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Empirically Analyzing Market Reactions to Green Bond Issuances and Green Bond Disclosures of European Banks and Insurers

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Abstract

This paper empirically analyzes market reactions to first-time issuances of green bonds and first-time disclosures of green bond frameworks of 45 large, listed European banks and insurers with an event study. Covering recent regulatory developments of the European Green Bond Standard, we investigate how the market reacts to the issuance of green bonds and the disclosure of green bond frameworks from 2015 to 2022. It will also be examined which key financial figures, green bond-, and framework-related characteristics influence market reactions as measured by cumulative abnormal returns. We find that market reactions are not significant due to offsetting positive and negative effects. However, statistically significant cumulative abnormal returns can be observed in absolute terms. Finally, we identify a firm's size, leverage, and the offered coupon (text length and eligible green projects) as significant influencing factors for positive and negative market reactions to first-time green bond issuances (disclosures of green bond frameworks).

Zusammenfassung

In diesem Beitrag werden Marktreaktionen auf die erstmalige Emission von Green Bonds und die erstmalige Offenlegung von Green Bond Rahmenwerken von 45 großen, börsennotierten europäischen Banken und Versicherungen mit einer Ereignisstudie empirisch analysiert. Unter Berücksichtigung der aktuellen regulatorischen Entwicklungen des European Green Bond Standards untersuchen wir, wie der Markt auf die Emission von Green Bonds und die Offenlegung von Green Bond Rahmenwerken von 2015 bis 2022 reagiert. Es wird auch analysiert, welche finanziellen Kennzahlen sowie Green Bond- und Rahmenwerks-bezogene Merkmale die Marktreaktionen beeinflussen, gemessen an kumulativen abnormalen Renditen. Wir stellen fest, dass die Marktreaktionen aufgrund sich ausgleichender positiver und negativer Effekte nicht signifikant sind. Allerdings können statistisch signifikante kumulative abnormale Renditen in absoluten Werten beobachtet werden. Schließlich identifizieren wir die Größe eines Unterneh-

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mens, den Verschuldungsgrad und den angebotenen Kupon (Textlänge und förderfähige grüne Projekte) als wesentliche Einflussfaktoren für positive und negative Marktreaktionen auf die erstmalige Emission grüner Anleihen (erstmalige Offenlegung von grünen Anleiherahmenwerken).

JEL classification: G14, G21, G22

Keywords: Green bonds, green bond issuance, green bond framework, market reactions

1. Introduction

Green bonds, i. e., fixed income securities that are used to (re)finance projects with a positive environmental benefit such as reducing CO2 emissions or preventing pollution (see, e. g., Flammer, 2021), play an important role in financing assets needed for the transition to a low-carbon economy. The European market for green bonds has become increasingly popular in recent years, with about 42 % of the global green bond volume (total issuance volume amounting to 2.2 trillion USD in 2022) being issued in EUR (see Climate Bonds Initiative (CBI), 2023). At the same time, the voluntary guidelines of the European Green Bond Standard (GBS)[1] and the Green Bond Principles[2] emerge as a key lever to promote sustainable growth. To comply with such principles, issuers of green bonds increasingly publish green bond frameworks, which are typically reviewed by independent auditors and contain information on environmental risks, environmental targets, the use of proceeds, or green project evaluations (see European Sustainable Investment Forum (Eurosif), 2022). Overall, disclosing green bond frameworks and issuing green bonds are steps taken by companies to demonstrate their environmental commitment (see, e. g., Flammer et al., 2021; Wang et al., 2020) as well as to seek cheap (re)financing sources and thereby reduce the cost of capital (see, e. g., Tang and Zhang, 2020). In this context, especially banks and insurance companies as large financial services providers have the potential to accelerate the transition to a low-carbon economy (see, e. g., Di Tommaso and Mazzuca, 2023). Therefore, the aim of the present study is to investigate how European banks and insurers are perceived by investors when issuing green bonds and disclosing green bond frameworks for the

[1] The GBS originates from the European Green Deal (see EC, 2019) with the aim of creating a reliable standard for investors and issuers as well as combating greenwashing by ensuring compliance with external verification. The GBS determines what types of projects qualify as environmentally sustainable and includes specific requirements for bonds to be labeled as green (see Section 2 for a review of the EU GBS).

[2] The Green Bond Principles, developed by the International Capital Markets Association (ICMA), aim to assist issuers in financing environmental and sustainable projects that promote a low-carbon economy and preserve the environment. For further information, see https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/.

first time and what effect this could have on their Cumulative Abnormal Returns (CARs).

In recent literature, many empirical studies investigate green bonds by reverting to the green bond premium (i. e., "Greenium"), which pertains to the differential returns between conventional and green bonds (see Bachelet et al., 2019; Fatica et al., 2021; Flammer, 2021; Hachenberg and Schiereck, 2018; Immel et al., 2021; Larcker and Watts, 2020; Löffler et al., 2021; Pástor et al., 2022; Zerbib, 2019). However, among the considered studies, there still exists mixed evidence on whether returns from green bonds surpass those of conventional bonds. Irrespective of the direction of green bond returns, Pástor et al. (2022) find that Greenium effects can emerge from investors' reactions to the publication of corporate sustainability documents. Such market reactions are commonly investigated by reverting to an event study methodology, which has recently been applied in the broader context of sustainability: Kordsachia et al. (2023), e. g., analyze stock market reactions to Greta Thunberg's speech at the UN Climate Action Summit of listed US firms, while Ramelli et al. (2021) investigate negative stock price effects of the first global climate strike in 2019 of carbon-intensive companies. Further event studies within the European insurance industry exist, e. g., on market reactions to the disclosure of the first Solvency and Financial Condition Reports (see Gatzert and Heidinger, 2020), on the information content of solvency and earnings information (see Mukhtarov et al., 2022) as well as on stock market reactions to Environmental, Social, and Governance (ESG) ratings (see Di Tommaso and Mazzuca, 2023).

Stock market reactions to green bond issuances have already been examined in different cross-sectional studies (see Section 2.1 for a more detailed literature review), where many studies find positive effects of green bond issuances on stock prices (see, e. g., Baulkaran, 2019; Flammer, 2021; Tang and Zhang, 2020). Recent investigations closely related to this work have been conducted by Jakubik and Uguz (2021). However, in contrast to the present study, the authors focus exclusively on the insurance industry and examine the direct influence of green bond issuances on equity prices rather than CARs by referring to a smaller sample within an earlier time period. In addition, Flammer (2021) examines green bond issuances primarily among non-financial firms without a particular focus on Europe between 2013 and 2018. Rather than investigating determinants of CARs – as done in the present paper – Flammer (2021) focuses on the relationship between green bond issuances and environmental performance as well as ownership structure with a difference-in-differences approach. Furthermore, market reactions to the disclosure of green bond *frameworks* have not been analyzed so far, even though this type of disclosure becomes increasingly important against the background of the ongoing development of the EU GBS, with its widely unexamined effects on stock markets. Therefore, the present article provides two separate event studies on market reactions to first-time green bond issuances and first-time disclosures of green bond frameworks by focusing on European banks and insurance companies.

Studying market reactions to green bond issuances and voluntary disclosures of green bond frameworks by European banks and insurers is especially relevant since these firms play a central role in financing the transition to a low-carbon economy, but there are no mandatory requirements for issuing green bonds and disclosing green bond frameworks. Consequently, European banks' and insurers' issuance of green bonds and disclosure of corresponding frameworks can be seen as an additional and voluntary step towards sustainable commitment besides the otherwise mandatory sustainability reporting requirements these firms must adhere to. Thus, analyzing market reactions to first-time green bond issuances and disclosures of green bond frameworks is of considerable importance to evaluate whether investors value European banks' and insurers' voluntary environmental commitment. The increasing relevance of green bonds is further reflected in its market development, with a total corporate issuance volume rising from nearly 100 billion EUR in 2016 to 481 billion EUR in 2022 (see CBI, 2023). However, despite its growing trend, green, social, sustainable, and sustainability-linked bonds (GSSSB)[3] nevertheless only comprise approximately 5 % of the total bond volume in 2022 (see CBI, 2023). Hence, the green bond market exhibits considerable growth potentials, especially against the background of the substantial investment amounts needed to finance the transition to a low-carbon economy (see European Parliament and European Council, 2023). Financial institutions account for a proportion of 29 % of the total corporate green bond volume in 2022 and therefore represent the largest contributors next to sovereigns, non-financial corporates or government-backed entities, whereby especially banks emerge as leading issuers (see CBI, 2023). Apart from that, banks considerably differ from non-financial issuing firms since the use of proceeds from a green bond can also be directed towards green loans instead of green projects (see Fatica et al., 2021; Flammer, 2021). For insurers, green bonds are of particular interest as they offer cheap and long-term (re)financing sources (see Jakubik and Uguz, 2019), which are at the same time suitable to hedge long-term liabilities especially in the life insurance sector (see Mukhtarov et al., 2022).

The contribution of this paper is twofold: On the one hand, we examine first-time disclosures of green bond frameworks – as a new event type in the context of climate-related reporting activities – as well as first-time announcements of green bond issuances to investigate whether quantitative characteristics (*Volume*, *Coupon*, and *Maturity*) or textual elements (*Length*, *GreenProjects*, and

[3] Green bonds represent more than half of all GSSSB issuances in 2022 (see S&P Global Ratings, 2024), which emphasizes their dominating role in financing the transition to a low-carbon economy.

Tone) represent significant determinants of market reactions. On the other hand, an analysis of market reactions to both green bond issuances and disclosures of green bond frameworks allows for a comparison regarding investors' perceptions of these two forms of environmental commitment. Thus, the results of this study provide insights into the effectiveness of green bond issuances and green bond reporting from a capital market perspective as well as possible influencing factors of market reactions.

