically significant.

Table 11. Regression of cumulative abnormal returns [0,1] on bond and firm-specific characteristics

Model	(1)	(2)	(3)	(4)	(5)
	CAR	*CAR*	*CAR*	*CAR*	*CAR*
Firm size	-0.387*	-0.496**	-0.364	-0.408*	-0.359
	(0.236)	(0.232)	(0.245)	(0.250)	(0.234)
Leverage	3.024	2.982	3.099	2.957	2.622
	(2.033)	(1.976)	(2.049)	(2.055)	(2.009)
Return on assets	-2.272	-2.173	-2.052	-2.430	-1.988
	(4.532)	(4.405)	(4.585)	(4.583)	(4.468)
Bond size	0.588	0.784	0.556	0.609	0.512
	(0.498)	(0.489)	(0.508)	(0.505)	(0.491)
Coupon	-0.144	-0.185	-0.121	-0.147	-0.140
	(0.175)	(0.171)	(0.187)	(0.176)	(0.174)
Maturity	-0.123	-0.139	-0.117	-0.123	-0.130
	(0.112)	(0.109)	(0.114)	(0.113)	(0.111)
Callable	-0.780	-0.347	-0.799	-0.829	-0.455
	(0.949)	(0.861)	(0.953)	(0.805)	(0.987)
Corporate		-2.632***			
		(0.861)			
Europe			0.244		
			(0.665)		
First-time issue				-0.220	
				(0.805)	
Scope 1&2 KPI					-1.024
					(0.765)
Scope 3 KPI					0.996
					(0.939)
Constant	-7.028	-7.657	-6.851	-6.976	-5.481
	(8.625)	(8.386)	(8.664)	(8.655)	(8.499)
Observations	151	151	151	151	151
R^2	0.049	0.108	0.050	0.049	0.095

, ** and * indicate statistical significance at the 10%, 5% and 1% confidence level, respectively.*

When we link these results back to hypotheses 3, 4 and 5, we cannot reject the null hypotheses for all three hypotheses. These findings conclude that we cannot significantly prove that inaugural SLB issuances are better received by the market than seasoned issuances. Finally, we cannot say that including a GHG emissions reduction KPI in general or a scope 3 KPI leads to significantly higher abnormal returns.

6. CONCLUSION

In this paper, we shed light on the fairly new sustainability-linked bond product. The results of this research provide several insights into the rapidly growing market. Research shows that there is still ambiguity and uncertainty in the new market. Small positive, but statistically insignificant cumulative average abnormal stock returns surrounding the announcement of the SLB issue imply that there is not enough evidence to say that stock prices react positively to SLB announcements. Therefore, we cannot conclude that shareholders benefit from a sustainability-linked bond issuance. The results of this event study are not consistent with prior studies on other sustainable finance instruments such as green bonds. These studies are suggesting positive stock market reactions to companies announcing sustainable eco-friendly behaviour (Flammer, 2013; Krüger, 2015). There may be several reasons for these contrasting results. First of all our contrasting results may be due to data limitations, as further explained in Section 7. Another proposed theory argues that the confidence in this product needs to grow as it still is a relatively new product. Furthermore, as outlined in the study by Reboredo (2018), green bonds attract investors trying to satisfy their green mandates and simultaneously seek to enhance their ESG scores. The increase in demand for this product can lead to increasing stock prices. Relying on this theory, statistically insignificant results for the announcement of a sustainability-linked bond issuance may imply that investors are slightly hesitant in investing in this instrument for their ESG funds. This notion is supported by the fact that these products do not explicitly specify what the use of the proceeds of the bonds are, making it harder to prove that it is being used for the right purpose. Furthermore, due to the infancy stage of the SLB market, there currently is a lack of consistency and alignment in SPTs and coupon step-ups, resulting in significant divergences in SLB structuring. The uncertainty about the level of ambition of the targets after major acquisitions by the company and the functionality of the penalties for callable SLBs could play a role in the absence of acknowledgement by the market for issuing an SLB. Stricter frameworks for the use of SLBs and more credible targets verified by the Science Based Targets initiative may be a solution to this uncertainty in the market and provide more consistency among the SLBs. We expect further issuing volume, greater standardisation and increased scrutiny of the product to help with the robustness of the structures. To conclude, the market has several promising features for issuers. Especially for companies going through a transition phase, this product may provide a solution to revolutionise a firm into a more sustainable one. However, the market first needs to mature to further push its potential.

