

An Empirical Study on the Stock Market Reaction to Corporate Green Bond Issuance in China

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Abstract. China has become one of the major green bond issue countries and is the only developing country. Research on green corporate bonds is currently a novel direction, and very few studies focus on the Chinese market. Researching Chinese corporate green bonds is essential for the Chinese and merging market. This article discusses corporate green bonds in the Chinese market from the perspective of stock market reaction, institutional investor positions and cost of capital. Firstly, the author analyzes the Chinese stock market reaction to the issuance of corporate green bonds by using an event-study methodology. The paper finds that Chinese stock markets respond positively to green bond issuance announcements, but this response reflects speculative trading behavior. Secondly, the author compares the stock positions of institutional investors after the issuance of corporate green bonds and finds that green corporate bond issuance in the Chinese market can attract long-term investors (institutional investors). Finally, this author adopts the exact matching method to verify the cost of capital argument and finds no significant benefit to the cost of capital, which is consistent with prior works.

Keywords: Sustainable finance; Green bonds; Impact investing; Stock market reaction; Individual investors.

1. Introduction

With the growing attention to environmental protection, the green bond has become increasingly popular as a nascent financial instrument for environmentally friendly projects. Generally, scholars and financial institutions accept that the green bonds market was in its infancy as early as 2007, but it experienced explosive growth until 2013. According to the Climate Bonds Initiative (CBI), governments and multilateral development institutions (including the World Bank and European Investment Bank) are the top issuers of green bonds. Corporate green bond issuance has also gradually increased over the past few years. Intuitively, green bonds are issued by governments or multilateral development banks to fund environmental projects rather than for financial gain. However, what is the purpose of issuing corporate green bonds? There are many academic discussions on the motivation and purpose of corporate green bond issuance.

The first argument is the signaling argument. Companies with desirable characteristics want to lessen information asymmetry by giving investors a reliable signal. Mitigating information asymmetry can reduce the transaction cost when firms need to transform some signals to their investors [1-3]. Similarly, Investors are also unable to accurately distinguish companies that are environmentally friendly or not due to information asymmetry [4]. Such signals are often credible, and Flammer (2021) points out: (1) By issuing green bonds, companies must commit to investing a large number of funds in environmentally friendly projects and clearly indicate investment in green projects in the prospectus. (2) green bonds often need to be certified by third parties (such as CBI), which is costly. Moreover, the cost of facing "green default" is expensive. In addition, Flammer (2021) finds that companies have improved their environmental ratings and reduced CO2 emissions by issuing green bonds. Therefore, such companies are more attractive to long-term and green investors to invest in and hold their stocks for a long time [3].

The cost of capital argument is the second argument. The majority of studies cover the question of whether green bonds carry a yield premium over traditional bonds. According to Zhang et al. (2021), issuing green bonds lowers the issuer's debt and total capital cost [5]. However, Larcker and Watts

(2020) point out that mismatching methodology leads to biased estimates. The green premium disappears when strict matching methods are used [6]. Flammer (2021) adopts a very tight matching methodology to verify that there is no appreciable difference in yield between brown and green corporate bonds issued by the same issuers [3].

According to CBI's report, the issuance of green bonds is dominated by developed countries and areas such as Europe and the United States. In 2021, China's green bond issuance scale ranked second in the world, and it is the only developing and Asian country among major green bond issuing countries. This phenomenon is inseparable from the fact that the Chinese government prioritizes its green policy, such as, The Chinese government has promise to achieve carbon neutrality by 2060 and a peak in carbon dioxide emissions by 2030. A significant recent achievement of the Chinese government in environmental protection has been establishing a green financial system to support environmentally friendly projects [7]. The author finds that research on green corporate bonds is currently in a novel direction, and research on Chinese corporate green bonds is essential for Chinese and emerging markets.