Considering the underlying event study methodology, we separately examine market reactions to the first-time announcement of green bond issuances and the disclosure of green bond frameworks of listed European banks and insurers with at least 1 billion EUR market capitalization, since larger firms might have a more pronounced impact on market reactions. We calculate CARs around the event of first-time announcements of green bond issuances and disclosures of green bond frameworks from 2015 to 2022. Based on this, Ordinary Least Square (OLS) regressions are applied to investigate what impact financial-, green bond-specific characteristics as well as narrative elements have on market reactions. The sample represents a market share of 39.97 % relative to the total industry market capitalization and consists of 45 large listed European banks and insurance undertakings that issued a green bond (with data extracted from LSEG Workspace Green Bond Guide) and disclosed a green bond framework (as retrieved from the respective corporate websites) for the first time with non-overlapping events[4]. We find that announcements of green bond issuances and disclosures of green bond frameworks do not result in significant CARs. However, in terms of absolute values, statistically significant "extreme" market reactions can be observed. Finally, a firm's size, leverage, and the offered coupon represent statistically significant drivers for positive and negative market reactions to green bond issuances, while the overall text length and the number of addressed eligible green projects result as significant determinants of CARs regarding the disclosure of green bond frameworks.

The article is organized as follows: Section 2 introduces the theoretical background, encompassing a literature review on market reactions to green bond issuances and a summary about regulatory developments of the EU GBS. The underlying methodology and the development of hypotheses are described in Section 3. Section 4 presents empirical results regarding market reactions and determinants of CARs. Section 5 provides further analyses on differences between banks and insurers as well as robustness checks, and the last section concludes.

[4] All firms in the sample that issued a green bond for the first time exhibit an available green bond framework at their corporate website, so that the selection criteria did not appear to be restrictive (see Section 3.2 for further information).

2. Theoretical Background

2.1 Literature Review on Market Reactions to Green Bond Issuances

Table 1 provides an overview of existing studies on market reactions exclusively related to green bond issuances, as no scientific literature specifically exists on event studies in the context of disclosing green bond frameworks to date. Most of the investigated studies refer to signaling effects in the context of green bond issuances, i.e., companies credibly demonstrate their commitment to the environment by issuing green bonds. Accordingly, market reactions to green bond issuances among different issuer types (e.g., corporates or governments) as well as industries (e.g., financials or industrials) result to be generally positive, especially in the case of first-time issuances and issuances that are verified by third parties (see Flammer, 2021; Zhou and Cui, 2019). The studies of Wang et al. (2020) and Zhou and Cui (2019) are closely related due to their focus on the Chinese green bond market and resulting positive stock price reactions. However, Wang et al. (2020) additionally investigate yield spreads between conventional and green bonds and identify a strong Greenium effect especially for first-time issuances and issuers with a good social reputation. Besides examining green bond issuances, Jakubik and Uguz (2021) analyze the impact of commitments to green investments and the launch of green funds on European insurers' equity prices with a pooled estimate model but do not measure market reactions by CARs. They find that the issuance of green bonds and the launch of green funds are significantly positively priced by the market, whereas commitments to green investments, i.e., announcements on the introduction of green bond policies, lead to non-significant changes in stock prices. Verma and Bansal (2023) focus on market reactions to green bond issuances in the banking sector, which result in significantly positive CARs for Indian banks during the event window, but negative returns for the announcement date itself.

Lebelle et al. (2020) represent the only study that reports adverse effects regarding market reactions to green bond issuances, which at the same time rejects the existence of a green bond premium. With respect to Greenium effects, empirical evidence provides mixed results: On the one hand, return differentials between green and conventional bonds are not found to be significant, indicating that investors do not trade off financial returns for environmental benefits (see Flammer, 2021; Larcker and Watts, 2020). On the other hand, it has been observed that investors are willing to accept lower returns for green bonds as compared to their conventional peers, so that issuing firms can profit from cheap financing sources (see Immel et al., 2021; Löffler et al., 2021; Tang and Zhang, 2020; Wang et al., 2020; Zerbib, 2019). Consequently, empirical literature shows heterogeneous results dependent on the respective issuer environment, whereby Fatica et al. (2021), e.g., identify a green bond premium for supranational institutions and non-financial firms but not for financial institutions.

Table 1 shows that existing studies on green bond issuances considerably differ in terms of the defined event, the underlying model, the type of issuer (i. e., corporates vs. sovereigns, industry type) as well as the applied estimation and event windows. Moreover, the examined sample period of the present article deviates from previous literature as it refers to more recent green bond issuances and disclosures of green bond frameworks from 2015 to 2022, which are especially relevant against the background of current regulatory developments of the EU GBS. Thus, we contribute to the existing literature on green bond issuances by studying both European banks and insurers and by additionally examining market effects with respect to the disclosure of green bond frameworks, which have not been studied so far.

Table 1

Empirical results on market reactions to green bond issuances

Authors	**Defined event/topic**	**Model**	**Estimation/ Event window**	**Number of unique issuers**	**Empirical results**
Baulkaran (2019)	Stock market reactions to green bond issuances in Europe, Canada, and the US (2007 – 2016)	Market model (MSCI World, domestic market index)	*[–250; –21]* [–10; 10], [–10; 20]	54	• Positive, statistically significant CARs for announcements of green bond issuances • Decline in firm risk after green bond issuance • Positive and significant influence of firm size, Tobin's Q, and asset growth on CARs, negative relation between operating cash flow and CARs
Flammer (2021)	Stock market reactions to green bond issuances and post-issuance observations (2013 – 2018)	Market model (Compustat Global)	*[–220; –21]* [–5; 10], [–20; –11], [–10; –6], [11; 20], [21; 60]	169	• Positive reaction of investors to issuance announcements (stronger for non-financial issuers, first-time issuances and bonds certified by third parties) • Improved environmental performance post issuance: higher environmental ratings, lower carbon emissions • Increase in ownership by long-term and green investors
Lebelle et al. (2020)	Stock market reactions to green (and conventional) corporate bond issuances (2009 – 2018)	CAPM, Fama and French 3-factor model, Carhart 4-factor model	*[–250; –50]* [–20; 20], [–5; 5], [–3; 3], [–1; 1], [0; 1]	145	• Negative market reactions to the announcement of green bond issuances (especially for first green bond issuances, issuances in developed markets) • No significant differences between market reactions to green and conventional bond issuances

Jakubik and Uguz (2021)	Impact of green bond policies on European insurers' equity prices (2012–2019)	Pooled estimate model	/	7	• Significantly positive impact of issuance of green bonds and launch of green funds on equity prices • Non-significant, positive effect of green bond commitments on stock prices • Only certain types of green policies are positively priced by the market
Tang and Zhang (2020)	Announcement effects of green bond issuances of financial and industrial corporations (2007–2017)	CAPM (index of the stock market on which the stock is listed)	*[−300; −50]* [−10; 10], [−5; 10]	132	• Positive stock price reactions to green bond issuances, no evidence for Greenium effects • Increasing institutional ownership, improved stock liquidity after green bond issuances • Fundamental channel theory: green bonds highlight a firm's dedication to sustainable development
Verma and Bansal (2023)	Stock market reactions to Indian financial institutions' green bond issuances (2015–2019)	Market model (NIFTY 50)	*[−170; −20]* [−1; 10], 0, [1; 10]	6	• Significantly positive effect of green bond issuances of Indian banks on stock returns • Negative market reactions on the day of announcement
Wang et al. (2020)	Debt and stock market reactions to green bond issuances in China (2016–2019)	Market model (Shanghai, Shenzhen, Hang Seng Composite Index)	*[−281; −30]* [−1; 1], [−3; 3], [−10; 10]	305	• Significant price premium for green compared to conventional bonds • Positive announcement effect for first-time green bond issuance • Positive effect of corporate engagement on firm value

(continue next page)

(Table 1 continued)

Authors	**Defined event/topic**	**Model**	**Estimation/ Event window**	**Number of unique issuers**	**Empirical results**
Zhou and Cui (2019)	Stock price reactions to Chinese green bond issuances (2016–2019)	Market model (Shenzhen Composite Index)	*[−250; −20]* [−20; −11], [−10; −2], [−1; 1], [2; 5], [6; 10], [11; 20]	70	• Positive effect of green bond issuances on corporate profitability, operational performance, innovation capacity and Corporate Social Responsibility (CSR) • Green bond issuances serve as a form of signaling and attract new investors

Note: The estimation window (displayed in *italics*) is used to estimate the normal (expected) returns in the absence of the event, while the event window defines the period in which the potential influence of an event is expected to turn into corresponding market reactions (see Section 3.3 for the concrete measurement).

2.2 Regulatory Developments of the European Green Bond Standard

As the EU is a global leader in issuing green bonds (with 42 % of the global green bond volume being issued in EUR (see CBI, 2023)), the GBS plays a central role for the development of standardized requirements regarding the issuance of green bonds and the disclosure of green bond frameworks. The legal basis of the EU GBS can be attributed to Regulation (EU) 2023/2631 on European Green Bonds and optional disclosures (see European Parliament and European Council, 2023), which – amongst other – addresses bonds that are labeled as environmentally sustainable and defines requirements for sustainability-linked bonds. By establishing a voluntary standard, the EU seeks to raise capital to finance sustainable investments, to foster trust among investors, to prevent market disruptions caused by misleading green claims and to define minimum criteria that classify bonds as green (see Eurosif, 2022). Hence, issuers can decide whether to issue their bond as an EU Green Bond or not, implying that certain criteria must only be fulfilled in case the bond is issued as an EU Green Bond. Moreover, only new issuances are affected, so that existing bonds cannot be relabeled as EU Green Bonds. The standard further aims to ensure that funds raised through green bonds are directed towards Taxonomy-aligned[5] economic activities (see EC, 2021).

