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Do Investors Care About Green Bonds? Evidence From China

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Abstract: This study provides an empirical examination of green bond issuance within the Chinese capital market and its differential effects on short-term and long-term corporate stock performance. Em-ploying both event studies and DID analysis, I investigate the impact of green bonds, compared to conventional bonds. The findings reveal that green bond issuance elicits positive short-term market reactions, reflected by positive CAR before and after the issuance announcement, which is separated by an insignificant negative CAR on and days after the announcement. However, the long-term analysis indicates no significant effect on stock price or firm valuation, suggesting the market's limited recognition of long-term ESG improvements. The research highlights sec-tor-specific responses, with public utilities and state-owned enterprises exhibiting more pro-nounced reactions to green bond announcements. These outcomes underscore the complexity of the green bond impact in the context of the evolving standards and investor perceptions shaping the Chinese market.

Keywords: ESG; Green Bond; Abnormal Return

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1.Introduction

The integration of environmental, social, and governance (ESG) considerations into corporate strategies has become an essential facet of contemporary business practices, reflecting a paradigm shift toward the recognition and incorporation of broader stakeholder interests within corporate decision-making frameworks. Existing papers explore the emergent and rapidly expanding domain of the green bond market—a financial instrument innately crafted to bolster environmental and social welfare. Pioneered in corporate finance, green bonds represent an innovative mechanism through which firms can acquire capital to fund investments, inextricably linked to the promulgation of environmental goodness, such as amelioration of carbon footprint and pollution mitigation. These bonds are distinguished not only by their explicit commitment to environmental projects but also by the requirement of certification from third-party entities, a validation process that can impose additional administrative and compliance burdens, particularly on first-time issuers.

Scholars have approached the study of green bond issuance and its effect on corporate stock returns from various angles, yielding a spectrum of conclusions. This divergence can be attributed to multiple factors, including the temporal context of analysis, the heterogeneity of data drawn from disparate capital markets, and the selection of distinct research timeframes, which have fundamental implications on the resultant insights. Post-2016, a notable surge in the green bond market has influenced sample selections, altering the landscape of empirical evidence, and consequently, skewing the interpretations of green bonds' impacts. Additionally, national disparities in the recognition standards for green bonds, levels of regulatory

oversight, and societal acceptance of sustainable investments have resulted in heterogeneous findings across different countries.

China, as one of the key participants in the green bond market and the country with the largest issuance volume, necessitates a focused study on its latest green bond samples. The unique features of Chinese capital market and green bonds, in turn, influences the mechanism by which green bonds impact corporate stock prices. Therefore, the uniqueness and the imperative for a dedicated study of green bonds in the Chinese context are further emphasized by these factors. More than the event study that is used by existing studies, I have further employed the Difference-in-Differences (DID) analytical technique to differentiate between the impacts of green bond and conventional bond issuances for both the short-term and long-term effects of green bonds.

The results of the event study and DID analysis regarding the short-term impact of green bond issuance on stock prices indicate the occurrence of positive CAR in the window period around 10 days before and after the event. Upon further segmentation, positive CAR is significant in the range from 1 day before the announcement to 5 days before and from 5 days after to 9 days after, while CAR is slightly negative but not significant in the range from the announcement day to 4 days after. However, the DID analysis shows that green bond issuance does not lead to a significant increase in stock price or company value in the long term.

This lack of enhancement is attributed to the absence of an improvement in the company's ESG governance level in the long term, rendering it unrecognized by investors—a potential consequence of the lack of clarity in "greenwashing" and green bond standards and regulations. In contrast, green bond issuance in the short term generates abnormal returns and is associated with increased stock trading volumes, consistent with the limited attention theory, where the issuance of green bonds as positive news attracts more attention to the company. The DID analysis also reveals a more significant effect on public utility companies and central state-owned enterprises.

The conclusions drawn from this study on Chinese green bonds harmonize with the existing research on green bonds in other countries and feature detailed short-term influence and underlying mechanisms. Moreover, this study conducts a comparative analysis of the short-term and long-term effects of green bonds and delves into the underlying mechanisms. These research findings are consistent with the characteristics of the Chinese capital market. In synthesizing these findings, the study contributes to a nuanced appreciation of the intricate dynamics between green bond issuance and corporate stock performance, as embedded in the idiosyncrasies of the Chinese green bond market.

2.Literature review and motivation

2.1 Related theories

Efficient Market Hypothesis (EMH): The Efficient Market Hypothesis, introduced by Fama[1] asserts that financial markets efficiently incorporate all available information, rendering attempts to consistently outperform the market through analysis of publicly available information futile. It suggests that asset prices reflect all available information, making it challenging for investors to gain exceptional returns on their investments. EMH is categorized into three forms: weak, semi-strong, and strong, each reflecting the extent to which information is already factored into stock prices.

Limited Attention Theory: Limited Attention Theory, introduced by Egeth and Kahneman[2] explores the cognitive constraints and selective information processing capabilities of individuals. It posits that individuals have limited attention spans and are more likely to focus on readily accessible and simplified information, potentially overlooking more complex and comprehensive data. This theory has broad implications for consumer behavior, financial decision-making, and market dynamics, offering insights into the interplay between information availability and individual decision processes.

Stakeholder Theory: The Stakeholder Theory, conceived by Freeman[3], emphasizes the intricate relationships between a company and its stakeholders, advocating for the consideration of the diverse interests and expectations of stakeholders beyond shareholders. This theory asserts that businesses should manage their operations regarding the welfare of multiple stakeholders, including customers, suppliers, employees, and the wider community, to achieve sustainable and equitable corporate governance and social responsibility outcomes.

Theory of Asymmetric Information: The Theory of Asymmetric Information, spearheaded by Akerlof[4], investigates the dynamics of transactions when one party holds more information than the other. It highlights the potential for market inefficiencies and adverse outcomes due to information imbalance. The theory addresses issues such as moral hazard and adverse selection, shedding light on how the unequal distribution of information can impact markets, contracts, and economic decision-making processes.

Signaling Theory: Signaling Theory, pioneered by Spence[5], elucidates how individuals or entities with superior information can transmit credible signals to parties with limited or asymmetric information. This theory is paramount in understanding how signaling actions, such as educational qualifications, dividend announcements, and corporate disclosures, can serve as credible indicators of unobservable attributes, mitigating information asymmetry and influencing market behaviors and outcomes.

2.2 Recent related literatures

Before the rise of ESG, much literature study the impacts of CSR events on corporate financial performance (CFP). Klassen and McLaughlin[6] and Flammer[7] reveal positive investor reactions to CSR events, but the margin impact is decreasing. Byun and Oh[8] provide evidence that publicized CSR activities significantly and positively impact shareholder value as measured by Tobin's q. But Krüger[9] finds that investors respond weakly negatively to positive events, suggesting that investors do not appreciate the implementation of CSR policies. Krüger[9] also finds that investors react strongly negatively to negative CSR events, especially those about communities and the environment.

With the rise of ESG, the impact of ESG events on stock market is also studied. Capelle-Blancard and Petit[10] use the news from Covalence EthicalQuote and find that firms get a drop in market value of 0.1% from negative ESG news but nothing on average from positive. Serafeim and Yoon[11] and Yoon[12] investigate the relation between ESG news, ESG rating and stock price. They find that firm with higher ESG rating is likely to have more positive ESG news. They also suggest little price reaction for companies with high ESG ratings for positive news, as the prices already incorporate the news. However, the reaction is significant for negative news regardless of the rating.

Green bonds, as a typical positive practice of ESG, have garnered increasing attention from scholars in recent years. The academic discourse on corporate green bonds, financial instruments designated for funding environmentally beneficial projects, has intensified, offering nuanced insights into their market impacts and investor perceptions. This literature review synthesizes key findings from several seminal studies in this field.

Tang and Zhang[13] present the empirical investigation into green bond issuance's announcement returns and real effects across 28 countries from 2007 to 2017. Their comprehensive dataset reveals a positive stock price response to green bond issuance. However, they note the absence of a consistent significant premium for green bonds, implying that the positive stock returns are not wholly attributable to a lower cost of debt. Intriguingly, post-issuance, an increase in institutional ownership, particularly domestic institutions, and a significant improvement in stock liquidity are reported. These findings suggest benefits to existing shareholders following green bond issuance, albeit with nuances regarding the bonds' pricing.

Similarly, Flammer[14] provides a pivotal analysis of corporate green bonds, underscoring their growing prevalence, particularly in sectors where environmental issues significantly affect firm operations. This study reveals that the announcement of green bond issuance generally elicits a positive investor response, more pronounced for first-time issuers and bonds with third-party certification. Notably, post-issuance, these firms tend to demonstrate enhanced environmental performance, evidenced by improved environmental ratings and reduced CO2 emissions. Furthermore, a surge in ownership by long-term and green investors is observed. Flammer's findings align with the signaling theory, suggesting that by issuing green bonds, firms credibly demonstrate their commitment to environmental stewardship.

While Tang and Zhang[13] and Flammer[14] highlight positive market reactions and potential benefits for issuers, Baulkaran[15] and Lebelle et al.[16] provide a more nuanced view, indicating that investor responses can vary based on bond characteristics and issuer profiles.

Baulkaran[15] examines the stock market reaction to green bond announcements, observing positive and significant cumulative abnormal returns. This outcome suggests that shareholders perceive green bond financing as value-enhancing, with the funds

likely directed towards profitable green initiatives or risk mitigation. An interesting aspect of Baulkaran's analysis is the impact of bond and firm characteristics on investor response. Higher coupon rates on green bonds correlate with negative investor reactions, while firm size, Tobin's Q, and growth exhibit positive relations to the cumulative abnormal return. This complex interplay underscores the multifaceted nature of green bond issuance and its perception in the market.