7. LIMITATIONS AND FUTURE RESEARCH

Since the market is still in an early stage of development, we recognize that due to the limited availability of data, the empirical results and conclusions drawn in this study need to be considered carefully. For example, compared to similar event studies conducted on green bonds, our study makes use of a more limited dataset as the market has only been around for a shorter period of time. However, since our study is one of the first to address the new concept of sustainability-linked bonds, this paper sheds light on the SLB market and opens up the floor for future research. As the market grows exponentially, this research can be repeated in a few years, with a more comprehensive sample of sustainability-linked bonds. Future directions of research could relate to the following areas. First, future investigation is necessary to explore the actual improvement of the sustainability profile of the company, after issuing an SLB. This has already been studied for green bonds in the papers of Zhou and Cui (2019) and Flammer (2021). Secondly, as a follow-up to the previous suggestion, future research could analyse the stock price reactions around the observation dates of the sustainability performance targets set by the company. As of now, the market is still young and the targets are still too far in the future to examine the market effects surrounding these target observation dates. However, it would be interesting to see how many companies do achieve their targets. What implications does the failure of an SPT have on the development of the company? One would expect a company's stock prices to decrease when it fails to achieve an SPT. This argument would be in line with the findings of Flammer (2013), who shows that companies behaving irresponsibly towards the environment are punished for their harmful behaviour with a significant decrease in their stock price. Thirdly, future research could analyse the wealth creation effect after the issuance of an SLB in comparison to the wealth creation after issuing a green bond. In this way, one can compare the signal a company sends to the market about its ESG commitments with each of the different debt instruments. Lastly, our research focuses on the issuer's perspective and motivations to issue an SLB. Future research could analyse how this instrument is priced by investors and what their motives are to buy these products. This would also be useful information for issuers, as they can act on this.

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Appendix A – Volumes issued in the labelled bond market