In addition, issuers of EU Green Bonds must comply with specific transparency obligations, such as the publication of annual allocation reports that are disclosed on the issuers' website. The EU GBS further sets out disclosure requirements for green bond frameworks, whereby disclosed contents must fulfill qualitative information on green project investment allocations, the use of proceeds, criteria for the selection of green projects, reporting and transparency requirements, as well as Second Party Opinions (SPOs) of external reviewers verifying whether the projects raised with the directed funds are indeed positively contributing to the environment (see European Parliament and European Council, 2023; Eurosif, 2022). Moreover, issuers often state their alignment with the Green Bond Principles[6] in green bond frameworks (see ICMA, 2022). As a

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[5] Taxonomy alignment refers to an economic activity that is eligible to make a substantial contribution to at least one of the environmental objectives defined by the EU Taxonomy Regulation (i.e., sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control as well as protection and restoration of biodiversity and ecosystems), while at the same time doing no significant harm to any other of these objectives and complying with minimum human rights and labor standards (see European Parliament and European Council, 2020).

[6] Major differences between the Green Bond Principles and the EU GBS result from the fact that the Green Bond Principles *recommend* impact monitoring and reporting, external review requirements and transparency of green bond documentations, while this is *required* under the EU GBS (see European Parliament and European Council, 2023;

result, investors can benefit from increased standardization, comparability, and augmented transparency requirements in terms of reliable and accessible information, which might contribute to an enhanced decision-making process (see, e. g., Steuer and Tröger, 2020).

Table A.1 in the Appendix chronologically summarizes the most important steps towards the current state of the EU GBS.

3. Hypotheses and Methodology

In what follows, first the hypotheses are derived, followed by the data collection approach. Subsequently, the underlying event study methodology is introduced.

3.1 Derivation of Hypotheses

Consistent with the efficient market hypothesis (see Fama, 1970), we hypothesize that prices should reflect all available information in a frictionless market. Following previous literature on event studies (see, e. g., Baulkaran, 2019; Flammer, 2021; Jakubik and Uguz, 2021), we assume that disclosing information on green bonds (in terms of either issuing green bonds or disclosing green bond frameworks) has an informative value that is incorporated into the valuation of investors and thus has the potential to induce market reactions. We control for further commonly used financial regression variables, with the respective measurement being laid out in Section 3.3. For the development of hypotheses, market reactions are considered separately for the issuance of green bonds and the disclosure of green bond frameworks, whereby the following three hypotheses exclusively relate to the first-time issuance of green bonds.

Volume: Following Jakubik and Uguz (2021), we investigate the impact of the green bond volume on CARs by reverting to the natural logarithm of the issued amount (in Mio. EUR). In recent literature, Löffler et al. (2021) find that green bond volumes are on average larger than issued amounts of conventional bonds, while Pástor et al. (2022) observe opposite effects. Even though larger issuing amounts could evoke investor concern about the issuer's financial stability, we assume that larger green bond volumes might indicate a company's increased commitment to sustainable activities in line with the signaling theory (see Flammer, 2021; Wang et al., 2020), and therefore assume more positive market reactions for larger first-time issued green bond amounts. Thus, we expect:

ICMA, 2022). Moreover, the EU GBS requires alignment with the EU Taxonomy for bonds to be labeled as green, which does not hold for the Green Bond Principles.

H1: *Firms that issue green bonds with larger volumes experience more positive CARs.*

Coupon: In addition to the pivotal role of yields in the assessment of green bonds (see, e.g., Hachenberg and Schiereck, 2018; Löffler et al., 2021; Zerbib, 2019), we aim to analyze whether there is a relation between a green bond's coupon at first-time issuance and corresponding stock market reactions. In this context, the underlying coupon describes the percentage annual yield paid by the issuer relative to the green bond's face value.[7] On the one hand, issuing a green bond with a high coupon might attract investors due to potential expectations of receiving higher interest payments. On the other hand, a higher offered coupon might serve as an indicator of financial distress or high issuer credit risks, stating that green bonds with higher coupon rates could induce negative market reactions (see Baulkaran, 2019). We follow the latter perspective and hypothesize:

H2: *Firms that issue green bonds with lower coupons experience more positive CARs.*

Maturity: We further investigate the influence of term to maturity, i.e., the difference in years between issuance date and maturity date on CARs, as market reactions to long-term issued green bonds might differ from short-term bonds (see Baulkaran, 2019; Wang et al., 2019; 2020). Even though green bonds with a higher term to maturity might be more susceptible to interest rate changes (see Wang et al., 2019), Hachenberg and Schiereck (2018) as well as Zerbib (2019) show that term to maturity has no significant impact on the green bond premium. We expect that green bonds with a longer term to maturity might experience more positive market reactions, since long-term green bonds might signal higher bond quality (see Wang et al., 2019) and long-term commitment to environmental sustainability, which leads to the following assumption:

H3: *Firms that issue green bonds with a longer term to maturity experience more positive CARs.*

Analogously to the previously introduced hypotheses, we anticipate that the first-time disclosure of green bond frameworks contains price-sensitive information, which has the potential to induce market reactions. For the hypotheses on the disclosure of green bond frameworks, we focus on the following three textual and qualitative characteristics:

Length: We investigate the impact of text length on market reactions to the disclosure of a green bond framework as measured by the natural logarithm of the total number of words per framework (see Gatzert and Heidinger, 2020).

[7] Note that in the case of floating coupons, the rate on the date of issuance is used as a proxy for fixed coupon rates.

Consistent with the observations of Loughran and McDonald (2014), who find that firms that disclose larger 10-K reports show more extreme stock return volatilities, we assume that larger green bond frameworks contain more information and might thus lead to more positive market reactions. Consequently, the fourth hypothesis is formulated as follows:

H4: *Firms that disclose green bond frameworks with a higher total number of words experience more positive CARs.*

Green projects: Since green bonds are specifically intended to fund projects with a positive environmental contribution, we investigate how reporting on eligible green asset categories regarding a fund's usage[8] influences market reactions. Even though addressing different eligible green assets for the use of proceeds might convey a stronger commitment to environmentally friendly initiatives in line with the signaling theory (see Flammer, 2021; Wang et al., 2020), a higher number of eligible green assets at the same time might evoke skepticism about the credibility regarding the use of proceeds for the funded projects. Accordingly, Deschryver and de Mariz (2020) address greenwashing concerns in the context of green bonds. Thus, focusing on fewer eligible green projects, but emphasizing them in more detail, might enhance credibility and comprehensibility regarding which projects are actually financed with the proceeds from a green bond. Therefore, we anticipate more positive market reactions for green bond frameworks that focus on fewer eligible green projects and hypothesize:

H5: *Firms that disclose green bond frameworks with a lower number of eligible green projects experience more positive CARs.*

Tone: Empirical research further shows that the sentiment of corporate disclosures can have a significant impact on market reactions (see, e.g., Loughran and McDonald, 2011; Yekini et al., 2016). Therefore, we examine the effect of *Tone* and apply an updated version of Loughran's and McDonald's (2011) word list, as similarly done by Gatzert and Heidinger (2020).[9] Accordingly, *Tone* is measured as the number of relative word hits regarding negative words[10] from the applied word list (with the total number of analyzed tokens as denominator). In line

[8] Eligible green asset categories for the use of proceeds of green bonds typically include projects that contribute to environmental sustainability, e.g., renewable energy, energy efficiency, green buildings, sustainable transport, pollution prevention and control, or wastewater management.

[9] Even though there exist more recent word lists that contain a higher number of negative words, such as published by Harvard University (https://cran.r-project.org/web/packages/SentimentAnalysis/SentimentAnalysis.pdf), we refer to the list of Loughran and McDonald (2011), who find that almost 75% of the words in the Harvard IV psychosocial dictionary are misclassified in a business context.

[10] The focus lies exclusively on negative words as positive words are often negated in a business context and might thus lead to biased positive results (see Gatzert and Heidinger, 2020).

with Loughran and McDonald (2011), who find that negative words are associated with a higher level of penetration, we state:

H6: *Firms that disclose green bond frameworks with a higher number of negative words experience more positive CARs.*

3.2 Data Sample

Regarding the underlying data sample, we retrieve all listed European banks and insurance companies (The Refinitiv Business Classification (TRBC) = "banks" and "insurance")[11] from LSEG Workspace database (including UK and Switzerland due to their meaningful insurance markets and strong business relations with Europe). We focus on publicly traded companies with a market capitalization of at least 1 billion EUR, as large banks and insurers are more likely to issue green bonds and might have a more significant impact on market reactions. After having retrieved eligible firms, we checked which of them issued a green bond by reverting to LSEG Workspace Green Bond Guide, which provides information on the date of issuance, issued amount, coupon, maturity, and bond type. Subsequently, we examined which of these issuing firms disclosed a green bond framework (and a corresponding SPO) on their corporate websites. Since all firms in the sample that issued a green bond simultaneously disclosed a green bond framework, no additional exclusions had to be made regarding the selection criteria (except for one firm with a disclosed framework that was only available in German, as stated in Table 2). Thus, we investigate two separate events (first-time announcement to issue a green bond and first-time disclosure of a green bond framework) per firm with different event dates[12] and the same underlying sample per event. This allows for a more meaningful comparison of market reactions to both events rather than using different sample sizes with distinct firm characteristics. To mitigate potential interaction effects between the two examined events, we presume a minimum time span of at least five days before or after the respective event date.[13] We thereby exclusively consider first-time green bond issuances and first-time disclosures of green bond frameworks,

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[11] We use the term "banks" for all firms included in the TRBC sector banks, consumer lending, corporate banks, and retail & mortgage banks, and the term "insurer" refers to all firms included in the TRBC sector life & health insurance, life insurance, multiline insurance & brokers, and property & casualty reinsurance.

[12] Note that two firms have subsequently been excluded because they issued a green bond closely after the disclosure of their green bond framework, which led to partially overlapping event windows.