Lebelle, Lajili Jarjir, and Sassi[16] provide a contrasting perspective, noting a negative market reaction to green bond announcements. Analyzing a sample of 475 corporate green bonds from 2009 to 2018, they find that the stock market reacts negatively on the announcement date and the day after, with cumulative abnormal returns ranging between -0.5% and -0.2%, depending on the pricing model used. This negative reaction is particularly pronounced during the first issuance and in developed markets. The authors suggest that this investor behavior towards green bonds is akin to that towards conventional or convertible bonds, indicating that green bond offerings might convey unfavorable information about the issuer. However, they also note that this negative reaction is less pronounced in firms with fewer financial constraints and more growth opportunities.

The extant research on the impact of green bond issuance on corporate stock returns yields divergent conclusions. This variation largely stems from scholars conducting their analyses at different points in time, leveraging data from disparate capital markets, and selecting distinct research timeframes. The rapid expansion of the green bond market post-2016 has notably influenced the sample selection and, consequently, the research outcomes pertaining to green bonds. Additionally, variations in the national standards for green bond recognition, regulatory oversight, and levels of acceptance have contributed to differences in research findings across countries.

Furthermore, as the concept of ESG becomes increasingly ingrained in the collective consciousness, investors' perceptions, and degrees of endorsement of green bonds are also evolving. This shift may further account for the dynamic landscape of research conclusions pertaining to the relationship between green bond issuance and stock performance.

2.3 Research motivation

As previously noted, the selection of research period and capital market is critical in studies examining the impact of green bonds, potentially leading to contrasting conclusions. China, as one of the key participants in the green bond market and the country with the largest issuance volume[14], which has been rapidly increasing in recent years, necessitates a focused study on its latest green bond samples. Moreover, scholars have highlighted the prevalence of "greenwashing" among Chinese corporations[17][18][19], a factor that significantly affects investors' perception and acceptance of green bonds. This, in turn, influences the mechanism by which green bonds impact corporate stock prices. Therefore, the uniqueness and the imperative for a dedicated study of green bonds in the Chinese context are further emphasized by these factors.

In terms of research methodology, scholars like Baulkaran[15], Tang and Zhang[13], and Flammer[14] have utilized the event study approach to analyze the abnormal returns of issuing companies' stock prices during the green bond issuance window. However, this method may not sufficiently disentangle the "green" attributes of green bonds from the effects solely attributable to the bond issuance itself on the abnormal returns. Consequently, building upon an event study of green bond issuances in China, I have further employed the Difference-in-Differences (DID) analytical technique to differentiate between the impacts of green bond and conventional bond issuances. Additionally, considering the presence of "greenwashing, " the short-term and long-term effects of green bonds may differ.

Following the aforementioned rationale, I concentrate my investigation on green bonds issued in China from 2016 through October 2023, and hereby propose two testable hypotheses:

Hypothesis 1: The issuance of green bonds in China does indeed exert a positive impact on the company's stock price in the short term.

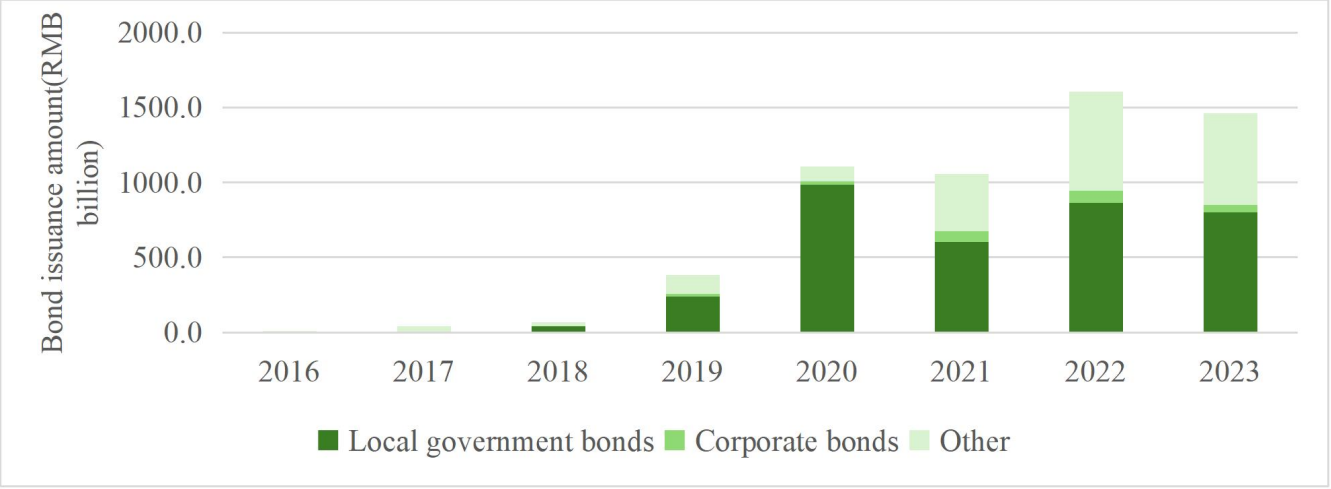
Hypothesis 2: In the long term, the issuance of green bonds in China does not enhance corporate value.

3.Data and descriptive

I primarily utilized the Wind database as the source of my data. The Wind database is a robust repository encompassing comprehensive economic and company data pertinent to China. From its bond segment, I procured the bond data as the

focus of my study revolves around the impact of green bond issuance on companies. Consequently, I selected the corporate bond data of Chinese firms from this database. Through the utilization of Wind, I obtained the pertinent data associated with these corporate bonds, including the bond codes, issuance announcement dates, issuance amounts, coupon rates, green bond classification, as well as the names of the bond-issuing companies, their public listing status, and the corresponding stock codes. These green bonds are labeled by Wind primarily based on the alignment of their fundraising proceeds with green industries or projects. The delineation of green industries or projects primarily refers to guidelines or project directories issued by various relevant regulatory authorities. The announcement dates for the issuance of these green bonds span from 2016, with the first domestic bond issued by the China Three Gorges Corporation being a corporate bond, up to October 31, 2023. These green bonds have been categorized by Wind as local government bonds, corporate bonds, and others, which includes commercial paper, medium-term notes, financial bonds, and asset-backed securities. It is evident that the overall issuance amount of Chinese green bonds has exhibited an increasing trend, experiencing a significant surge in 2020, primarily dominated by local government bonds, which have accounted for over 50% of the total issuance amount each year. (Figure 1).

Figure1:Chinese green bond issuance over time



This figure depicts the annual issuance amounts of green bonds from 2016 to October 31st , 2023, categorized by Wind. Within the classification, corporate bonds strictly pertain to a narrow definition of corporate bonds, while the other category encompasses instruments such as commercial paper, medium-term notes, financial bonds, and asset-backed securities.

I only consider issuers which are financials and industrial corporations. Due to the limited availability and infrequent updating of public data for non-publicly listed companies, this study focuses on examining the impacts of green bond issuance on publicly listed companies, particularly those in China, encompassing both the companies and bonds within the Chinese financial market. Given these considerations, the study has selected green bonds issued by companies listed on the stock exchanges of mainland China, including the Shanghai Stock Exchange and the Shenzhen Stock Exchange. Wind provides robust stock data, and I have cleaned and organized the stock codes of companies issuing green bonds. In cases where companies are listed on both mainland Chinese exchanges and other exchanges such as the Hong Kong Stock Exchange, only the codes for companies listed on mainland Chinese exchanges are retained.

Table 1 shows summary statistics for sample of public issuers' green bonds' characteristics. The average issuance amount of the 204 green bonds issued by mainland Chinese listed companies is 3140 million RMB, with the highest amount reaching 30,000 million RMB and the lowest being only 300 million RMB. The median amount and the mode is both 1000 million RMB, indicating that the majority of green bonds have a issue amount around 1000 million RMB. The average maturity is 4.2 years, with the minimum being 0.3 years and the maximum extending up to 18 years. Both the median and the mode are 3.0 years, indicating that the majority of green bonds have a maturity period around 3 years. The average coupon rate is 3.2%, with the minimum at 2.1% and the maximum at 6.5%. The median rate is 3.1%, and the mode is only 2.8%.

Table1: Summary statistics for public issuers' green bonds

	Amount (100 million)	Maturity (year)	Coupon rate (percent %)
Mean	31.4	4.2	3.2
Median	10.0	3.0	3.1
Mode	10.0	3.0	2.8
Std.	59.2	3.5	0.8
Minimum	0.3	0.3	2.1
Maximum	300.0	18.0	6.5
N	204	204	204

This table shows summary statistics for sample of public issuers' green bonds' characteristics.

I also collect data for ESG (Environmental, Social, and Governance) bonds for comparative study. Table 2 shows summary statistics for sample of public issuers' ESG bonds' characteristics. These ESG bonds are also categorized by Wind based on the definitions of ESG projects provided by regulatory authorities. In the context of sustainable finance, (ESG bonds represent a broader concept than green bonds. ESG bonds encompass not only green bonds but also include social bonds and sustainability-linked bonds, among others. Specifically, in the Chinese market, green bonds constitute the predominant category within the ESG bond spectrum, accounting for approximately 80% of ESG bonds. Generally, both industry and academic circles exhibit a heightened focus on green bonds, given their significant proportion and pivotal role in advancing environmental objectives within the broader framework of ESG financing.