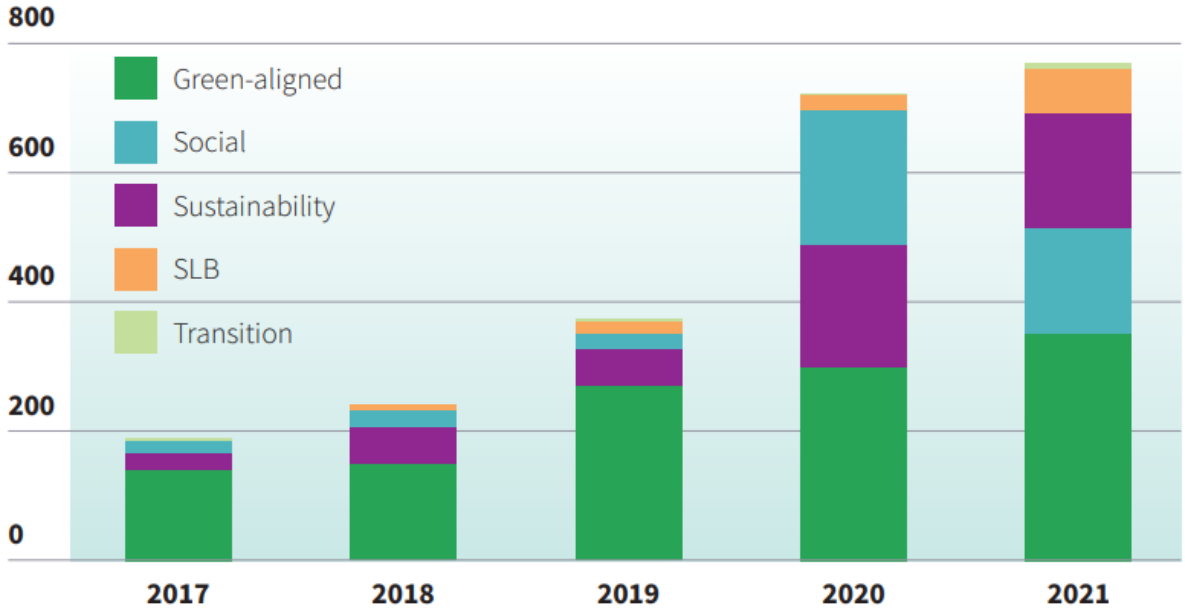

Figure A. Volumes issued in the green, social, sustainability(-linked) and transition bond market from 2017 until 3Q 2021 (in USDbn). The 2021 numbers refer to the first three quarters of that year, whereas the other columns refer to year-end numbers.

Source: Climate Bonds Initiative, 2021.

Appendix B – Country-specific indices

Table B. Country-specific indices used as market returns in the event study

Country	*Index*	*BBG ticker*
Argentina	S&P MERVAL	MERVAL Index
Australia	S&P/ASX 200	AS51 Index
Austria	ATX	ATX Index
Brazil	IBOVESPA	IBOV Index
Canada	S&P/TSX composite	SPTSX Index
Chile	S&P/CLX IGPA	IGPA Index
China	Shanghai Composite	SHCOMP Index
France	CAC 40	CAC Index
Germany	DAX	DAX Index
Greece	FTSE/Athex 20	FTASE Index
Hong Kong	Hang Seng	HSI Index
India	S&P BSE SENSEX	SENSEX Index
Indonesia	JCI	JCI Index
Ireland	ISEQ 20	ISEQ20P
Israel	TA-125	TA-125 Index
Italy	FTSE MIB	FTSEMIB Index
Japan	NIKKEI 225	NKY Index
Luxembourg	LuxX	LUXXX Index
Mexico	S&P/BMV IPC	MEXBOL Index
Netherlands	AEX	AEX Index
Norway	OBX	OBX Index
Poland	WIG 30	WIG30 Index
Portugal	PSI 20	PSI20 Index
Singapore	STI	STI Index
South Africa	FTSE/JSE Africa top 40	TOP40 Index
Spain	IBEX 35	IBEX Index
Sweden	OMX S30	OMX Index
Switzerland	SMI	SMI Index
Thailand	SET	SET Index
Turkey	BITS 100	XU100 Index
United Kingdom	FTSE 100	UKX Index
United States	S&P 500	SPX Index
Global	*MSCI ACWI*	*MXWD Index*

Appendix C – Country, region and currency split

Table C. Sustainability-linked bonds by country

Country	*Region*	*# Bonds*	*$ amount (bn)*	*# Unique Issuers*
Netherlands	Europe	20	21.53	3
France	Europe	17	9.36	13
Brazil	Latin America	12	8.96	8
United States	North America	9	6.95	8
Italy	Europe	9	5.81	8
Mexico	Latin America	9	5.69	6
Israel	Asia-Pacific	4	5.01	1
Switzerland	Europe	5	3.73	2
Australia	Asia-Pacific	8	3.43	4
United Kingdom	Europe	6	3.36	4
Canada	North America	6	3.13	4
China	Asia-Pacific	9	2.84	8
Sweden	Europe	10	2.15	8
Germany	Europe	4	1.85	3
Greece	Europe	3	1.85	2
Ireland	Europe	2	1.70	2
Hong Kong	Asia-Pacific	4	1.54	2
Spain	Europe	3	1.51	2
Japan	Asia-Pacific	11	1.32	11
India	Asia-Pacific	3	1.20	3
Austria	Europe	3	1.17	3
Luxembourg	Europe	1	0.80	1
Poland	Europe	3	0.78	2
Thailand	Asia-Pacific	6	0.63	2
Singapore	Asia-Pacific	3	0.61	2
Norway	Europe	3	0.55	3
Chile	Latin America	1	0.50	1
Turkey	Europe	1	0.50	1
Indonesia	Asia-Pacific	1	0.35	1
Portugal	Europe	1	0.15	1
South Africa	Africa	3	0.13	2
Argentina	Latin America	1	0.05	1
Total		*181*	*99.16*	*122*