[13] Despite adhering to a minimum time difference between event days, the possibility of interaction effects cannot be entirely ruled out. However, the mean absolute time difference between the two events amounts to 133 days (see Section 4.1). Therefore, we do not expect potential interaction effects to exert a major influence on the results.

as stronger market reactions have been observed for first-time than for repeated issuances in previous studies (see Flammer, 2021; Lebelle et al., 2020; Tang and Zhang, 2020). In addition, firms with confounding events (i.e., mergers and acquisitions, stock repurchases, earnings announcements or changes in credit ratings) during the respective event windows have been removed by considering press releases and announcements of regulatory changes (see, e.g., Wang et al., 2020). The final sample comprises 34 banks and 11 insurers (see Table A.2 in the Appendix for the investigated firms), representing a market share of 39.97 % relative to the total market capitalization at the end of 2022. Table 2 summarizes the sample selection process.

Table 2

Sample selection process

Screening criteria	**% of total market capitalization**	**Total firms**	**Number of banks**	**Number of insurers**
Initial data sample (European firms with TRBC = "Insurance", "Banking & Investment Services", status = listed)	100 % (EUR 2,599,223,323,954)	957	875	82
After exclusion of small-cap firms (available market capitalization >1 billion EUR)	96.84 % (EUR 2,517,212,655,049)	205	165	40
After exclusion of TRBC subsectors "Financial & Commodity Market Operators", "Insurance Brokers" and firms with other business models[14]	86.49 % (EUR 2,248,093,463,514)	83	145	38
Firms that issued a green bond and disclosed a green bond framework for the first time between 2015 and 2022	42.72 % (EUR 1,110,332,250,400)	52	41	11
After exclusion of firms without available green bond framework in English	42.66 % (EUR 1,108,928,915,000)	51	40	11
After exclusion of firms without available accounting or return data	**39.97 % (EUR 1,038,822,303,578)**	**45**	**34**	**11**

Note: The data has been retrieved from LSEG Workspace in September 2023.

[14] Insurers and banks that have been excluded due to their business model are, e.g., brokerage firms or firms that deal with commercial leasing, stock exchanges, diversified

3.3 Event Study Approach

The following event study approach allows us to investigate variations in stock returns of listed European banks and insurers, which in our study relate to two separate events: the first-time announcement of a green bond issuance as well as the first-time disclosure of a green bond framework.[15] For the calculation of CARs, we revert to continuously compounded (log) returns (see Strong, 1992).[16] Since benefits from employing multi-factor models might be limited (see MacKinlay, 1997), we use a one-factor market model and employ FTSE Eurotop 100[17] as a benchmark index for the considered market returns (see, e. g., Gatzert and Heidinger, 2020). We estimate the normal (expected) stock rate return r_t^i of firm *i* at day *t* by applying the following one-factor model in line with previous literature on event studies (see, e. g., Gatzert and Heidinger, 2020; MacKinlay, 1997), which is defined as

$$r_t^i = \alpha^i + \beta^i \cdot r_t^m + \varepsilon_t^i \tag{1}$$

and accounts for the rate of return of the selected benchmark r_t^m, the intercept α^i, the systemic risk coefficient β^i as well as the error term ε_t^i. For each firm *i*, OLS regressions are applied to estimate the α^i and β^i coefficients in Equation (1). We use the standard estimation window of 250 trading days (see, e. g., Lebelle et al., 2020; Tang and Zhang, 2020), ending the day before the event window to avoid overlapping the estimation and event windows (see MacKinlay, 1997). Accordingly, for the event window (0; 5), the corresponding estimation window ranges from trading day –250 to –1. To avoid biased parameter estimates, we remove nontrading days (see Mukhtarov et al., 2022) and we control for thin trading (see Strong, 1992) by applying volume filters to exclude days with low trading volumes, i. e., less than 10,000 trades. This led to marginal adjustments regarding the covered sample period of 250 trading days. In line with MacKinlay (1997), abnormal returns are subsequently calculated by subtracting the estimated expected returns from the observed returns, i. e.,

$$AR_t^i = r_t^i - \left(\hat{\alpha}^i + \hat{\beta}^i \cdot r_t^m\right). \tag{2}$$

investment services, factoring, private equity, and venture capital as provided by the company descriptions in LSEG Workspace.

[15] As no specific announcement date is available for green bond frameworks, the event date (t = 0) refers to the official publication date.

[16] The observed returns are calculated as the closing price of stock *i* at day *t* divided by the closing price of stock *i* at day *t-1*, i. e., $r_t^i = \ln\left(p_t^i / p_{t-1}^i\right)$.

[17] FTSE Eurofirst 100 and FTSE Eurotop 100 are highly correlated (Pearson's correlation coefficient of 0.9896 for monthly log-returns from November 2015 to December 2022), indicating that comparable leading European stock market indices would yield similar results.

Accordingly, CARs for event windows (T1; T2) with different lengths $T = T2 - T1$ are computed by summing up the individual abnormal returns:

$$CAR^{i}\left(T1;T2\right) = \sum\nolimits_{t=T1}^{T2} AR_{t}^{i}. \tag{3}$$

Finally, mean CARs are calculated as follows (see, e.g., Kordsachia et al., 2023):

$$\overline{CAR}_{n}\left(T1;T2\right) = \frac{1}{n} \cdot \sum\nolimits_{i=1}^{n} CAR^{i}\left(T1;T2\right). \tag{4}$$

For the investigation of extreme market reactions (see Section 4), mean absolute CARs irrespective of their specific positive or negative direction are computed analogously to Flannery et al. (2017)[18]:

$$\left|\overline{CAR}\right|\left(T1;T2\right) = \frac{1}{n} \cdot \sum\nolimits_{i=1}^{n} \left|CAR^{i}\left(T1;T2\right)\right|. \tag{5}$$

We define the standard event window of (0;5) to avoid market reactions to possible confounding events but at the same time allow for sufficient reaction time. Moreover, the event window (0;5) exhibits the highest (second highest) mean CARs for green bond issuances (disclosures of green bond frameworks) (see Section 4.1). For comparison purposes, the event windows (0;3), (0;4), (–3;3), (–4;4), and (–5;5) are additionally investigated. In the subsequent regression analyses, CARs (0;5) serve as the dependent variable to test our hypotheses, which are regressed over seven potential influencing factors, comprising three variables exclusively related to green bond issuances as well as three variables that only relate to the disclosure of green bond frameworks (see Section 3.1). Furthermore, we include three commonly used firm-specific control variables *Size*, *Leverage*, and *market-to-book (MB) ratio* (see Section 4 for the concrete measurement) as well as year-fixed effects to account for the respective year of issuance or disclosure. With this, we aim to analyze which distinct features related to green bond issuances and disclosures of green bond frameworks give rise to CARs. Therefore, the following two regression equations are applied:

$$\begin{aligned} CAR\left(0;5\right)_{GB\ Issuance} = {} & \alpha + \beta_{1} Size + \beta_{2} Leverage + \beta_{3} MB + \beta_{4} Volume \\ & + \beta_{5} Coupon + \beta_{6} Maturity + \beta_{7-14} Year + \varepsilon \end{aligned} \tag{6}$$

[18] Next to Flannery et al. (2017), non-directional measures of market reactions have been applied by Loughran and McDonald (2014) in the context of announcement effects of 10-K reports as well as Gatzert and Heidinger (2020) to measure extreme market reactions to the publication of Solvency and Financial Condition Reports.

$$CAR(0;5)_{GB\ Framework} = \alpha + \beta_1 Size + \beta_2 Leverage + \beta_3 MB + \beta_4 Length + \beta_5 GreenProjects + \beta_6 Tone + \beta_{7-14} Year + \varepsilon \tag{7}$$

4. Empirical Results

For the evaluation of the results, first the descriptive statistics are displayed, and then the results of the regression analyses are presented.

4.1 Descriptive Statistics

The summary statistics for event and firm characteristics regarding the first-time issuance of green bonds (Panel A) and the first-time disclosure of green bond frameworks (Panel B) are provided in Table 3. The first green bond (green bond framework) in the sample was issued (disclosed) on 18 November 2015 (5 November 2015), continuing until the most recent issuance (disclosure) on 15 November 2022 (29 July 2022).[19] Differences between financial key figures of Panel A (green bond issuance) and Panel B (disclosure of green bond framework) result to be rather small. This can be explained by the fact that accounting data is based on annual values, so that if both event types occur in the same year (which is the case for 34 firms), the summary statistics regarding *Size, Leverage*, and *MB* differ only marginally. However, despite similarities in accounting-based measures, the two separate events of issuing a green bond and disclosing a green bond framework for the first time do not lead to overlapping event windows. The time difference between both event dates thereby ranges from a minimum of five days (based on the largest investigated event window) up to a maximum of two years[20], leading to a mean (median) absolute difference of 133 (43) days.

Regarding green bond characteristics, sample firms issued a mean amount of about 600 million EUR, which represents approximately 0.1 % relative to the globally issued corporate green bond volume of 481 billion EUR in 2022 (see CBI, 2023). This translates into a mean value of 6.28 in terms of the natural logarithm, as shown in Table 3. The average time span from the date of issuance to the date of maturity amounts to 8.25 years. The investigated green bond frame-

[19] If no specific disclosure date is available for the publication of a green bond framework, we take the date of the disclosed corresponding SPO, since SPOs are usually either published at the same day as the green bond framework or closely before its publication date (which in turn represents the first time the information is provided to the market).

[20] The maximum time difference of two years between first-time issuance of a green bond and first-time disclosure of a green bond framework stems from HSBC Holdings PLC. The first green bond framework was published in October 2016 and the first green bond issuance took place in November 2018.

works comprise a mean number of 4,234 words (resulting in a mean of 8.19 words in terms of the natural logarithm) and mention on average 3.96 eligible *GreenProjects* for the use of proceeds. Considering *Tone*, an average proportion of 1.91 % of negative words can be observed, so that most words contained in the investigated frameworks are rather neutral or positive.