Table2: Summary statistics for public issuers' ESG bonds

	Amount (100 million)	Maturity (year)	Coupon rate (percent %)
Mean	27.4	4.3	3.4
Median	10.0	3.0	3.1
Mode	10.0	3.0	2.8
Std.	53.9	3.8	1.0
Minimum	0.3	0.3	2.1
Maximum	300.0	24.0	7.5
N	253	253	253

This table shows summary statistics for sample of public issuers' ESG bonds' characteristics.

Using Excel VBA, the codes are formatted into standard stock codes recognizable by the Wind stock database. This facilitated the retrieval of daily closing price data, daily return data and monthly return data for companies issuing green bonds, with the stock price and return being adjusted for prior rights issues, bonus issues, stock splits, and reverse stock splits, to enable a more accurate calculation of the true stock returns. The corporate fundamental database of Wind is also utilized to obtain the fundamental information of the companies.

4.Short-term event study for green bonds

4.1 Event study methodologies

To study the short-term impact of green bond, I use the event study methodology to examine the short-term stock price change due to the announcement of green bond. Following Tang and Zhang[13], I selected the announcement of bond issuance, rather than the actual issuance, as the event for the event study because the issuance announcement represents the formal dissemination of issuance information to the market and investors. In contrast, the actual issuance merely signifies the completion of the issuance process procedurally, without providing additional information to the market and investors.

As the issuance of green bonds is the event for this event study, the issuance date of the green bonds is considered as the event date, also referred to as day 0. I set the event window for the event study from 10 trading days before the issuance announcement date of the green bonds to 19 trading days after the issuance announcement date, also referred to as day [-10,19]. The reason for starting the event window before the issuance announcement date is following Krüger[20]'s research, considering that some information may have already been disseminated to certain investors through various means before the announcement date, especially in light of the widely held view that China's capital market governance is not yet mature, and insider trading is not uncommon. The reason why I choose day 19 rather than a more rounded figure, such as day 20, as the end of the event window, is because I aim for a more detailed observation. I divide the event window into shorter sub-windows of 5 days each to closely monitor the event effects, resulting in a total of 30 days or 6 sub-event windows for day [-10,19].

After setting the event window, I estimate the abnormal return, which is used to measure the impact of green bond issuance on stock price. For bond i, the coefficients α_i and β_i of the market model are estimated by ordinary least squares (OLS) based on pre-event estimation window, which is day [-220, -15]. Formally, I estimate:

$$R_{i,t} = \alpha_i + \beta_i \times R_{m,t} + \varepsilon_{i,t}$$

Where $R_{i,t}$ is the return on the stock of the issuer company of bond i on day t, $R_{m,t}$ is the daily market return, and $\varepsilon_{i,t}$ is the residual. I use the total return of CSI 300 Index which is obtained from Wind for $R_{m,t}$.

The estimated return stock of firm i is calculated using estimated coefficient $\widehat{\alpha}_i$ and $\widehat{\beta}_i$. The daily abnormal return $AR_{i,t}$ of the issuer company of bond i is the difference between real return $R_{i,t}$ and the estimated return $\widehat{R}_{i,t}$. The cumulative abnormal return CAR_i for each sub-event window is the sum of $AR_{i,t}$ of every day in that sub-event window. All in all, I calculate the daily abnormal return $AR_{i,t}$ of firm i on day t and cumulative abnormal return for the sub-event windows as follows:

$$\widehat{R}_{i,t} = \widehat{\alpha}_i + \widehat{\beta}_i \times R_{m,t}$$

$$AR_t = R_t - \widehat{R}_t$$

$$CAR_i = \sum_{t=begin\,date}^{end\,date} AR_{i,t}$$

For the robustness checks, I also estimate $\widehat{R}_{i,t}$using market model based on pre-event estimation window of day [-120, -15] and day [-420.-15]. Following Flammer[14], to mitigate the abnormal return driven by industry trend, I also estimate $\widehat{R}_{i,t}$ using industry adjusted return, where the $R_{m,t}$ is represented by the total return of industry index, based on Wind First-Level Industry Classification. And the corresponding CARs are called industry-adjusted CARs. Table 3 shows the methods for abnormal returns estimation.

Table3: Abnormal returns estimation methodologies

Cumulative abnormal return	Pre-event estimation window	Index for market return
CAR1	[-220, 15]	CSI 300 Index
CAR2	[-120, 15]	CSI 300 Index
CAR2	[-420, 15]	CSI 300 Index
CAR4	[-220, 15]	Wind Industry Index
CAR5	[-120, 15]	Wind Industry Index
CAR6	[-420, 15]	Wind Industry Index

This table shows summary of abnormal returns estimation methodologies.

4.2 Event study results for green bond announcement

In accordance with the described event study methodology, I conducted the event study on the sample of green bonds and their corresponding stocks. Some companies, having been listed relatively recently, lacked complete stock price and return

data during the pre-event estimation window and the event window. These green bonds and stocks are excluded from the sample in the event study. Additionally, to facilitate a subsequent comparison with the impact of conventional bond issuances, I also excluded a small number of samples from companies that had only issued green bonds. Table 4 shows the result for the event study.

Table4: Event study result for the green bonds announcement

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-10, -6]	-0.1258 (0.3014)	0.0257 (0.3060)	-0.0387 (0.3016)	-0.1058 (0.2555)	-0.0628 (0.2630)	-0.1193 (0.2559)
Day [-5, -1]	0.7506* (0.4240)	1.0742** (0.4312)	0.7918* (0.4231)	0.6112* (0.3162)	0.7952** (0.3259)	0.5689* (0.3114)
Day [0, 4]	-0.2939 (0.3192)	-0.1384 (0.3317)	-0.1311 (0.3345)	-0.0708 (0.2800)	-0.0288 (0.2903)	0.0585 (0.2840)
Day [5, 9]	0.9486** (0.3966)	1.0065** (0.4001)	1.0676*** (0.4010)	0.7673** (0.3261)	0.7135** (0.3342)	0.8384*** (0.3202)
Day [10, 14]	0.2351 (0.3319)	0.3992 (0.3352)	0.3990 (0.4265)	-0.0368 (0.2471)	-0.0227 (0.2504)	0.1325 (0.3204)
Day [14, 19]	-0.5150 (0.3539)	-0.3583 (0.3600)	-0.4574 (0.3434)	-0.5763* (0.3102)	-0.4984 (0.3097)	-0.5308* (0.3049)
N	152	156	146	152	156	146

N is the number of observations, the upper number in each cell is the mean of CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

Figure2: CAR trends over time in this event study

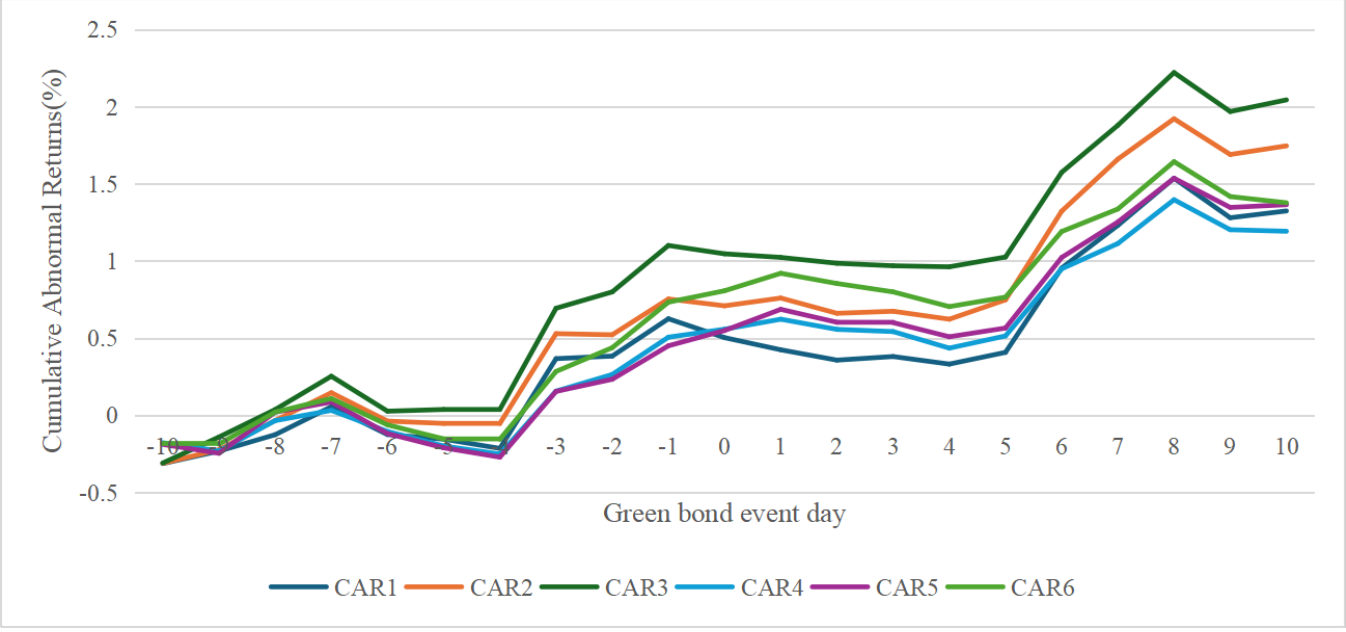
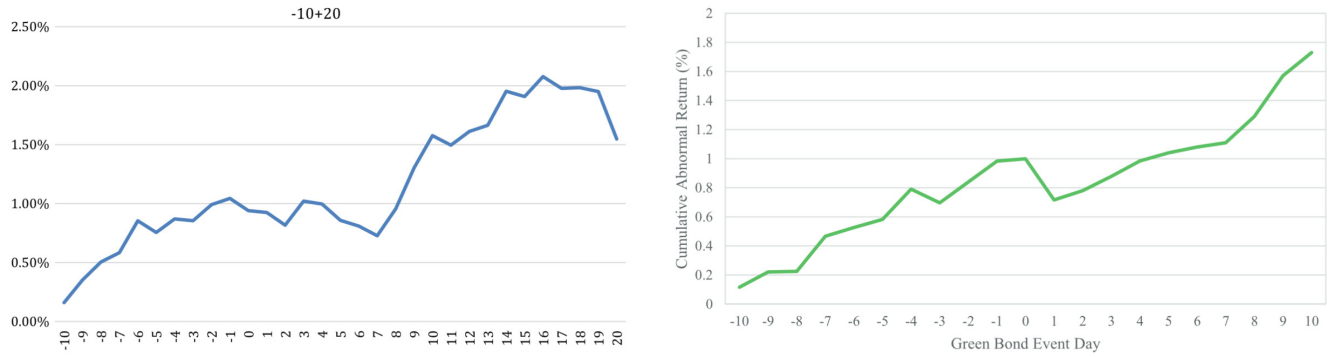