The Chinese capital market is already the second-largest in the world, and researchers show strong interest in the Chinese market with its rapid growth. Compared with developed capital markets, The Chinese stock market has a sizable number of private investors. Individual investors made up more than 99% of all investors in the Chinese market [8]. In addition, individual Chinese investors generally show high speculative trading behavior [8, 9]. Further, Individual investors are more susceptible to overreacting to good market news [10]. Therefore, when the signal of companies' commitment to environmentally responsible development is credible, the market reaction in the Chinese stock market may be positive and speculative. If the market reaction is speculative, is it unattractive to long-term and green investors? This paper explores the market reaction from two aspects: (1) stock market reaction; (2) long-term investors' stockholding; Then, this paper also examines the cost of capital argument in the Chinese bond issuance market. To answer the above discussion, the hypotheses are stated as follows:

H1: When green bond issuances were announced, the stock market reacted positively and speculatively.

H2: Long-term and environmentally friendly investors are eager to boost their stock holdings after the announcement of issuing green bonds.

H3: Corporate green bonds do not have a material yield difference from other corporate bonds.

The author integrates two corporate green bond data sets from CSMAR and Wind in order to conduct an empirical analysis of corporate green bonds. Using Natural Language Processing (NLP), the corporate bonds clearly mentioned as green bonds in the bond information are recognized as corporate green bonds. In the end, the sample only includes the issuers, Chinese A stock market listed firms, and the period from 2016 to 2021.

Using an event-study approach, the author examines the Chinese stock market reaction to the issuance of corporate green bonds. The paper finds that Chinese capital markets respond positively to green bond issuance announcements, but this response is short-termly speculative and reverses later. The cumulative abnormal return (CAR) of time intervals [-5,10] and [21, 60] is 1.49% and -2.00%, which are significantly different from zero at the 5% level and 1% level, respectively. The main reason is that individual investors dominate the Chinese stock market, and their overreaction and speculative behavior led to the reversal situation. Furthermore, this paper contrasts institutional investors' stock holdings following the issuing of corporate green bonds. Institutional investors' shareholding of stock *i* will increase by about 1.74% after its green bond issuance announcement, which is significantly positive at 1% confidence level. The result shows that green bond issuance will indeed attract the favor of long-term and institutional investors. Finally, this paper adopts the exact matching method and finds no significant green bond premium consistent with prior works.

This study makes several contributions. Firstly, this study adds to the body of empirical research on the green bond market [3, 4, 6]. This study reveals that issuing corporate green bonds has a positive, short-term impact on the Chinese stock market, partially supporting Flammer (2021). The situation

can be explained by the dominant role of individual investors in Chinese stock markets. Secondly, this study suggests that corporate green bonds can draw long-term investors in the Chinese stock market. This finding adds to the literature on the green bonds signaling argument literature and investors' preferences for responsible investment. Finally, this study contributes to the body of knowledge about the unique function of individual investors in the Chinese stock market [8-10]. A credible signal might be sent by the issue of a corporate green bond, which will make individual investors cause sensitive to positive reactions and prone to overreact.

The rest of this paper is structured as follows. The methodology and data are described in Section 2. The results are shown in Section 3. A brief conclusion is provided in Section 4.

2. Data Statistics

Firstly, there is currently no mature and professional Chinese green corporate bonds database. According to previous studies, Flammer (2021) used Bloomberg's fixed income database, which includes global fixed income information [3]. Moreover, Wang et al. (2020) adopted the Chinese green bonds data from the CSMAR database, a widely covered database in China [7].

The data in this article comes from two data sets, CSMAR and Wind, which scholars and financial institutions in China widely use. Bond's information comes from the CSMAR Bond Basic Information database, which contains information on all bonds issued in the Chinese market since 1990. Bond types data include government, municipal, corporate, etc. The bond's basic information data includes such as maturity, amount, issue date, rating, yield, etc. The Wind database contains detailed firm-level information, institutional investor shareholdings position data, stock market data, and bond issuance announcement data.