Table 3

Summary statistics of independent regression variables regarding first-time green bond issuances and first-time disclosures of green bond frameworks

	Mean	**Median**	**Std.**	**Min.**	**Max.**
Panel A: Green bond issuances of banks and insurers (n = 45)					
Size	12.59	12.37	1.54	9.62	17.31
Leverage	0.93	0.93	0.03	0.88	1.04
MB	0.77	0.63	0.40	0.16	1.97
Volume	6.28	6.21	0.51	5.06	7.13
Coupon	1.67	1.13	1.67	0.10	7.00
Maturity	8.25	6.00	5.80	3.00	30.00[21]
Year	4.56	5.00	1.89	0.00	7.00
Panel B: Green bond framework disclosures of banks and insurers (n = 45)					
Size	12.59	12.44	1.53	9.62	17.31
Leverage	0.93	0.93	0.03	0.86	1.04
MB	0.74	0.64	0.39	0.16	1.97
Length	8.19	8.17	0.48	7.09	9.02
GreenProjects	3.96	4.00	2.00	1.00	7.00
Tone	1.91	1.84	0.62	0.82	4.07
Year	4.14	5.00	2.03	0.00	7.00

Note: Size equals the natural logarithm of the book value of total assets (in Mio. EUR). *Leverage* is calculated as the book value of total liabilities divided by the book value of total assets. *MB* is the market value of the ordinary (common) equity divided by the book value of the ordinary (common) equity. *Year* comprises dummy variables from 0 to 7 representing the years 2015 to 2022. *Volume* is measured as the natural logarithm of the total issued green bond amount (in Mio. EUR). *Coupon* represents the percentage annual coupon paid by the issuer relative to the green bond's face value. *Maturity* is the difference in years between issuance date and maturity date. *Length* is measured as natural logarithm of the total number of words in a green bond framework. *GreenProjects* is the number of mentioned eligible green projects to which the use of proceeds from a green bond is allocated. *Tone* indicates the relative number of negative word hits derived from Loughran's and McDonald's (2011) word list.

[21] Note that one green bond in the sample contains a perpetual term to maturity. In this case, the term to maturity was set to 30 years.

Table 4 provides an overview of resulting mean and median CARs for both event studies. The standard event window (0; 5) shows mean CARs of 1.27 % for green bond issuances and 0.18 % for the disclosure green bond frameworks. Thus, mean CARs result to be more positive for the first-time issuance of green bonds than for the first-time disclosure of green bond frameworks. In Panel A, positive mean but negative median CARs can be observed for all considered event windows, so that a small number of extreme positive market reactions might have a large influence on the overall results. In Panel B, investors seem to react mainly positive to the disclosure of green bond frameworks (expect for negative mean CARs within the event windows (0; 3) and (−3; 3) as well as negative median CARs within the standard event window (0; 5)). However, mean and median (positive) CARs are not significantly different from zero.

Table 4

Market reactions (mean and median CARs) to first-time green bond issuances and first-time disclosures of green bond frameworks for different event windows

Panel A: Market reactions to banks' and insurers' green bond issuances (n = 45)				
	Mean ($\overline{CAR}$)	p-value	Median CAR	p-value
CAR (0; 3)	0.3598 %	0.6637	−0.6464 %	0.3407
CAR (0; 4)	0.7521 %	0.3960	−0.7439 %	0.8757
CAR (0; 5)	1.2706 %	0.2065	−0.8355 %	0.7713
CAR (−3; 3)	0.3600 %	0.7293	−1.0676 %	0.3350
CAR (−4; 4)	0.5857 %	0.6094	−0.8708 %	0.6306
CAR (−5; 5)	0.5749 %	0.6609	−1.7579 %	0.2252
Panel B: Market reactions to banks' and insurers' disclosures of green bond frameworks (n = 45)				
	Mean ($\overline{CAR}$)	p-value	Median CAR	p-value
CAR (0; 3)	−0.1160 %	0.8283	0.2179 %	0.9110
CAR (0; 4)	0.1415 %	0.8219	0.6662 %	0.2917
CAR (0; 5)	0.1830 %	0.7613	−0.0404 %	0.7713
CAR (−3; 3)	−0.4338 %	0.5689	0.0944 %	0.9495
CAR (−4; 4)	0.1147 %	0.8765	0.6230 %	0.5019
CAR (−5; 5)	0.3865 %	0.6026	0.0475 %	0.6628

Note: This table shows market model mean and median CARs for green bond issuances and disclosures of banks and insurers using an estimation window of 250 trading days, ending the day before the event window (see Section 3.3). Two-sided t-tests are used to evaluate the statistical significance of mean CARs to be different from zero, and Wilcoxon rank-sum tests (non-parametric tests) are applied to assess the statistical significance of median CARs to be different from zero.

Table 5

Market reactions (absolute mean and median CARs) to first-time green bond issuances and first-time disclosures of green bond frameworks for different event windows

Panel A: Market reactions to banks' and insurers' green bond issuances (n = 45)				
	Mean ($\lvert\overline{CAR}\rvert$)	p-value	Median $\lvert CAR\rvert$	p-value
$\lvert CAR\ (0;3)\rvert$	3.3716 %***	0.0006	2.7758 %***	< 0.0001
$\lvert CAR\ (0;4)\rvert$	4.0199 %***	0.0003	2.5866 %***	< 0.0001
$\lvert CAR\ (0;5)\rvert$	4.2500 %***	0.0007	2.7571 %***	< 0.0001
$\lvert CAR\ (-3;3)\rvert$	4.7227 %***	<0.0001	3.1357 %***	< 0.0001
$\lvert CAR\ (-4;4)\rvert$	5.1350 %***	<0.0001	3.4032 %***	< 0.0001
$\lvert CAR\ (-5;5)\rvert$	5.4488 %***	0.0002	2.9753 %***	< 0.0001
Panel B: Market reactions to banks' and insurers' disclosures of green bond frameworks (n = 45)				
	Mean ($\lvert\overline{CAR}\rvert$)	p-value	Median $\lvert CAR\rvert$	p-value
$\lvert CAR\ (0;3)\rvert$	2.7934 %***	0.0002	2.1504 %***	< 0.0001
$\lvert CAR\ (0;4)\rvert$	3.1160 %***	0.0003	2.4514 %***	< 0.0001
$\lvert CAR\ (0;5)\rvert$	3.0765 %***	0.0001	2.7015 %***	< 0.0001
$\lvert CAR\ (-3;3)\rvert$	3.6951 %***	<0.0001	2.5185 %***	< 0.0001
$\lvert CAR\ (-4;4)\rvert$	3.8342 %***	<0.0001	3.3458 %***	< 0.0001
$\lvert CAR\ (-5;5)\rvert$	3.7862 %***	<0.0001	3.1448 %***	< 0.0001

Note: This table shows absolute values of market model mean and median CARs for green bond issuances and disclosures of banks and insurers using an estimation window of 250 trading days, ending the day before the event window (see Section 3.3). One-sided t-tests are used to evaluate the statistical significance of absolute mean CARs to be greater than the mean absolute abnormal returns during the estimation window, and Wilcoxon rank-sum tests (non-parametric tests) are applied to assess the statistical significance of absolute median CARs to be greater than the absolute median abnormal returns during the estimation window. *** denotes statistical significance at the 1 % level.

A possible reason for the non-significance of the observed CARs in Table 4 might be that traditional and green investors trade in opposite directions because of preference heterogeneity (see Goldstein et al., 2022). This divergence can lead to insignificant results due to offsetting positive and negative reactions. When calculating absolute values of mean and median CARs, statistically significant CARs at the 1 % level can be observed for all considered event windows, as shown in Table 5. Analogously to Flannery et al. (2017), we assess the statistical significance of mean and median absolute CARs for each event window by comparing them to its mean and median absolute abnormal returns during the estimation window. Table 5 further shows that market reactions over all analyzed event windows are less extreme in Panel B (disclosure of green bond frameworks) as compared to Panel A (issuance of green bonds). A possible explanation for this might result from high information and search costs leading to lower (absolute) CARs (see Gatzert and Heidinger, 2020), which particularly holds for the disclosure of green bond frameworks, since these frameworks are exclusively disclosed on corporate websites and thus more difficult to access. In contrast, data on green bond issuances is disclosed transparently on financial analysis platforms and therefore easier to obtain.

4.2 Regression Results

In what follows, we apply two separate regression analyses to investigate the influence of firm-and green bond-related characteristics as well as textual elements on the direction and magnitude of CARs within the standard event window (0;5) (see Equation (6) and Equation (7)). Even though CARs are not significantly different from zero (see Table 4), identifying potential determinants can nevertheless provide valuable insights regarding influencing factors of market reactions.

Concerning regression characteristics, we do not simulate the effect of event-date clustering since only two issuances of different firms have taken place on the same date.[22] Moreover, intragroup correlations are not expected and thus robust standard errors at the firm level are not applied, as only one observation per firm is considered for each of the two events. We further introduce dummy variables to account for the impact of year-fixed effects. Additionally, Pearson's and Spearman's correlation coefficients between the remaining independent regression variables result in rather low values for both event studies, so that multicollinearity should not pose a problem (see Tables A.3 and A.4 in the Appendix, where the highest correlation of –0.478 can be observed between *Leverage* and *Maturity* in Table A.3). Furthermore, we control for endogeneity as companies with confounding events during the event window are excluded (see Section 3.2) and statistical tests are conducted regarding the correlation between independent regression variables and residuals, which result in considerable small correlation coefficients. In addition, Newey-West robust standard errors are applied to account for heteroscedasticity. Resulting Durbin-Watson tests do not indicate autocorrelation for both regression models. In total, we find no indications of violated regression assumptions (i. e., linearity, normality, homoscedasticity, no multicollinearity, and no autocorrelation).

[22] ING Groep NV and Societe Generale SA both issued their first green bond on 18 November 2015. Their green bond frameworks were disclosed on 6 November 2015 (ING Groep NV) and 5 November 2015 (Societe Generale SA).