Figure 2 delineates the overarching trajectory of the CARs during the event study window, depicting an ascending CAR trend prior to the issuance announcement date. This is followed by a slight downtrend for approximately five days subsequent to

the announcement, after which the CARs experience a continued upward movement for a subsequent five-day period. The empirical results from my event study corroborate the trends demonstrated in the CAR over time as depicted in the Figure 3 from Baulkaran (2019) and Tang and Zhang (2020). Specifically, the CAR trajectory exhibits a slight initial decline during the period spanning from the announcement date to several days thereafter, which is statistically insignificant for the window day [0, 4] in my event study result. The periods preceding and succeeding this period by approximately six days display a significant upswing in the CAR series, which is in alignment with my findings of statistical significance for the windows day [-5, -1] and day [5, 9]. While Baulkaran (2019) and Tang and Zhang (2020) report a positive and significant CAR throughout the entire event window, my analysis extends these findings by detailing the 5-day-window CAR movements within said event window in the following part.

Figure3: CAR trends over time in comparable studies [13], [15]



The empirical results from my event study corroborate the trends demonstrated in the CAR over time as depicted in the left figure from Baulkaran (2019) and the right figure from Tang and Zhang (2020). The CAR trajectory exhibits a slight initial decline during the period spanning from the announcement date to several days thereafter, which is statistically insignificant for the window day [0, 4] in my event study result. The periods preceding and succeeding this period by approximately six days display a significant upswing in the CAR series, which is in alignment with my findings of statistical significance for the windows day [-5, -1] and day [5, 9].

The observation of positive CARs preceding the issuance announcement of green bonds could plausibly be attributed to the leakage of issuance information. This aligns with the Efficient Market Hypothesis (EMH), suggesting that in weak-form and semi-strong form efficient markets, insider information can still yield abnormal returns. Several studies also confirm the stock return predictability by insider trading in China's stock market[21][22]. The retail investor-dominated market structure in China's stock market significantly increases insiders' incentives to trade with significant informational advantage over general market participants[23]. In the practice of bond issuance in China, particularly for credit bonds, institutional investors typically constitute the primary investors. During the pre-issuance phase, intermediary institutions engage in preliminary communications with potential institutional investors to ensure sufficient buying interest at the time of issuance, thereby fulfilling their underwriting responsibilities. Consequently, institutional investors are indeed likely to be privy to information about upcoming bond issuance announcement. Although regulatory requirements stipulate information barriers between different departments within financial institutions – thereby theoretically preventing bond investment and equity investment departments from exploiting insider information – in practice, it is challenging to completely prevent the leakage of issuance information.

The CARs for the period day [5, 9] are also positive and statistically significant. This can likely be attributed to retail investors purchasing the company's stock upon learning of the green bond issuance, leading to excess returns. This aligns with the general paradigm of event studies, where the occurrence of a company-beneficial event leads to excess stock returns. The robust positive CARs in both the day [5, 9] and day [-5, 1] windows suggest that the issuance of green bonds indeed has a short-term positive impact on the company's stock price, indicating that investors perceive the issuance of green bonds as a positive event for the company. Flammer[14] explicates this phenomenon by integrating theories of information asymmetry and signaling, suggesting that the observed positive CAR around the bond issuance announcement are indicative of the market's

response to signals emitted by the firm. These signals, underpinned by the issuance of green bonds, are interpreted by market participants as informative cues about the firm's commitment to sustainability and its potential future performance, thereby reducing information asymmetry between the firm and its investors.

Counterintuitively, during the issuance announcement window of green bonds, specifically day [0, 4], the stocks of companies that announce issuing green bonds do not exhibit significant positive CARs, despite the surrounding periods of day [-5, 1] and day [5, 9] manifesting significant positive CARs for these stocks. This consists with the finding of Baulkaran[15], that the mean abnormal returns in the green bond issuing announcement day is negative and not statistically significant. This anomaly can be plausibly explained by two credible scenarios. One possibility is that investors privy to insider information prior to the issuance announcement may have commenced selling their shares post the formal announcement of the green bond issuance, leading to the absence of significant positive returns in the period of day [0, 4]. This consist with the Overreaction Theory of Bondt and Thaler[24], which suggests that markets can exhibit overreactions to new information, leading to excessive buying or selling of securities based on psychological factors rather than fundamental analysis. This behavior can result in stock prices moving beyond what is justified by their intrinsic value. Since the prices move beyond the intrinsic value, some investors may take advantage of the temporary price increase to sell and lock in profits, which contributes to the stock price exhibiting downward pressure after the positive news. Another possibility suggests that some investors, following the announcement of the issuance, might have anticipated additional costs for the company to comply with the various requirements associated with green bonds, which they deem to be disadvantageous for the company. This is similar to the announcement effect of convertible bonds[25], and may suggests that green bond offerings convey unfavorable information about the issuing firms[16]. Furthermore, for the period of day [14, 19], CARs estimated by two methodologies exhibit significance at the 10% level, yet the CARs estimated by other methodologies during this period do not show significance, thus mitigating their interpretative value.

The empirical results from above illustrate that investors hold a generally positive view towards green bonds. However, this sentiment may not be consistent across the board; it appears to be mixed, interspersed with diverging opinions, potentially reflecting the complex attitudes and cognitive dissonance among Chinese investors towards green bonds.

4.3 Comparative event study

Furthermore, to validate that the positive CARs are attributable to the announcement of green bond issuance announcement rather than ordinary bond issuance announcement, and to affirm that the "green" value of green bonds is what investors value, I also selected conventional bonds as a control group for the event study to substantiate the aforementioned perspective. As previously discussed, when elaborating on the event study methodology, I have excluded companies that have only issued green bonds. This exclusion allows me to select conventional bonds issued by the same companies that issued green bonds for the control group, thereby minimizing the influence of issuer-specific characteristics. Additionally, to prevent potential interference between the announcements of green and conventional bond issuances, the announcement dates of the bonds in the control group are deliberately spaced at least 15 trading days apart from those in the experimental group. On this basis, the conventional bond with the closest issuance announcement date was chosen for the control group. As shown in Table 5, in the case of conventional bond issuance announcements, the CARs estimated for various periods using different methodologies are not statistically significant. This finding consist with the study of Myers and Majluf[26] that the stock market shows no significant reaction to bond issues, substantiates the earlier assertion that the positive CARs associated with the announcements of green bond issuances are indeed attributable to the "green" aspect of these bonds.

Table5: Event study result for the conventional bonds announcement

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-10, -6]	-0.1502 (0.6158)	0.1407 (0.6097)	-0.1051 (0.6150)	-0.0660 (0.4095)	0.0424 (0.4275)	0.0450 (0.4156)

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-5, -1]	0.2130 (0.5354)	0.4757 (0.5125)	0.2550 (0.5371)	0.1366 (0.3962)	0.3125 (0.3594)	0.1249 (0.4014)
Day [0, 4]	-0.0283 (0.6714)	0.1166 (0.6967)	0.0890 (0.6758)	0.5917 (0.5519)	0.6826 (0.6015)	0.5864 (0.5579)
Day [5, 9]	-0.1260 (0.7153)	0.2157 (0.7066)	0.0475 (0.7158)	-0.1237 (0.5429)	0.0030 (0.5328)	-0.1469 (0.5474)
Day [10, 14]	-1.0815 (0.6963)	-0.7045 (0.6603)	-1.0279 (0.7179)	-0.9200 (0.5654)	-0.7149 (0.5349)	-0.9916 (0.6124)
Day [14, 19]	0.3337 (0.7099)	0.5232 (0.6621)	0.5097 (0.7112)	0.1458 (0.5810)	0.2539 (0.5254)	0.1147 (0.5931)
N	152	156	146	152	156	146

N is the number of observations, the upper number in each cell is the mean of CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

I also applied the same event study methodology to ESG bonds. ESG bonds, encompassing a broader spectrum than the common green bonds, include sustainable development bonds and social responsibility bonds, among others, that allocate funds towards ESG (Environmental, Social, and Governance) related projects. These ESG bonds are also categorized by Wind based on the definitions of ESG projects provided by regulatory authorities. The event study results shown in Table 6 for ESG bonds indicate that their issuance announcements also generate positive CARs for the corresponding companies' stocks. However, the range of significant CARs is narrower compared to green bonds, suggesting a relatively lower degree of investor recognition for ESG bonds compared to green bonds. This could be attributed to the less clear-cut criteria for defining sustainable development and social responsibility bonds as opposed to green bonds.