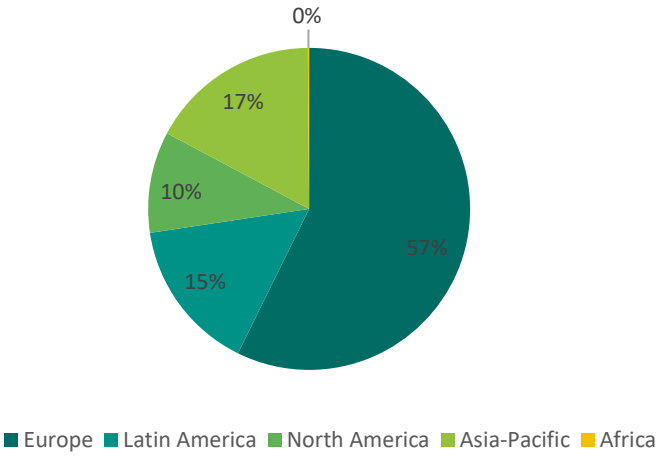

Figure C.1. Sustainability-linked bonds by region (% of monetary terms)

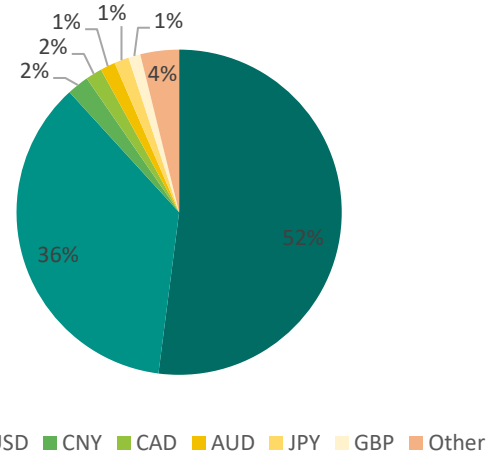

Figure C.2. Sustainability-linked bonds by currency (% of monetary terms)

Appendix D – Industry split

Table D. Sustainability-linked bonds by industry

Industry	*# Bonds*	*$ amount (bn)*	*# Unique Issuers*
Communication	**4**	**2.52**	**4**
Wireless Telecommunications Services	2	1.40	2
Wireline Telecommunications Services	2	1.12	2
Consumer Discretionary	**20**	**9.38**	**16**
Airlines	3	0.74	2
Apparel & Textile Products	2	0.21	2
Auto Parts Manufacturing	5	3.70	4
Consumer Services	1	0.13	1
Retail - Consumer Discretionary	7	3.63	5
Travel & Lodging	2	0.97	2
Consumer Staples	**24**	**12.29**	**15**
Consumer Products	3	1.82	2
Food & Beverage	13	7.04	9
Retail - Consumer Staples	2	0.12	1
Supermarkets & Pharmacies	6	3.32	3
Energy	**8**	**5.23**	**5**
Exploration & Production	1	0.16	1
Integrated Oils	3	2.69	2
Pipeline	2	1.86	1
Refining & Marketing	2	0.52	1
Financials	**26**	**7.78**	**21**
Banks	3	1.45	2
Commercial Finance	2	0.22	2
Financial Services	7	2.67	5
Real Estate	14	3.44	12
Health Care	**7**	**7.34**	**3**
Medical Equipment & Devices Manufacturing	2	0.16	1
Pharmaceuticals	5	7.17	2
Industrials	**21**	**8.31**	**19**
Electrical Equipment Manufacturing	2	1.19	2
Industrial Other	8	2.84	7
Machinery Manufacturing	1	0.80	1
Railroad	1	0.50	1
Transportation & Logistics	7	2.33	6
Waste & Environment Services & Equipment	2	0.65	2
Materials	**31**	**15.34**	**21**
Chemicals	9	3.69	6
Construction Materials Manufacturing	6	2.47	3
Containers & Packaging	5	2.48	4
Forest & Paper Products Manufacturing	4	3.25	2
Metals & Mining	7	3.45	6
Technology	**4**	**2.06**	**4**
Hardware	1	0.35	1
Semiconductors	1	0.75	1
Software & Services	2	0.96	2
Utilities	**36**	**28.91**	**14**
Power Generation	11	4.54	8
Utilities	25	24.37	6
Total	*181*	*99.16*	*122*