Table 6

Results of the OLS regressions on CARs (0; 5)

Panel A: Green bond issuance			**Panel B: Green bond framework**		
	Regression coefficient (CAR)	p-value		Regression coefficient (CAR)	p-value
Size	1.8819**	0.0102	Size	–0.5423	0.2354
Leverage	117.5103***	0.0081	Leverage	43.7577	0.1005
MB	–2.1241	0.4110	MB	2.3757	0.1738
Volume	–2.4532	0.2070	Length	4.2498**	0.0134
Coupon	–1.5723**	0.0183	GreenProjects	–0.7711**	0.0261
Maturity	0.0461	0.7934	Tone	0.8545	0.4458
Year	FE		Year	FE	
Intercept	–127.9435***	0.0061	Intercept	–70.6176**	0.0467
R^2	0.5449		R^2	0.4236	
Adjusted R^2	0.3540		Adjusted R^2	0.1819	
p-value	0.0082		p-value	0.0985	

Note: Size equals the natural logarithm of the book value of total assets. *Leverage* is calculated as the book value of total liabilities divided by the book value of total assets. *MB* is the market value of ordinary (common) equity divided by the book value of ordinary (common) equity. *Volume* is measured as the natural logarithm of the total issued green bond amount (in Mio. EUR). *Coupon* represents the percentage annual coupon paid by the issuer relative to the green bond's face value. *Maturity* is the difference in years between issuance date and maturity date. *Length* is measured as natural logarithm of the total number of words in a green bond framework. *GreenProjects* is the number of mentioned eligible green projects to which the use of proceeds from a green bond is allocated. *Tone* indicates the relative number of negative word hits of Loughran's and McDonald's (2011) word list. Factor variables for Year fixed effects are not reported. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % level, respectively.

Table 6 depicts the results of the applied regressions. In Panel A, the variables *Size* and *Leverage* show a significantly positive coefficient, suggesting that larger firms as well as firms with a higher leverage experience significantly more positive market reactions to the issuance of a green bond. Thus, the extent to which issuing firms can make a positive contribution to the environment appears to be more significant for larger companies, resulting in more positive CARs. With respect to the significant and positive effect of *Leverage*, the issuance of green bonds might be perceived as a strategy to diversify funding sources and mitigate financial risk, which could serve as an explanation for why market reactions are more positive for highly leveraged firms, even though such firms are generally considered as riskier (see, e. g., Bhagat et al. (2015) for the relationship between risk-taking and leverage). Regarding the underlying hypotheses on green bond issuances (see Section 3.1), results reveal a negative relationship between *Vol-*

ume and CARs, which contrasts our expectations in H1, but we find no statistical support. In this regard, larger issuing amounts could evoke investor concern about the issuer's financial stability, especially if funds are used for projects that do not generate positive financial returns in the long term. However, H2 can be confirmed, since we find a significantly negative relationship between CARs and *Coupon*, so that lower coupons might indicate lower probabilities of financial distress and might thus lead to more positive CARs, as outlined in Section 3.1. These findings are consistent with Baulkaran (2019), who observes negative market reactions for green bond issuances with higher coupon rates. Considering H3, the variable *Maturity* shows a positive coefficient in line with our assumption, but there is no statistical evidence.

With respect to hypotheses on the disclosure of green bond frameworks, we find statistical support for H4 and H5, since the regression results display a significantly positive relationship between *Length* and CARs as well as a significantly negative relationship between *GreenProjects* and CARs. Fatica et al. (2021) additionally support the notion that more eligible green projects might lead to confusion by stating that identifying a clear link between green bonds and corresponding green projects is challenging for investors. Consequently, textual features have a significant influence on market reactions in the present setting, which is in line with Yekini et al. (2016) but contrasts Li (2010), who refers to misunderstandings and higher processing costs of corporate disclosures in the context of market efficiency. However, for H6, we find no statistical support. A possible explanation for why the tone of green bond disclosures plays a minor role could be the lower proportion of negative words as compared to annual reports (see Gatzert and Heidinger, 2020).

Using a shorter event window for CARs as the dependent variable, i. e., (0; 3) the statistically significant effects of *Size*, *Leverage*, and *Coupon* remain unchanged in Panel A. For Panel B, the significant effect of *Length* can no longer be confirmed for the event window (0;3), but the coefficient for *GreenProjects* remains significant, indicating that market participants need some time to react to textual information.

We additionally conducted the regressions with absolute CARs (0;5) as the dependent variable to explore factors influencing the statistically significant "extreme" market reactions, irrespective of their specific positive or negative direction (see Table 5). The results are provided in Table A.5 in the Appendix.[23] In Panel A, our observations remain unchanged as compared to Table 6, except for

[23] Note that we adjust the financial regression coefficients in Equation (7) to resemble extreme values and to ensure linearities in the data (see Gatzert and Heidinger, 2020; Powell, 1984), whereby the subscript *Dev* refers to the absolute deviation from the median for each observation.

MB resulting in a significantly negative coefficient. This indicates that investors might be more surprised about firms with a lower MB ratio to issue a green bond, consequently resulting in more extreme (positive or negative) market reactions (see, e. g., Harris and Marston (1994) for the relationship between growth prospects and MB values). Moreover, the coefficient *Maturity* turns negative, but again, we find no statistical support. Major differences between Table 6 and Table A.5 in Panel B can be observed for the variables *GreenProjects* and *Length*, which are no longer significant. Instead, a significantly negative relationship emerges between *Dev_Leverage* and absolute CARs in Panel B: On the one hand, firms with below-median leverage (i. e., large negative deviations) could experience less extreme market reactions since investors might expect firms with a lower leverage to have stronger financial positions. Accordingly, these firms might have established more transparent sustainability reporting practices, which can in turn lead to reduced information asymmetries and thus lower absolute CARs as investors might anticipate transparent disclosures of green bond frameworks (see Ahmad et al., 2023). On the other hand, despite having a higher leverage (i. e., large positive deviations), green bond frameworks might convey increased commitment to sustainability following the signaling theory (see Flammer, 2021; Wang et al., 2020). This could outweigh financial concerns and thus offset possible negative market reactions associated with highly leveraged firms, resulting in less extreme reactions. Furthermore, *Dev_MB* emerges as another significant and positive coefficient in Panel B, implying that firms with a higher absolute deviation from the median MB ratio experience more extreme market reactions to the disclosure of green bond frameworks. In this regard, large positive (negative) deviations could be attributed to heightened (diminished) investors' perception about future growth potentials (see, e. g., Harris and Marston, 1994), consequently evoking more extreme CARs.

5. Further Analyses

In further analyses, differences between banks and insurers are investigated, followed by robustness checks on observed market reactions and regression results.

5.1 Differences between Banks and Insurers

Table 7 provides an overview of univariate differences between banks and insurers regarding the applied regression coefficients and (absolute) CARs. One can derive that sample banks are significantly larger than insurers and exhibit a higher leverage, whereby banks at the same time issue larger green bond volumes than insurers. However, insurers in the sample offer significantly higher

Table 7

Univariate differences between banks and insurers

	Banks (n = 34)		**Insurers (n = 11)**		**Differences**	
	Mean	Median	Mean	Median	In Means	In Medians
Panel A: Green bond issuance						
|*CAR* (0; 5)|	4.81	2.83	2.52	1.64	2.29*	1.19
CAR (0; 5)	2.06	–0.49	–1.17	–1.55	3.23*	1.06
Size	12.83	12.79	11.87	12.19	0.96**	0.60*
Leverage	0.94	0.94	0.91	0.91	0.03***	0.03***
MB	0.76	0.62	0.77	0.87	–0.01	–0.25
Volume	6.35	6.21	6.06	6.21	0.29	0.00
Coupon	1.39	0.84	2.50	1.75	–1.11	–0.91**
Maturity	5.71	5.76	16.13	15.29	–10.42***	–9.53***
Year	4.32	5.00	5.27	5.00	–0.95**	0.00
Panel B: Green bond framework						
|*CAR* (0; 5)|	3.26	2.74	2.51	2.22	0.75	0.52
CAR (0; 5)	0.22	–0.04	0.05	1.36	0.17	–1.40
Size	12.82	12.72	11.88	12.19	0.94**	0.53*
Leverage	0.94	0.94	0.91	0.90	0.03***	0.04***
MB	0.74	0.62	0.76	0.87	–0.02	–0.25
Length	8.23	8.23	8.36	8.44	–0.13	–0.21
GreenProjects	4.12	5.00	3.45	3.00	0.67	2.00
Tone	1.80	1.73	1.81	1.94	–0.01	–0.21
Year	4.15	5.00	5.27	5.00	–1.12**	0.00

Note: Size equals the natural logarithm of the book value of total assets (in Mio. EUR). *Leverage* is calculated as the book value of total liabilities divided by the book value of total assets. *MB* is the market value of the ordinary (common) equity divided by the book value of the ordinary (common) equity. *Volume* is measured as the natural logarithm of the total issued green bond amount (in Mio. EUR). *Coupon* represents the percentage annual coupon paid by the issuer relative to the green bond's face value. *Maturity* is the difference in years between issuance date and maturity date. *Length* is measured as natural logarithm of the total number of words in a green bond framework. *GreenProjects* is the number of mentioned eligible green projects to which the use of proceeds from a green bond is allocated. *Tone* indicates the relative number of negative word hits of Loughran's and McDonald's (2011) word list. *Year* comprises dummy variables from 0 to 7 representing the years 2015 to 2022. As the subsample only comprises eleven insurers, Shapiro-Wilk tests have been applied to ensure normality. Differences in means are based on t-tests and differences in medians are based on non-parametric Wilcoxon rank sum tests.[24] ***, **, and * denote statistical significance at the 1 %, 5 % or 10 % level, respectively.