Table6: Event study result for the ESG bonds announcement

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-10, -6]	-0.1756 (0.2986)	-0.1117 (0.3041)	-0.0047 (0.3034)	-0.0582 (0.2460)	-0.0933 (0.2479)	0.0264 (0.2523)
Day [-5, -1]	0.2507 (0.4078)	0.2956 (0.4075)	0.5365 (0.4111)	0.2646 (0.2837)	0.2297 (0.2803)	0.4320 (0.2895)
Day [0, 4]	-0.4659 (0.3257)	-0.3402 (0.3271)	-0.2538 (0.3362)	-0.2245 (0.2751)	-0.1729 (0.2823)	-0.1309 (0.2804)
Day [5, 9]	1.0133** (0.3988)	1.1274*** (0.3938)	1.0795*** (0.4029)	0.6697** (0.3189)	0.7502** (0.3079)	0.6343* (0.3266)
Day [10, 14]	0.2987 (0.3324)	0.4427 (0.3949)	0.4394 (0.3377)	0.0778 (0.2568)	0.2104 (0.3035)	0.1279 (0.2616)
Day [14, 19]	-0.0624 (0.3367)	0.0074 (0.3272)	0.1586 (0.3382)	-0.3862 (0.2701)	-0.3444 (0.2676)	-0.2518 (0.2694)
N	179	184	173	179	184	173

N is the number of observations, the upper number in each cell is the mean of CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

To mitigate the impact of outliers, I performed a 1% two-tailed winsorization on the CARs prior to conducting the event study. Table 7 displays the results post-winsorization. It can be noted that the significance of CARs for the pre-announcement period of day [-5, -1] is no longer robust, with only two methods estimating significant positive CARs. This suggests that the previously significant results may have been influenced by extreme values. This is a reasonable observation, given that, unlike widely circulated public information, the extent of dissemination of insider information before each green bond announcement varies, consisting with the study that stock returns are affected by the accuracy of insiders' private information, and the number of days that insiders have obtained the information in advance[27]. Consequently, certain stocks exhibited more pronounced CARs than others. After the application of winsorization, the significance of CARs for the day [-5, -1] period became less robust.

Table7: Event study result for the green bonds announcement (winsorized)

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-10, -6]	-0.1413 (0.2899)	-0.1275 (0.2435)	-0.0513 (0.2931)	-0.1324 (0.2468)	0.0112 (0.2948)	-0.0779 (0.2501)
Day [-5, -1]	0.5741 (0.3874)	0.4321 (0.2774)	0.6330 (0.3906)	0.4149 (0.2768)	0.9050** (0.3947)	0.6084** (0.2851)
Day [0, 4]	-0.3123 (0.2882)	-0.1238 (0.2386)	-0.1819 (0.3050)	-0.0031 (0.2447)	-0.1534 (0.2998)	-0.0771 (0.2435)
Day [5, 9]	0.8846** (0.3736)	0.7264** (0.3101)	1.0009*** (0.3795)	0.8033*** (0.3061)	0.9372** (0.3775)	0.6875** (0.3181)
Day [10, 14]	0.3372 (0.3128)	-0.0331 (0.2347)	0.3806 (0.3508)	0.0485 (0.2667)	0.4953 (0.3184)	0.0014 (0.2378)
Day [14, 19]	-0.4033 (0.3174)	-0.4798* (0.2807)	-0.3569 (0.3145)	-0.3916 (0.2813)	-0.2644 (0.3247)	-0.3890 (0.2780)
N	152	156	146	152	156	146

N is the number of observations, the upper number in each cell is the mean of CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

5.Short-term difference in difference study for green bonds

5.1 Difference in difference study methodologies

To further ascertain that the CARs observed around the issuance announcement of green bonds are attributable to the "green" attributes of the bonds, rather than the mere act of bond issuance announcement, I employed a Difference-in-Differences (DID) approach to analyze the experimental group of green bonds and the control group of conventional bonds, as previously constructed. Considering the internal information and the observed CARs prior to the announcement date of green bond issuances, pinpointing the exact effective date of the event posed a challenge. Therefore, I adopted a dynamic DID methodology, examining whether the differences between the control and experimental groups in each sub-event window are statistically significant. Formally, I estimate:

$$CAR_{i,t} = \beta \times Green_i \times Period_t + \alpha_i + \alpha_t + \epsilon_{i,t}$$

Where $CAR_{i,t}$ is the cumulative abnormal return of the issuer company of bond i in period t. $Green_i$ is the dummy variable (treatment dummy) that equals one if the bond i is green bond and equals zero if the bond i is not green bond. $Period_t$ is the categorical variable for the sub-event windows or periods. $\alpha_i, \alpha_t, \epsilon_{i,t}$ are the individual (bond) fixed effects, time fixed effects and error term. The coefficient of interest is β, which measures the difference-in-differences in outcome variable $CAR_{i,t}$ between treated and control bonds. In deviation from the basic DID model setup, the current model does not include separate terms for $Green_i$ and $Period_t$. This is because, in the dynamic Difference-in-Differences approach, the individual fixed effects and time fixed effects are already capable of capturing the effects of these two variables. I also excluded control variables at the bond level or the firm level. This exclusion is justified because, within the event study window, the attributes of each bond and the fundamental data of the corresponding companies remain constant. Consequently, the effects of these control variables are already encompassed by individual fixed effects. Incorporating them into the model would result in their impact being absorbed by the individual fixed effects.

5.2 Difference in difference study result

Table 8 presents the results from the DID analysis, which are in line with the earlier event study results, exhibiting a similar pattern and confirming that the announcements of green bond issuance indeed result in positive CARs for the issuing companies' stocks before and after the announcement date. However, there are several distinctions. The coefficient of interest for Day [-5, -1]*Green is not robustly significant. When the CSI 300 index is used as the market return, the DID results for the estimated CARs are not significant, whereas using the Wind industry index, the DID results are significant. This is logical for a couple of reasons. On one hand, the use of the Wind industry index accounts for industry-specific trends, which may otherwise cause anomalous changes in stock prices [14], allowing the industry-adjusted CARs to capture the effects of the green bond issuance announcements more accurately. Hence, the results are more significant compared to those obtained using the CSI 300 index. On the other hand, as previously mentioned, the dissemination of insider information prior to the announcement date is unstable. Therefore, it is reasonable that the CARs induced by the insider information before the green bond issuance announcements are not robust.

Moreover, the coefficient of interest for Day [10, 14]*Green following Day [5, 9] is also significant, which is not evident in the earlier event study, suggests that DID indeed more precisely captures the differential impacts of the announcements of green bond and conventional bond issuances.

Table8: DID result for the green bonds announcement

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-10, -6] *Green	0.9294 (0.9700)	0.9556 (0.9742)	0.9028 (0.9825)	1.2044 (0.7643)	1.2725 (0.7757)	1.2048 (0.7747)
Day [-5, -1] *Green	1.4426 (0.9700)	1.4260 (0.9742)	1.6162 (0.9825)	1.7987** (0.7643)	1.8808** (0.7757)	1.7927** (0.7747)
Day [0, 4] *Green	0.6394 (0.9700)	0.6692 (0.9742)	0.7628 (0.9825)	0.6616 (0.7643)	0.9090 (0.7757)	0.5987 (0.7747)
Day [5, 9] *Green	1.9796** (0.9700)	1.9093* (0.9742)	1.8086* (0.9825)	2.2152*** (0.7643)	2.4221*** (0.7757)	2.0206*** (0.7747)
Day [10, 14] *Green	2.2216** (0.9700)	2.3162** (0.9742)	2.1214** (0.9825)	2.2074*** (0.7643)	2.5609*** (0.7757)	2.0024*** (0.7747)
Day [14, 19] *Green	0.0563 (0.9700)	-0.0778 (0.9742)	0.1363 (0.9825)	0.6021 (0.7643)	0.7913 (0.7757)	0.5578 (0.7747)
N	152	156	146	152	156	146
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for each CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

5.3 Comparative difference in difference study result

In a manner akin to previously conducted event studies, Table 9 presents the findings from the DID analysis regarding the impact of ESG bond issuance announcements on CAR. Table 10 further elucidates the relationship between 1% two-tailed winsorized CAR and green bond issuance announcements via a DID analysis. The outcomes of the DID analyses are in concordance with those observed in the aforementioned event studies. Moreover, the discrepancy in significance and robustness between the control DID results and the original DID outcomes is markedly less than that observed between the control event studies and the initial event study findings. This suggests that the DID analysis more precisely captures the effect of green or ESG bond issuance announcements on the firm's stock price as measured by CAR.