Appendix E – Distribution of AR and CAR [0,1]

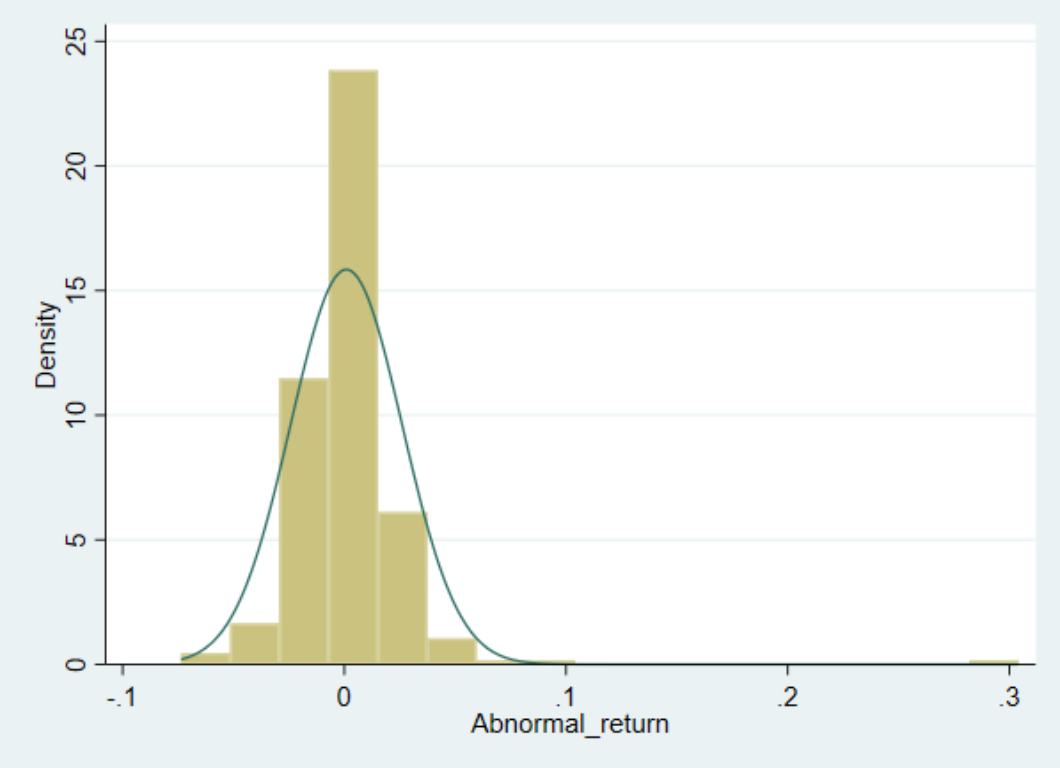

Figure E.1. Distribution of abnormal returns to sustainability-linked bond announcements in event window [0,1]