Corporate green bonds: The bond-type 50 is identified as Green Debt Financing Instrument in the CSMAR Bond Basic Information database. Wang et al. (2020) used a similar green flag to label green bonds [7]. However, the majority of the categories of green corporate bonds are divided into different bond-type in this database, such as Corporate Bonds (02), Enterprise Bonds (03), Asset-backed Securities (10), and Medium-term Note (17). In order to make the Chinese corporate green bond data cover a more comprehensive range, this paper does not directly use CSMAR green flag. Instead, Using Natural Language Processing (NLP), the corporate bonds clearly carrying a green bond label in the bonds information are recognized as corporate green bonds. The dataset excludes issuers who are delisted and ST shares. Gu et al. (2018) mention that a St share is given a risk warning due to its continuous negative profit [11]. Also, to avoid the effects of IPOs, the event-study subsample excludes issuers that have been listed on the Chinese market for less than six months. Finally, the full-sample dataset constructs a sample with 214 green bonds issued by 87 companies from 2016 to 2021, and the event-study subsample contains 174 green bonds issued by 78 companies.

Table 1 lists the history of corporate green bond issuance in the Chinese market. It shows that corporate green bonds were issued steadily before the COVID-19 crisis and recovered gradually in 2021. By 2021, the total issuance of corporate green bonds is CNY 490.73 billion (corresponding to 214 bonds). Compared with conventional bond issuance, the Chinese green corporate bond market is still a nascent market, regardless of amount or number.

Table 1. Issuance of Corporate bonds and Corporate green bonds

Year	Conventional Bond		Corporate Green Bond	
	Numbers	Amount (¥ Billion)	Numbers	Amount (¥ Billion)
2016	906	1516.04	25	123.81
2017	741	1560.48	31	85.64
2018	977	1927.48	31	99.60
2019	1077	2782.52	51	84.09
2020	1327	3554.94	28	32.13
2021	1281	3408.07	48	65.47
Total	6309	14749.54	214	490.73

Table 2 reports the issuance of corporate green bonds by industries. This paper uses the industry classifications of CSRC. Based on the table, the primary corporate green bond issuing industries are Finance (68 bonds, CNY 357.09 billion), Production and supply of electricity, gas and water (62bonds, CNY 80.22 billion), and Manufacturing (50 bonds, CNY 31.08 billion), respectively.

Table 2. Issuance of Corporate green bonds by industry

Industry	Numbers	Amount (¥ Billion)
Extractive	5	4.97
Production and supply of electricity, gas and water	62	80.22
Real estate	1	1.08
Construction	6	3.70
Transportation and warehousing	2	2.00
Finance	68	357.09
Wholesale and retail trade	2	1.20
Water conservancy, environment and public facilities management	18	9.40
Manufacturing	50	31.08
Total	214	490.73

Table 3 provides summary statistics of corporate green bonds, which includes the issuance amount (in CNY billion), the maturity of the corporate green bond (in years), the yield for fixed-rate bonds (in %), and crediting rating summary of different level ratings. The table describes the following: (1) The average issuance amount is CNY 2.29 billion, and the median amount is CNY 1.00 billion, meaning most of the issuance amounts of corporate green bonds are less than the average. (2) The mean of maturity is 3.61 years, and the median maturity is three years, meaning that most corporate green bonds are medium-term bonds. (3) The average yield is 4.32%, and the median yield is 4.05. (4) the credit ratings of most corporate green bonds are AAA, the highest credit rating in the Chinese market. In addition, there is no bond's credit rating below A.

Table 3. Summary statistics of corporate green bonds

	N	Mean	Maximum	Median	Minimum	Standard Deviation
Amount (in billions)	214	2.29	30.00	1.00	0.02	4.56
Maturity (Year)	204	3.61	10.00	3.00	0.03	1.63
Yield	203	4.32	7.76	4.05	2.08	1.10
Credit Rating of corporate green bonds						
Non Grading	AAA	AA+	AA	A+	A	Total
31	137	30	14	1	1	214

3. Methodology

3.1. Signaling Argument

Following Flammer (2021), this paper examines the market response to the announcement of Chinese corporate green bond issuance using the event study approach [3]. In event studies, the announcement date is favored above the release date because it captures the information that was initially made available to the market.

Firstly, this study utilizes five comparable event windows and the announcement date as the event date (day 0), following Krueger (2015) and Flammer (2021). The time intervals [-20, -11] and [-11, -6] reflect that the market may obtain the announcement information in advance and react before the announcement. The time interval [-5, 10] is the baseline event window to observe the market reaction around the event. The time intervals [11, 20] and [21, 60] are to observe whether the market reaction will reverse or lag.