Table9: DID result for the ESG bonds announcement

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-10, -6] *ESG	0.4267 (0.9332)	0.4629 (0.9336)	0.3821 (0.9505)	0.6845 (0.7284)	0.6118 (0.7378)	0.6434 (0.7395)
Day [-5, -1] *ESG	1.3154 (0.9332)	1.3287 (0.9336)	1.3429 (0.9505)	1.3758* (0.7284)	1.4240* (0.7378)	1.2999* (0.7395)
Day [0, 4] *ESG	0.5918 (0.9332)	0.6068 (0.9336)	0.6879 (0.9505)	0.3949 (0.7284)	0.5676 (0.7378)	0.3587 (0.7395)
Day [5, 9] *ESG	1.8647** (0.9332)	1.8827** (0.9336)	1.5251 (0.9505)	1.6789** (0.7284)	1.8810** (0.7378)	1.4043* (0.7395)
Day [10, 14] *ESG	2.3278** (0.9332)	2.3948** (0.9336)	2.2276** (0.9505)	1.8400** (0.7284)	2.1886*** (0.7378)	1.7008** (0.7395)
Day [14, 19] *ESG	1.1069 (0.9332)	1.0264 (0.9336)	1.1295 (0.9505)	0.7675 (0.7284)	0.9159 (0.7378)	0.7233 (0.7395)
N	179	184	173	179	184	173
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for each CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

Table10: DID result for the green bonds announcement (winsorized)

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-10, -6] *Green	0.8798 (0.8957)	0.9276 (0.8989)	0.8562 (0.9093)	1.1031 (0.6930)	1.1003 (0.7005)	1.1050 (0.7010)

	$R_{m,t}$ = CSI 300 Index			$R_{m,t}$ = Wind Industry Index		
	CAR1	CAR2	CAR3	CAR4	CAR5	CAR6
Day [-5, -1] *Green	1.0078 (0.8957)	1.0376 (0.8989)	1.1955 (0.9093)	1.3519* (0.6930)	1.4677** (0.7005)	1.3341* (0.7010)
Day [0, 4] *Green	0.4005 (0.8957)	0.4206 (0.8989)	0.5452 (0.9093)	0.4624 (0.6930)	0.7372 (0.7005)	0.3919 (0.7010)
Day [5, 9] *Green	1.6724* (0.8957)	1.6425* (0.8989)	1.5047* (0.9093)	1.8213*** (0.6930)	2.0460*** (0.7005)	1.6565** (0.7010)
Day [10, 14] *Green	2.0502** (0.8957)	2.0831** (0.8989)	1.9833** (0.9093)	1.9470*** (0.6930)	2.1847*** (0.7005)	1.7774** (0.7010)
Day [14, 19] *Green	0.0693 (0.8957)	-0.0549 (0.8989)	0.1520 (0.9093)	0.5517 (0.6930)	0.7919 (0.7005)	0.5316 (0.7010)
N	152	156	146	152	156	146
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for each CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

5.4 Homogeneity and heterogeneity

Subsequent to the initial findings, I have utilized the DID methodology to conduct an analysis of both homogeneity and heterogeneity, aiming to further elucidate the characteristics and mechanisms driving the impact of green bond issuance announcements on the issuing firms' CAR. Considering the comparison involving diverse industries, to enhance the precision of the results, this analysis is confined to the examination of industry-adjusted CAR (CAR4, CAR5, CAR6), for the DID result comparison. It should also be acknowledged that the relatively small sample size may introduce some bias into these findings of following homogeneity and heterogeneity analysis.

First, in terms of industry, given that utilities constitute the most prolific issuers of green bonds, I segmented the issuing firms into two categories: utilities and non-utilities. I then applied the aforementioned DID analysis to the green bond issuance events for these two cohorts separately. The results presented in Table 11 reveal that for utility companies, the DID analysis of CAR shows stronger significance compared to the overall DID analysis, with the majority of positive CARs being significant at the 1% level. Moreover, the duration of significant positive CAR following green bond announcements extends further, from the initial day [5, 14] to day [5, 19]. This finding aligns with intuitive reasoning, as utilities typically comprise companies engaged in electricity, energy, and water resources, which have a strong correlation with "green" initiatives and are industries where the environment is financially material to the companies' operations according to the materiality classifications of SASB (Sustainability Accounting Standards Board). On one hand, these entities usually undergo more stringent environmental regulations and thus have a higher likelihood of allocating the proceeds from green bond issuances to genuine green projects. On the other hand, many of these green projects not only have environmental significance but also present opportunities for utilities to reduce costs and enhance operational efficiency. Consequently, green bond issuances by utility companies are met with greater recognition compared to those by general corporates, reflecting an acknowledgment of the close alignment between their core operations and the concept of sustainability. This also consists with previous

studies. The study of Flammer[14] shows that abnormal returns are only significant in industries where the natural environment is financially material to the firms' operations, which is explained by Signaling Theory that shareholders are sensitive to companies' eco-friendly behavior and would expect a stronger stock market response in industries where the natural environment is material to the companies' financial performance (CFP). Similarly, Khan, Serafeim, and Yoon[28] demonstrate financially material ESG issues have a greater impact on CFP according to the materiality classifications of SASB.

Furthermore, the presence of significantly negative CAR during the day[0, 4] can potentially be attributed to reasons analogous to those posited in the previous event study analysis. This finding is congruent with the research outcomes of Baulkaran[15] and Lebelle et al.[16], indicating that on the day of the green bond issuance announcement and the ensuing 3-5 days, the company's stock price exhibits a significantly negative abnormal return. Despite that the outcome might be attributed to the limited sample size, it is suggested that insider investors, who had access to information regarding the green bond issuance prior to the announcement, may have engaged in selling the company's stock following the public release of the announcement, consisting with the mentioned Overreaction Theory of Bondt and Thaler[24]. The prevailing sentiment among investors, who are more receptive to positive news, creates an irrational exuberance, leading to disproportionate reactions such that the stock price appreciation exceeds the intrinsic value. Consequently, this results in excessive upward pressure on prices, which then gives rise to greater downward correction forces subsequently. In the case for green bonds of utilities, as the positive CAR preceding the disclosure of green bond issuing is more pronounced, resulting in a larger uptick in stock price, the subsequent selling led to a greater extent of mean reversion. This overreaction could explain the negative CAR observed during the day [0, 4], which is more statistically significant to the overall DID analysis findings.

As mentioned earlier, another possibility suggests that some investors, following the announcement of the issuance, might have anticipated additional costs for the company to comply with the various requirements associated with green bonds. Lebelle, Lajili Jarjir, and Sassi[16] suggests that the announcement of a new green bond issuance, which may offer the information about upcoming evolution of operational and capital expenditures to make them more sustainable, might be interpreted by investors as providing uncertainty regarding whether this potential new business model would remain as profitable as it has been so far, broadly leading to negative market reactions.

Additionally, the DID analysis of non-utility firms also indicated that investors are less receptive to green bond issuances from these companies, evidenced by the notably weaker significance of the results compared to the overall DID analysis. On the one hand, post-announcement CAR for non-utilities was only significantly positive during the day [10, 14], which is a shorter and less significant period compared to the overall DID analysis. This suggests that the general investor sentiment towards green bond issuances by non-utility companies is not as favorable, possibly due to skepticism such as concerns over potential "greenwashing". Since environment is not financially material to most of these non-utility companies, green bonds are not necessary and essential, and may become a tool of "greenwashing"—the practice of making unsubstantiated or misleading claims about the company's environmental commitment, which is a widespread phenomenon[29][30][31].

On the other hand, the positive CAR generated by pre-announcement insider information for non-utility firms commenced five days earlier than what was observed in the overall DID analysis. This could be attributed to underwriting intermediaries perceiving a higher degree of difficulty in placing these bonds, thereby initiating communications with potential buyers ahead of schedule, leading to earlier information leakage and insider trading, as reflected in the advanced positive CAR. This temporal shift underlines the complexities and challenges faced by non-utility firms in aligning their green bond issuances with investor expectations and highlights the role of intermediaries in shaping market dynamics prior to public announcements. The analytical comparison between utilities and non-utilities in the context of green bond issuances highlights the industry as a critical determinant in the impact of such issuances on stock prices. It is evident from the findings that the market perceives green bond issuances by utility companies more positive than those by non-utility companies. Furthermore, the analysis indicates that the overall significant positive CARs observed before are predominantly driven by the contributions from the utility sector. This distinction underscores the importance of industry-specific dynamics in shaping investor responses to green finance initiatives and suggests a differential valuation mechanism in the market depending on the issuer's industry alignment with environmental objectives.