[24] Note that non-parametric tests have been applied to test differences in means for *Length* and *Year* in Panel B, as Shapiro-Wilk test did not confirm normally distributed data for the subsample of eleven insurers.

median coupons and issue green bonds with a significantly longer term to maturity than banks. With respect to Panel B, banks disclose shorter green bond frameworks but address a higher number of eligible green projects. In addition, banks contain fewer negative words in their green bond frameworks than insurers without statistically significant differences in means and medians. Finally, the variable *Year* depicts significantly lower mean values for banks in both panels, which can be attributed to the fact that two banks in the sample announced to issue their first green bond and disclosed their first green bond framework already in 2015, whereas for the insurance industry, the first green bond issuance and disclosure of a green bond framework has taken place in 2019. In summary, banks and insurers significantly differ in terms of financial, time-, and green bond-related characteristics, whereas framework-related aspects (*Length*, *GreenProjects*, and *Tone*) show no significant differences in means and medians.

To highlight differences between CARs of banks and insurers, Figure 1a and Figure 1b depict (absolute) market reactions to the issuance of green bonds and to the disclosure of green bond frameworks. Concerning differences in means and medians for CARs (0;5) without absolute values, it becomes evident that banks exhibit positive mean but weakly negative median CARs in Panel A (see (c) in Figure 1a). In contrast, insurers show both negative mean and median market reactions to the issuance of green bonds (see (d) in Figure 1a). In Panel B, banks again exhibit positive mean and weakly negative median CARs, whereas insurers' market reactions to the disclosure of green bond frameworks result to be positive in terms of both mean and median CARs. Consequently, despite the small subsample of eleven insurers, these firms considerably contribute to the overall negative median market reactions to green bond issuances displayed in Table 4. Regarding absolute values of CARs, stronger mean and median absolute market reactions can be observed for banks than for insurers in both panels. In summary, differences in mean (absolute) CARs between banks and insurers are significant for Panel A, but not for Panel B (see Table 7).

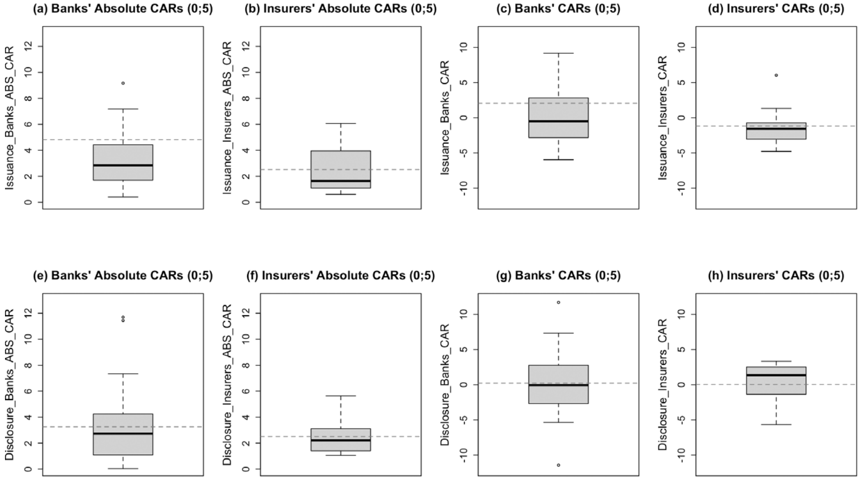

Fig. 1: (Absolute) market reactions to banks' and insurers' first-time issuance of green bonds and first-time disclosure of green bond frameworks

Note: The red dashed line displays mean (absolute) values, and the bold black line depicts median (absolute) CARs.

5.2 Robustness Checks

To review the robustness of the observed market reactions to green bond issuances, we compare CARs of first-time with subsequent issuances.[25] Therefore, we identify 35 companies from the initial sample that issued another green bond on a separate date from their initial issuance. We estimate CARs within the standard event window (0; 5) for these companies and limit the robustness check to one subsequent issuance per firm analogously to the initial event study. As a result, mean CARs in the absence of absolute values are lower for subsequent issuances (mean of –0.67 %). One-sided t-tests and Wilcoxon rank sum tests on differences in means and medians again show no statistical support for CARs to be significantly different from zero. When controlling for absolute CARs, mean and median absolute market reactions (3.21 % and 1.86 %) again exhibit lower values as compared to first-time issuances. These results are consistent with the findings of Flammer (2021), Lebelle et al. (2020) as well as Tang and Zhang (2020), who state that first-time announcements generate higher in-

[25] Since many firms in the sample issued multiple green bonds per year but disclosed only one green bond framework, we restrict the robustness check exclusively to green bond issuances.

vestor attention. Fatica et al. (2021) additionally confirm that green bond yields are lower in the case of repeated issuances.

Another robustness check has been applied by calculating standardized abnormal returns[26] and CARs, since empirical research suggests that statistical tests are more powerful with standardization (see Boehmer et al., 1991; Brown and Warner, 1985). Resulting CARs for the considered event windows are displayed in Table A.6 and Table A.7 (in absolute terms) in the Appendix. In comparison to Table 5, absolute CARs are lower with standardization. When testing the regression with standardized CARs (0;5), results remain robust but yield lower explanatory power in Panel A. In Panel B, regression results show a marginally higher R^2 and a lower p-value.

Regarding robustness checks on Panel B, we further control for the *Readability* of a green bond framework as an additional determinant, which is measured as the average number of words per sentence (see Gatzert and Heidinger, 2020; Loughran and McDonald, 2014). We thereby anticipate more positive market reactions for green bond frameworks that are easier to read (i.e., with a lower average number of words per sentence), since enhanced readability is assumed to increase the clarity of information. However, we find a weak positive coefficient and no statistical support, whereby all other regression coefficients remain unchanged.

Finally, we extend both regressions by the impact of the Environmental (E) Pillar Score[27] retrieved from LSEG Workspace. With this, we aim to analyze whether market reactions are less positive for environmentally friendly firms, since these firms could be anticipated to issue green bonds or disclose green bond frameworks. As the coefficient for the applied E Score is negative but not significant in Panel B, investors might be more surprised about a firm's publication of a green bond framework in case of lower E scores, resulting in more positive CARs. However, in Panel A, the investigated E Score shows a non-significant but positive coefficient.

6. Summary and Implications

This study examines market reactions to first-time green bond issuances and first-time disclosures of green bond frameworks by focusing on European banks

[26] Standardized abnormal returns are calculated by *AR/σ*, where σ represents an estimate of the standard deviation of ARs based on the time series of returns over the estimation window (–250; –1).

[27] The E pillar score measures to what extent a firm integrates environmental criteria by considering its impact on natural systems, ecosystems as well as by evaluating how a company applies best practices to manage environmental risks (see LSEG, 2023).

and insurers. We contribute to existing empirical literature in analyzing both European banks' and insurers' first-time green bond issuances as well as first-time green bond disclosures, while including recent data from 2015 to 2022, where the green bond market has experienced considerable growth. Resulting CARs reveal that (purely positive or negative) market reactions to green bond issuances and disclosures of green bond frameworks are not significant. Nevertheless, we find significant absolute market reactions and thus extreme CARs for both events, so that investors react both positively and negatively, which can lead to offsetting effects. Regarding determinants of market reactions, a larger firm size, a higher leverage, and a lower offered coupon significantly influence positive CARs in the event of a green bond issuance. Accordingly, a higher number of words and a lower number of eligible green projects represent statistically significant drivers for positive market reactions to the disclosure of green bond frameworks. Finally, we observe that banks experience stronger CARs than insurers in both event studies.

One major limitation of this study results from the rather small sample size, given that this paper analyzes market reactions with a particular focus on listed European banks and insurers. Thus, it would be of interest to extend the analysis to a larger sample of financial services providers as well as to compare the results with issuing firms outside the EU. Another limitation arises from general biases in event studies and adverse selection problems when firms issue new securities, so that observed effects could deviate from actual effects (see, e.g., MacKinlay, 1997). However, since this study is the first that examines market reactions to the publication of green bond frameworks and that focuses on European banks and insurers, the following first insights are obtained: Our findings demonstrate that market reactions depend on different influencing factors and underpin which aspects of green bond issuances and disclosures of green bond frameworks significantly influence CARs. With this, we provide reference points for banks and insurers to pay particular attention to these factors.

As an outlook, the entry into force of the EU GBS might lead to an increase in standardization, quality of reporting, and reliability of reported information due to harmonized external verification requirements. In this context, labeling effects and differences in market reactions to EU Green Bond issuances and related reporting activities could be subject to future research. Finally, European banks' and insurers' issuance of green bonds and disclosure of green bond frameworks can help channel financial resources towards environmentally sustainable projects and are thus not to be neglected, even though market reactions are not purely positive.