Then, the author does an ordinary least squares regression on the market model using 200 trading days' worth of data $([-220, -20])$ prior to the first event window $([-20, -10])$. The author uses the market model to calculate the abnormal return for each stock i . The coefficient vectors α_i and β_i are estimated by the regression result in Eq. (1).

$$R_{i,t} = \alpha_i + \beta_i \times Rmt_t + \varepsilon_{i,t} \quad (1)$$

Where $R_{i,t}$ is the daily return of stock i at day t , Rmt_t is the daily market return at day t , and $\varepsilon_{i,t}$ is the regression residual. This paper uses the Shanghai Securities Composite Index as the stock market index.

The results allow to estimate the expected return of stock i at day t is given by Eq. (2).

$$\hat{R}_{i,t} = \hat{\alpha}_i + \hat{\beta}_i \times Rmt_t \quad (2)$$

Finally, the abnormal daily return (AR) of stock i at day t is given by Eq. (3). The cumulative abnormal daily return (CARs) is calculated based on the abnormal daily return for each time interval. The results are reported in Section 3.

$$AR_{i,t} = R_{i,t} - \hat{R}_{i,t} \quad (3)$$

3.2. Long-Term Investors

According to Flammer (2021), issuing corporate green bonds will draw both long-term and green investors. [3]. Starks et al. (2018) find that higher Environmental, Social, and Governance projects are attracted by long-term institutional investors. Investors may consider these "green" firms which issued green bonds. In addition, Tang and Zhang (2018) mention that those firms that announce issuing green bonds are more attractive. Therefore, this paper analyzes institutional investors' stockholdings ratio changes in companies around the corporate green bond issuance announcement. This paper uses the quarter of the announcement date as time t and calculates the quarterly change from $t-1$ to $t+3$. The time intervals are to observe the investor stockholdings ratio change after the corporate green bond issuance announcement. The results are reported in Section 3.

3.3. Cost of Capital

The controversy over green bond premiums was discussed above, and this article follows the exact matching method described above to verify the cost of capital argument [3]. The exact matching approach in this paper, matched conventional bonds and green bonds must be issued by the same issuer in the same year and have a similar maturity. This article does not consider credit ratings because the ratings of bonds in China follow the issuer's ratings combined with our database. In addition, almost all bonds issued by the same issuer within a year have the same credit rating. It is possible to analyze whether there is a corporate green bond premium by comparing the difference in yield between green bonds and conventional bonds. The results are reported in Section 3.

4. Empirical Results

4.1. Signaling Argument

Table 4 reports the event study outcome of the market response to corporate green bond issuance disclosure. The sample includes 174 bonds issued by 78 unique firms. The average CAR in the event window $[-5, 10]$ is 1.49%, which is significantly positive at a 5% confidence level, and in the event window $[21, 60]$ is -2.00%, which is significantly negative at a 1% level of confidence. The findings for the remaining event windows are small and weak, which suggests that they have little correlation with the actual event. According to the positive CAR in the event window $[-5, 10]$, the information of a corporate green bond issue appears to impact the stock market positively. However, the negative CAR in the event window $[21, 60]$ suggests that the stock market's response is only temporarily positive. Moreover, the stock market reaction will reverse latterly and become even worse.

The pecking order hypothesis shows that there is no discernible stock market reaction to bond issuance, contrary to earlier studies on the market response to the issuing of securities [12]. The stock market will react positively to the release of corporate green bonds since issuing green bonds also conveys the company's commitment to the environment [3, 13]. The event study in this paper's conclusion reveals that the Chinese market's response to the issue of corporate green bonds is overreactive and speculative. That is partially inconsistent with Flammer (2021). Furthermore, the finding is consistent with previous studies of individual trading literature, especially in the Chinese market [8-10]. The speculative trading behavior of individual Chinese investors led to a reversal or even worse market return after a positive and short-time market reaction.