Table11: DID result for the green bonds issued by utilities and non-utilities

	Utility companies			Non-utility companies		
	CAR4	CAR5	CAR6	CAR4	CAR5	CAR6
Day [-10, -6] *Green	0.9751 (2.1412)	1.3572 (2.1098)	1.9379 (2.1264)	1.8419** (0.8316)	1.9077** (0.8425)	1.4632* (0.8485)
Day [-5, -1] *Green	6.0428*** (2.1412)	6.6371*** (2.1098)	5.8614*** (2.1264)	1.5583* (0.8316)	1.6976** (0.8425)	1.4061* (0.8485)
Day [0, 4] *Green	-5.1636** (2.1412)	-4.5755** (2.1098)	-4.7906** (2.1264)	0.6448 (0.8316)	0.8336 (0.8425)	0.5173 (0.8485)
Day [5, 9] *Green	9.2212*** (2.1412)	9.6132*** (2.1098)	10.1438*** (2.1264)	0.5980 (0.8316)	0.8974 (0.8425)	0.0018 (0.8485)
Day [10, 14] *Green	5.2881** (2.1412)	6.6869*** (2.1098)	4.6822** (2.1264)	1.9328** (0.8316)	2.1289** (0.8425)	1.4018* (0.8485)
Day [14, 19] *Green	8.6736*** (2.1412)	9.0994*** (2.1098)	8.8947*** (2.1264)	0.1642 (0.8316)	0.3115 (0.8425)	0.0818 (0.8485)
N	50	54	50	102	102	96
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Considering the comparison involving diverse industries, to enhance the precision of the results, this analysis is confined to the examination of industry-adjusted CAR (CAR4, CAR5, CAR6), for the DID result comparison. N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for each CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

Table 12 displays the results of the DID analysis, categorizing green bonds based on whether they are issued by central state-owned enterprises. Approximately half of these green bonds are issued by central state-owned enterprises, which may be due to their social responsibility mandates and the heightened requirements for green development, or it could be a reflection of the regulatory authorities' greater support for green bond issuance by these entities. Indeed, on December 8, 2023, the China Securities Regulatory Commission and the State-owned Assets Supervision and Administration Commission jointly issued a notice in support of green bond issuance by central state-owned enterprises. Although the date of this notice postdates the data cut-off for this study, it does manifest the attitude and orientation of Chinese regulatory bodies. Green bonds issued by central state-owned enterprises exhibit significant positive CARs around the announcement date. However, for green bonds not issued by central state-owned enterprises, significant positive CARs are observed only within a short period after the announcement. This heterogeneous analysis in DID suggests a higher degree of investor confidence in green bonds issued by central state-owned enterprises. This could be attributed to the stricter governance and more rigorous regulatory oversight of these enterprises, which likely assures investors of more standardized management and utilization of funds raised for green projects. Additionally, the close DID results between central state-owned enterprises and utilities could be related to their high degree of overlap. For instance, out of the 50 green bonds issued by utility companies and the 71 issued by centrally state-owned enterprises in the CAR4 samples, there is an overlap of 37 bonds, meaning these are issued by entities that are both utilities and central state-owned enterprises.

Table12: DID result for the green bonds issued by central state-owned enterprises and others

	Central state-owned enterprises			Others		
	CAR4	CAR5	CAR6	CAR4	CAR5	CAR6
Day [-10, -6] *Green	2.1118 (1.7019)	1.8153 (1.6734)	2.4213 (1.6895)	1.0753 (0.8800)	1.6196* (0.9217)	0.9102 (0.9062)
Day [-5, -1] *Green	5.3416*** (1.7019)	5.3358*** (1.6734)	4.9285*** (1.6895)	1.0695 (0.8800)	1.6002* (0.9217)	1.1106 (0.9062)
Day [0, 4] *Green	-3.176* (1.7019)	-3.0246* (1.6734)	-3.2148* (1.6895)	0.3271 (0.8800)	0.8029 (0.9217)	0.4225 (0.9062)
Day [5, 9] *Green	6.6732*** (1.7019)	6.6189*** (1.6734)	6.8392*** (1.6895)	0.6841 (0.8800)	1.3726 (0.9217)	0.3795 (0.9062)
Day [10, 14] *Green	3.8460** (1.7019)	4.0762** (1.6734)	2.9706* (1.6895)	2.3677*** (0.8800)	3.2953*** (0.9217)	2.1156** (0.9062)
Day [14, 19] *Green	6.1997*** (1.7019)	6.5322*** (1.6734)	6.3191*** (1.6895)	0.2309 (0.8800)	0.3874 (0.9217)	0.1635 (0.9062)
N	71	74	71	81	82	75
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Considering the comparison involving diverse industries, to enhance the precision of the results, this analysis is confined to the examination of industry-adjusted CAR (CAR4, CAR5, CAR6), for the DID result comparison. N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for each CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

Table 13 presents the results of the DID analysis of green bonds categorized by coupon rates. Specifically, the median coupon rate among the sampled green bonds was identified, and bonds are divided into two groups accordingly: those with coupon rates equal to or higher than the median, and those with rates below the median. Each group underwent separate DID analysis. The results for bonds with coupon rates equal to or higher than the median are similar to those previously observed for central state-owned enterprises and utilities. However, for the group with rates below the median, there are significant positive CARs observed during the day [-5, 9] period. This suggests that investors perceive green bonds with lower coupon rates as more favorable for the issuing company, as lower rates imply reduced financing costs, which aligns with fundamental theories in corporate finance. This consists with the study of Baulkaran [15], which shows that higher coupon rates on green bonds correlate with negative investor reactions.

Table13: DID result for the green bonds categorized by coupon rate

	Coupon rate>=Median			Coupon rate<Median		
	CAR4	CAR5	CAR6	CAR4	CAR5	CAR6
Day [-10, -6] *Green	1.7363 (1.5430)	1.9399 (1.5513)	1.6870 (1.5390)	1.0314 (0.9470)	1.0803 (0.9471)	1.1593 (0.9465)
Day [-5, -1] *Green	3.5564** (1.5430)	3.9408** (1.5513)	3.0155* (1.5390)	1.8770** (0.9470)	2.0141** (0.9471)	2.1546** (0.9465)

	Coupon rate>=Median			Coupon rate<Median		
	CAR4	CAR5	CAR6	CAR4	CAR5	CAR6
Day [0, 4] *Green	-3.9125** (1.5430)	-3.4515** (1.5513)	-3.8164** (1.5390)	2.0456** (0.9470)	2.1791** (0.9471)	2.4440** (0.9465)
Day [5, 9] *Green	3.7864** (1.5430)	4.2584*** (1.5513)	3.6516** (1.5390)	2.7560*** (0.9470)	2.8867*** (0.9471)	2.6293*** (0.9465)
Day [10, 14] *Green	4.7123*** (1.5430)	5.6816*** (1.5513)	2.9601* (1.5390)	0.2345 (0.9470)	0.3819 (0.9471)	1.1457 (0.9465)
Day [14, 19] *Green	4.4622*** (1.5430)	4.7762*** (1.5513)	4.1285*** (1.5390)	0.4671 (0.9470)	0.6029 (0.9471)	0.4672 (0.9465)
N	73	75	70	72	74	69
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Considering the comparison involving diverse industries, to enhance the precision of the results, this analysis is confined to the examination of industry-adjusted CAR (CAR4, CAR5, CAR6), for the DID result comparison. N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for each CAR and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

6. Long-term difference in difference study for green bonds

6.1 Difference in difference study methodologies for long-term

In the subsequent phase of my research, I investigated the long-term impacts of green bond issuance. Initially, I employ the DID analysis to examine whether the issuance of green bonds leads to sustained positive abnormal returns or enhances the overall value of the issuing firms in the long run. Formally, I estimate:

$$CAR_{i,t} = \beta \times Green_i \times Month_t + Controls + \alpha_i + \alpha_t + \epsilon_{i,t}$$

$$Tobin's\ Q_{i,t} = \beta \times Green_i \times Month_t + Controls + \alpha_i + \alpha_t + \epsilon_{i,t}$$

Where $CAR_{i,t}$ is the monthly cumulative abnormal return of the issuer company of bond i in $Month_t$. $Green_i$ is the dummy variable (treatment dummy) that equals one if the bond i is green bond and equals zero if the bond i is not green bond. $Month_t$ is the categorical variable for each month. $\alpha_i, \alpha_t, \epsilon_{i,t}$ are the individual (bond) fixed effects, time fixed effects and error term. $Tobin's\ Q_{i,t}$ is the Tobin's Q for bond i in $Month_t$, which equals firm's market value divided by firm's book value. I employ the DID analysis with and without control variables at the bond level or the firm level separately and some control variables are absorbed by the individual fixed effects.

The long-term DID analysis results, as presented in Table 14, indicate that the issuance of green bonds does not lead to significant changes in CAR, industry-adjusted CAR, or Tobin's Q. This suggests that, in the long run, green bond issuances do not enhance the issuing firm's value nor secure sustained investor recognition. If the temporal scope is extended to one year or even longer, the results derived from the DID analysis exhibit similar patterns. Contrasting these findings with the short-term DID analysis, which showed positive CAR around green bond announcements, it appears that the benefits conferred by green bond issuances are transient in nature. The discrepancy between the short-term positive impact and the lack of long-term value enhancement prompts further investigation into the underlying reasons for this phenomenon. My subsequent research will delve into potential explanations for why green bonds appear to offer only short-term advantages to issuing firms, without translating into long-term value creation or investor endorsement.