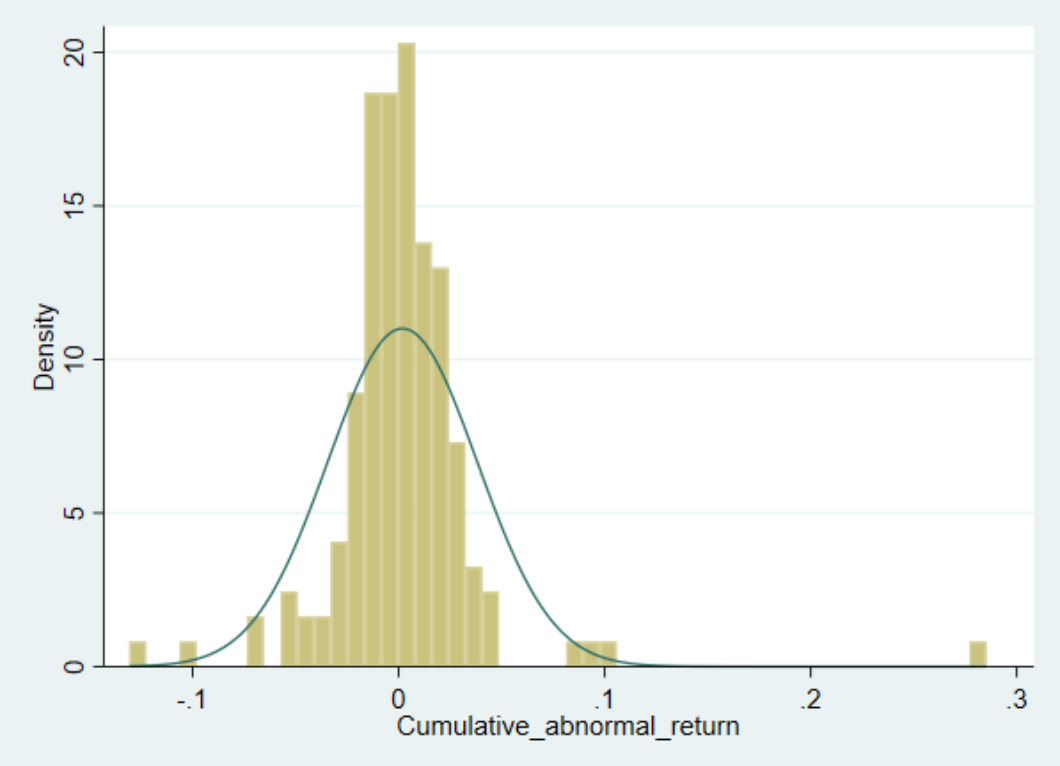

Figure E.2. Distribution of cumulative abnormal returns to sustainability-linked bond announcements in event window [0,1]

Appendix F – Correlation matrix control variables

Table F. Correlation matrix independent variables in the cross-sectional regression analysis

The independent variables with a correlation above |0.4| are highlighted in the table.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Firm size (1)	1.000											
Leverage (2)	-0.146	1.000										
ROA (3)	-0.039	-0.233	1.000									
Bond size (4)	0.395	-0.024	0.061	1.000								
Coupon (5)	-0.310	0.242	-0.139	-0.138	1.000							
Maturity (6)	0.031	0.023	0.116	0.267	-0.104	1.000						
Callable (7)	-0.028	0.056	0.112	**0.660**[1)]	0.039	0.357	1.000					
Europe (8)	-0.073	-0.114	-0.033	0.194	-0.289	-0.030	0.165	1.000				
Corporate (9)	-0.084	0.005	0.057	0.267	-0.040	0.084	0.328	0.183	1.000			
First-time (10)	-0.244	-0.071	-0.089	-0.094	-0.000	-0.051	-0.129	-0.006	-0.113	1.000		
Scope1&2 (11)	-0.006	-0.086	0.060	0.186	-0.048	0.141	0.314	0.047	0.279	-0.115	1.000	
Scope3 (12)	-0.049	0.044	-0.028	0.137	-0.050	0.139	0.164	0.174	-0.074	0.110	**-0.491**[2)]	1.000

[1)] A positive correlation of 0.660 between the control variables bond size and callable implies that the larger the size of the bond issued, the more often there is an option to call the bond.

[2)] There is a negative correlation of 0.491 between the dummy variables scope 1&2 and scope 3. Intuitively this makes sense. If dummy variable scope 1&2 is 1 for a sustainability-linked bond it cannot be a 1 for the scope 3 dummy variable and otherwise. This causes a negative correlation between the two.