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Appendix

Table A.1

Chronological development of the European Green Bond Standard

Date	Main developments	Source/Actor
8 March 2018	**Action plan: financing sustainable growth** with request for the Technical Expert Group (TEG) to prepare a report on the EU GBS	EC (2018)
6 March 2019	**Interim report** on EU GBS with invitation for feedback on preliminary recommendations until 7 April 2019	TEG (2019a)
18 June 2019	**Final report of TEG** on EU GBS	TEG (2019b)
9 March 2020	**Usability guide** (building on the recommendations of the June 2019 final report, with an updated proposal for a GBS)	TEG (2020)
6 April 2020 – 15 July 2020	**Public consultation** on the renewed sustainable finance strategy	EC (2020a)
12 June 2020 – 2 October 2020	**Targeted consultation** on the establishment of an EU GBS	EC (2020b)
6 July 2021	Presentation of a **legislative proposal** for a regulation establishing European Green Bonds	EC (2021)
13 April 2022	**Press release**: Council of the EU agrees its position on European Green bonds	European Council (2022)
28 February 2023	**Political agreement** reached on the EU GBS	European Council (2023b)
23 October 2023	**Adoption of regulation (entry into force** 20 days after publishment → application 12 months after entry into force)	European Council (2023a)

Table A.2

List of sample banks and insurers (insurers denoted in *italics*)

Name of bank/insurer	
Aareal Bank AG	*Just Group PLC*
Aib Group PLC	Kbc Groep NV
Assicurazioni Generali SpA	mBank SA
AXA SA	Mediobanca Banca di Credito Finanziario SpA
Baloise Holding AG	*Munich Re*
Banca Mediolanum SpA	Natwest Group PLC
Banca Popolare Di Sondrio SpA	*NN Group NV*
Banco Bilbao Vizcaya Argentaria SA	National Bank of Greece SA
Banco BPM SpA	Nordea Bank Abp
Banco de Sabadell SA	OTP Bank Nyrt
Banco Santander SA	Paragon Banking Group PLC
Bankinter SA	Raiffeisen Bank International AG
Barclays PLC	Skandinaviska Enskilda Banken AB
BNP Paribas SA	Societe Generale SA
Caixabank SA	Svenska Handelsbanken AB
Commerzbank AG	Swedbank AB
Credit Agricole SA	*Swiss Life Holding AG*
Credito Emiliano SpA	*Talanx AG*
Deutsche Bank AG	Unicaja Banco SA
Deutsche Pfandbriefbank AG	UniCredit SpA
Helvetia Holding AG	*Unipol Gruppo SpA*
HSBC Holdings PLC	*Uniqa Insurance Group AG*
ING Groep NV	

Table A.3

Pearson's and Spearman's correlation coefficients for the regression on market reactions to first-time green bond issuances

		CAR (0; 5)	*Size*	*Leverage*	*MB*	*Volume*	*Coupon*	*Maturity*
CAR (0; 5)	Pearson	1						
	Spearman	1						
Size	Pearson	0.1598	1					
	Spearman	0.1756	1					
Leverage	Pearson	0.1838	0.2791*	1				
	Spearman	0.2897*	0.3410**	1				
MB	Pearson	−0.2338	0.1581	0.1967	1			
	Spearman	0.0618	0.2313	0.0920	1			
Volume	Pearson	0.1284	0.3923***	0.0461	−0.1772	1		
	Spearman	0.0606	0.3984***	0.1232	−0.1186	1		
Coupon	Pearson	−0.2023	−0.2425	−0.2985**	−0.0947	−0.2777*	1	
	Spearman	−0.1207	−0.2841*	−0.3353**	−0.2559*	−0.1171	1	
Maturity	Pearson	−0.1046	−0.2398	−0.4518***	−0.0032	−0.1069	0.2059	1
	Spearman	−0.1783	−0.2306	−0.4780***	−0.0377	−0.0916	0.2920*	1

Note: 45 firm-year observations. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % level, respectively.

Table A.4

Pearson's and Spearman's correlation coefficients for the regression on market reactions to first-time disclosures of green bond frameworks

		CAR (0; 5)	*Size*	*Leverage*	*MB*	*Length*	*Green Projects*	*Tone*
CAR (0; 5)	Pearson	1						
	Spearman	1						
Size	Pearson	–0.0889	1					
	Spearman	0.0040	1					
Leverage	Pearson	0.2188	0.2554*	1				
	Spearman	0.2655*	0.3004**	1				
MB	Pearson	0.2300	0.1523	0.2302	1			
	Spearman	0.1513	0.2152	0.1390	1			
Length	Pearson	0.2667*	–0.045	–0.1372	–0.1246	1		
	Spearman	0.1669	0.0290	–0.1072	–0.1337	1		
GreenProjects	Pearson	–0.2213	0.1601	0.1549	0.1440	0.1235	1	
	Spearman	–0.2706*	0.1930	0.1404	0.1503	0.1106	1	
Tone	Pearson	0.0770	0.0448	–0.0224	0.0855	–0.1174	–0.0265	1
	Spearman	–0.0379	–0.0347	–0.0079	0.1099	–0.1303	0.0207	1

Note: 45 firm-year observations. ** and * denote statistical significance at the 5 % and 10 % level, respectively.

Table A.5

Results of the OLS regression for absolute values of CARs (0; 5)

Panel A: Green bond issuance			**Panel B: Green bond framework**		
	Regression Coefficient [|*CAR*|)	p-value		Regression Coefficient [|*CAR*|)	p-value
Size	1.1326**	0.0407	Dev_Size	0.3537	0.2348
Leverage	76.9790**	0.0223	Dev_Leverage	−35.6689*	0.0694
MB	−4.1758**	0.0415	Dev_MB	4.7515***	0.0034
Volume	−0.9355	0.5283	Length	−1.0734	0.3214
Coupon	−0.8701*	0.0834	GreenProjects	−0.0327	0.7790
Maturity	−0.0244	0.8570	Tone	0.1878	0.7883
Year	FE		Year	FE	
Intercept	−80.3494**	0.0227	Intercept	12.0215	0.2520
R^2	0.5638		R^2	0.4356	
Adjusted R^2	0.3809		Adjusted R^2	0.1990	
p-value	0.0050		p-value	0.0807	

Note: Size equals the natural logarithm of the book value of total assets. *Leverage* is calculated as the book value of total liabilities divided by the book value of total assets. *MB* is the market value of ordinary (common) equity divided by the book value of ordinary (common) equity. *Dev* refers to the absolute deviation from the median *Size*, *Leverage*, and *MB* in Panel B. *Volume* is measured as the natural logarithm of the total issued green bond amount (in Mio. EUR). *Coupon* represents the percentage annual coupon paid by the issuer relative to the green bond's face value. *Maturity* is the difference in years between issuance date and maturity date. *Length* is measured as natural logarithm of the total number of words in a green bond framework. *GreenProjects* is the number of mentioned eligible green projects to which the use of proceeds from a green bond is allocated. *Tone* indicates the relative number of negative word hits of Loughran's and McDonald's (2011) word list. Factor variables for Year fixed effects are not reported. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % level, respectively.

Table A.6

Market reactions in terms of *standardized* mean and median CARs

Panel A: Standardized market reactions to green bond issuances (n = 45)				
	Mean ($\overline{CAR}$)	p-value	Median CAR	p-value
CAR (0; 3)	0.0637 %	0.4202	–0.3497 %	0.7526
CAR (0; 4)	0.1648 %	0.3097	–0.3671 %	0.6101
CAR (0; 5)	0.3536 %	0.1720	–0.5229 %	0.5445
CAR (–3; 3)	0.0742 %	0.4289	–0.4342 %	0.6686
CAR (–4; 4)	0.0076 %	0.4934	–0.5756 %	0.6646
CAR (–5; 5)	–0.0482 %	0.5392	–0.8774 %	0.9114
Panel B: Standardized market reactions to disclosures of green bond frameworks (n = 45)				
	Mean ($\overline{CAR}$)	p-value	Median CAR	p-value
CAR (0; 3)	0.0630 %	0.3999	0.0977 %	0.3478
CAR (0; 4)	0.2239 %	0.2210	0.4083 %	0.1170
CAR (0; 5)	0.1901 %	0.2654	–0.0135 %	0.2766
CAR (–3; 3)	0.0524 %	0.4338	0.0287 %	0.4072
CAR (–4; 4)	0.2951 %	0.2001	0.4780 %	0.1675
CAR (–5; 5)	0.3565 %	0.1793	0.0107 %	0.2438

Note: Two-sided t-tests are used to evaluate the statistical significance of mean CARs to be different from zero, and Wilcoxon rank-sum tests (non-parametric tests) are applied to assess the statistical significance of median CARs to be different from zero.

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Table A.7

Market reactions in terms of *standardized absolute* mean and median CARs

Panel A: Standardized market reactions to green bond issuances (n = 45)				
	Mean ($\overline{CAR}$)	p-value	Median CAR	p-value
$\lvert CAR\ (0; 3)\rvert$	1.5804 %***	< 0.0001	1.2939 %***	< 0.0001
$\lvert CAR\ (0; 4)\rvert$	1.6851 %***	< 0.0001	1.1742 %***	< 0.0001
$\lvert CAR\ (0; 5)\rvert$	1.7931 %***	< 0.0001	1.3604 %***	< 0.0001
$\lvert \mathrm{CAR}\ (-3; 3)\rvert$	2.1224 %***	< 0.0001	1.6138 %***	< 0.0001
$\lvert CAR\ (-4; 4)\rvert$	2.3027 %***	< 0.0001	1.5606 %***	< 0.0001
$\lvert \mathrm{CAR}\ (-5; 5)\rvert$	2.3277 %***	< 0.0001	1.4589 %***	< 0.0001
Panel B: Standardized market reactions to disclosures of green bond frameworks (n = 45)				
	Mean ($\overline{CAR}$)	p-value	Median CAR	p-value
$\lvert CAR\ (0; 3)\rvert$	1.3245 %***	< 0.0001	1.1084 %***	< 0.0001
$\lvert CAR\ (0; 4)\rvert$	1.5235 %***	< 0.0001	1.2439 %***	< 0.0001
$\lvert CAR\ (0; 5)\rvert$	1.5698 %***	< 0.0001	1.4060 %***	< 0.0001
$\lvert \mathrm{CAR}\ (-3; 3)\rvert$	1.6956 %***	< 0.0001	1.5024 %***	< 0.0001
$\lvert CAR\ (-4; 4)\rvert$	1.8775 %***	< 0.0001	1.5972 %***	< 0.0001
$\lvert CAR\ (-5; 5)\rvert$	1.9533 %***	< 0.0001	1.4903 %***	< 0.0001

Note: One-sided t-tests are used to evaluate the statistical significance of absolute standardized mean CARs to be greater than the mean absolute abnormal returns during the estimation window, and Wilcoxon rank-sum tests (non-parametric tests) are applied to assess the statistical significance of absolute median CARs to be greater than the absolute standardized median abnormal returns during the estimation window. *** denotes statistical significance at the 1 % level.