Table14: long-term DID result for the green bonds

	CAR		CAR industry adjusted		Tobin's Q	
Month -2	-2.2547 (2.8967)	-2.8211 (2.5275)	-2.3367 (2.3896)	-1.7927 (1.9755)	0.0124 (0.0409)	0.0094 (0.0492)
Month -1	-1.2705 (2.8966)	1.4584 (2.5275)	0.1338 (2.3895)	0.2799 (1.9755)	0.0160 (0.0409)	0.0175 (0.0492)
Month -0	-2.2845 (2.8976)	-0.3269 (2.5275)	-0.4666 (2.3903)	0.6355 (1.9755)	0.0206 (0.0409)	0.0290 (0.0492)
Month 1	-1.1686 (2.9038)	-2.9359 (2.5275)	-1.5725 (2.3954)	-3.4217* (1.9755)	0.0319 (0.0410)	0.0465 (0.0492)
Month 2	-3.8254 (2.8964)	-2.5010 (2.5275)	-1.1120 (2.3893)	-1.5256 (1.9755)	-0.0184 (0.0409)	0.0072 (0.0492)
Month 3	-2.7213 (2.8950)	-1.2442 (2.5275)	-2.9616 (2.3881)	-0.3288 (1.9755)	0.0263 (0.0409)	0.0288 (0.0492)
Month 4	-0.7200 (2.8949)	0.7694 (2.5275)	-0.3934 (2.3881)	-0.3364 (1.9755)	-0.0142 (0.0409)	-0.0005 (0.0492)
Month 5	-4.5913 (2.8945)	-0.5327 (2.5275)	-2.9371 (2.3878)	-0.7102 (1.9755)	-0.0369 (0.0409)	-0.0354 (0.0492)
Month 6	0.9011 (2.8962)	-0.6693 (2.5275)	-0.8880 (2.3891)	-0.6462 (1.9755)	0.0127 (0.0415)	-0.0109 (0.0498)
N	107	107	107	107	107	107
Controls	Yes	No	Yes	No	Yes	No
Individual fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for CAR and Tobin's Q, and the number in the bracket is the corresponding standard error. All cumulative abnormal returns (CAR) are expressed in units of percentage (%). *, **, *** denote statistical significance at 10%, 5%, 1% respectively

6.2 The underlying drivers of long-term impact

The theoretical foundation underpinning the potential long-term value enhancement of firms through green bond issuance rests on the premise that the regulatory requirements attached to these bonds can drive improvements in a firm's ESG governance levels, thereby enhancing operational efficiency. Given the challenges in quantifying ESG governance standards, I employ the Wind ESG score as a proxy to examine this issue. The comprehensive Wind ESG score is constituted of two components: a management practice score (out of a total of 7 points) and a score for controversial incidents (out of a total of 3 points). This scoring system holistically reflects a company's level of ESG management practices along with its exposure to significant emergent risks. The Wind ESG index framework is comprehensive, encompassing 3 dimensions, 25 issues, and over 300 indicators. Utilizing advanced technologies such as artificial intelligence and big data, Wind tracks and gathers ESG information from over 22,000 data sources, providing investors with timely and objective bases for investment decisions. This approach enables a nuanced and detailed analysis of a company's ESG performance, crucial for understanding the impact of green bond issuances on firm value in the long term.

Employing a methodology analogous to my previous research, I conducted the DID analysis to ascertain the impact of green bond issuance on firms' ESG scores. The results shown in Table 15 indicate that issuing green bonds does not significantly enhance a company's ESG score, implying no substantial improvement in ESG governance. Several factors might contribute

to this outcome. The first one is the "greenwashing" concern. There is a possibility that some of these green bonds could be involved in "greenwashing", failing to meet the requisite environmental objectives and oversight standards of green bond issuance, which is a widespread phenomenon as mentioned[29][30][31]. Moreover, given that the regulatory framework for green bonds in China is still developing and is misaligned with international green bond certifications and standards, the prevalence of "greenwashing" could be more pronounced. This misalignment potentially undermines the ability of green bonds to positively influence a company's actual ESG performance. Previous research has delved into the implications of "greenwashing" by Chinese companies, a practice where firms misrepresent their environmental impact or sustainable initiatives[17].

The second one is rigid management in state-owned enterprises. Over 80% of green bonds in China are issued by central or local state-owned enterprises. The management practices in these organizations tend to be more rigid, making it challenging to enhance governance levels through ESG practices. The third one is imperfect ESG standards and regulatory framework in China. The current ESG standards and regulatory framework in China may not be sufficiently robust. This limitation potentially undermines the effective assessment and supervision of ESG practices, including those related to the issuance of green bonds. This analysis suggests that merely issuing green bonds does not automatically translate into enhanced ESG performance, underscoring the need for more stringent standards and practices in the green bond market, particularly in the context of Chinese issuers.

Table15: ESG score DID result for the green bonds

	Wind ESG Score	**Wind ESG Score**
Month -2	-0.0920 (0.1058)	-0.0286 (0.0687)
Month -1	-0.1008 (0.1058)	-0.0368 (0.0687)
Month -0	-0.1549 (0.1057)	-0.1006 (0.0687)
Month 1	-0.1162 (0.1060)	-0.0595 (0.0687)
Month 2	-0.0589 (0.1058)	-0.0308 (0.0687)
Month 3	-0.0378 (0.1057)	-0.0102 (0.0687)
Month 4	-0.0574 (0.1057)	-0.0436 (0.0687)
Month 5	0.0323 (0.1057)	0.0049 (0.0687)
Month 6	0.0181 (0.1058)	0.0015 (0.0687)
N	107	107
Controls	Yes	No
Individual fixed effects	Yes	Yes
Time fixed effects	Yes	Yes

N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for Wind ESG score, and the number in the bracket is the corresponding standard error. *, **, *** denote statistical significance at 10%, 5%, 1% respectively

6.3 The underlying drivers of short-term impact as comparison

The preceding section highlighted that the issuance of green bonds did not lead to long-term improvements in corporate

ESG governance levels, hence failing to bolster long-term firm value. It begs the question: what accounted for the positive CAR observed around the announcement of green bond issuances? To address this, I examined the effect of green bond announcements on the trading volume of the issuer's stock. For this purpose, several indicators of trading volume are employed, including the average daily trading volume, the percentage of the company's daily trading volume relative to the total daily trading volume of A-shares market, and similarly, the percentage relative to the industry's average trading volume. All the trading volume data is downloaded from Wind database.

As inferred from the results showcased in Table 16, there is a notable increase in the trading volume of the issuer's stock around the announcement date, particularly after the announcement of the green bond issuance. The less significant increase in trading volume prior to the announcement date is also reasonable, as the circulation of insider information is naturally limited and uncertain compared to public disclosures. It can be surmised that the green bond issuance announcements have augmented stock trading volume, possibly because these announcements serve as a positive news event that captures investors' attention. This can be explained by the Limited Attention Theory, which is introduced by Egeth and Kahneman[2]. Although green bonds may not enhance a firm's ESG performance in the long term due to challenges such as "greenwashing" that cast doubt on their legitimacy, the announcement of their issuance is indeed a generally positive event. It garners increased attention toward the company's stock, augments trading volumes, and thus contributes to a rise in the firm's stock price in the short term. This finding is consistent with existing research, which suggests that positive news—especially news related to ESG—can generate positive returns for stocks[10][11][32][33][34].

Table16: ESG score DID result for the green bonds

	Coupon rate>=Median		
	CAR4	**CAR5**	**CAR6**
Day [-10, -6] *Green	0.7267 (0.4974)	0.6317 (0.4929)	8.8422 (7.9357)
Day [-5, -1] *Green	0.8072 (0.4974)	0.8114* (0.4929)	2.7652 (7.9357)
Day [0, 4] *Green	1.3715*** (0.4974)	1.3387*** (0.4929)	14.5619* (7.9357)
Day [5, 9] *Green	1.3113*** (0.4974)	1.4964*** (0.4929)	10.8519 (7.9357)
Day [10, 14] *Green	1.0333** (0.4974)	1.2279** (0.4929)	24.5068*** (7.9357)
Day [14, 19] *Green	0.4600 (0.4974)	0.8497* (0.4929)	16.2474** (7.9357)
N	179	179	179
Individual fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes

N is the number of observations, the upper number in each cell is the estimated coefficient of interest β in each period for Wind ESG score, and the number in the bracket is the corresponding standard error. *, **, *** denote statistical significance at 10%, 5%, 1% respectively

7.Conclusion

This study employs event study methodology and DID analysis to investigate the short-term and long-term effects of green bond issuance on corporate capital market performance. The results of the event study regarding the short-term impact of

green bond issuance on stock prices indicate the occurrence of positive CAR in the window period around 10 days before and after the event. Upon further segmentation, positive CAR is significant in the range from 1 day before the announcement to 5 days before and from 5 days after to 9 days after, while CAR is slightly negative but not significant in the range from the announcement day to 4 days after. A comparison with event studies on conventional bond issuance supports the inference that these significant positive CARs are indeed attributed to the "green" attributes of green bonds rather than the bond issuance itself.

Utilizing green bonds as the experimental group and conventional bonds as the control group, the DID analysis of the short-term impact on stock prices aligns with the event study analysis that positive significant CAR indeed exists before and after the issuing announcement of green bonds. The DID result also demonstrates that the positive significant CAR brought about by green bond issuance expands from the 5-9 days range to the 5-14 days range post announcement. However, upon extending the observation period and applying the DID analysis method to study the long-term impact of green bond issuance on stock prices and firm value, it is evident that green bond issuance does not lead to a significant increase in stock price or company value in the six months or longer following the issuance, contradicting the short-term research results. This lack of enhancement is attributed to the absence of an improvement in the company's ESG governance level in the long term, rendering it unrecognized by investors—a potential consequence of the lack of clarity in "greenwashing" and green bond standards and regulations. In contrast, green bond issuance in the short term generates abnormal returns and is associated with increased stock trading volumes, consistent with the limited attention theory, where the issuance of green bonds as positive news attracts more attention to the company.

Similar event study and DID analysis embarked on ESG bonds on a larger scale and green bonds subjected to trimmed abnormal returns yield analogous results, although the significance of CAR before the announcement date is less robust. Furthermore, heterogeneous analysis of the impact of green bond issuance reveals a more significant effect on public utility companies and central state-owned enterprises. Additionally, compared to higher coupon rate bonds, lower coupon rate bonds notably alleviate the pressure of negative abnormal returns on and after the announcement day in the 3-4 subsequent days.

The conclusions drawn from this study on Chinese green bonds harmonize with the existing research on green bonds in other countries and feature detailed short-term influence and underlying mechanisms. Moreover, this study conducts a comparative analysis of the short-term and long-term effects of green bonds and delves into the underlying mechanisms. These research findings are consistent with the characteristics of the Chinese capital market.

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