Table 4. The response of the stock market to the announcement of corporate green bond issuing

Event time	N	CAR	T-Statistics	Standard Error
[-20, -11]	174	-0.0005	-0.1432	0.0037
[-10, -6]	174	0.0027	1.0133	0.0027
[-5,10]	174	0.0149**	2.1745	0.0068
[11, 20]	174	-0.0021	-0.4887	0.0043
[21, 60]	174	-0.0200***	-2.8837	0.0069

4.2. Long-Term Investors

The ownership structure's response to the announcement of corporate green bonds is shown in Table 5. The first period [T-1, T], which corresponds to the time of the announcement of the issue of corporate green bonds, shows a large growth in institutional investors' shareholdings. The average increase is about 1.074% at 1% confidence level. The results for the rest of the period are insignificant at any conventional confidence level. Furthermore, the research confirms that company green bond announcements can draw institutional investors and long-term investors to the Chinese stock market. Moreover, the outcome is also consistent with the signaling theory, which claims that the issuing of corporate green bonds can be a reliable signal of a company's environmental commitment [3, 14]. Compared with the result of section 3.1, the study discovers that long-term investors' share positions do not decline noticeably within a year. Therefore, the result shows that institutional investors pay more attention to long-term investment in environmentally friendly firms.

Table 5. Institutional ownership response to the announcement of corporate green bond issuance

time period	N	Mean	T-Statistics	Standard Error
[T-1, T]	174	1.0737***	2.6242	0.4092
[T, T+1]	174	0.2513	0.8290	0.3031
[T+1, T+2]	174	0.0098	0.0415	0.2351
[T+2, T+3]	174	0.2308	0.7751	0.2978

4.3. Cost of Capital

Table 6 reports the difference in yields between matched conventional and green bonds issued by the same issuers. There are 87 unique companies in the full-sample dataset. However, according to exact matching, only 29 firms have issued green bonds and conventional debt with the same term in the same year. Green bond average yields are 3.646%, while matched conventional bond average yields are 3.651%.

Economically speaking, the average change is negligible (0.0047%) and insignificant at any conventional confidence level. According to the facts, firms cannot reduce their cost of financing by issuing corporate green bonds. The result is consistent with previous studies [3, 6]. According to Flammer (2021), corporate green bonds are still in their infancy. Investors in green bonds may eventually accept lower yields than those on conventional bonds [3]. In addition, there are many policy supports for corporate green bonds in China. For instance, the National Development and Reform Commission of China advised expediting and streamlining the evaluation procedure for corporate green bonds. Also, Firms issuing green bonds are not subject to bond issuance quota

restrictions. Therefore, Chinese corporate green issuers may benefit from the policy support, which those benefits cannot be evaluated by cost of capital.

Table 6. Institutional ownership response to the announcement of corporate green bond issuance

		N	Mean
Green Bonds		29	3.646
Matched Conventional Bonds		29	3.651
N	Mean (Difference)	T-Statistics	Standard Error
29	0.0047	0.0394	0.1181

5. Conclusion

This paper demonstrates that A-stock listed companies typically issue corporate green bonds with good credit ratings, mainly in three industries: Finance, Production and Supply of electricity, gas and water, and Manufacturing. This paper confirms that stock markets react favorably to news of green bond issuance. However, the new findings of this article show that the Chinese market's immediate speculative response to news of green bond issuance would eventually reverse. This phenomenon is because the major participants in the Chinese stock market are individual investors, who will react briefly and sharply to the market's speculative trading behavior. However, after the announcement of the issue of green bonds, institutional investor holdings will still rise dramatically. This result shows that green bond issuance will indeed attract the favor of long-term investors. Finally, this paper adopts the exact matching method and finds that there is no considerable premium for green bonds, and the results are consistent with previous studies. Moreover, this article also points out that China's green corporate bond issuers have policy support from the Chinese government, so issuing green bonds may benefit from other aspects.

The contribution of this paper is various. (1) This study adds to the body of empirical research on the green bond market. (2) This study suggests that long-term investors in the Chinese stock market may be drawn to corporate green bonds. (3) This study contributes to the body of knowledge about the unique function of individual investors in the Chinese stock market.

Corporate green bonds are a nascent financial instrument whose development has just started. The current data are only short-term observations. For future research, more large-scale and accurate data are still needed to support research in the field of corporate green bonds. For example, including the issues discussed in this article, it is still necessary to demonstrate further in the future. Furthermore, the effects of corporate green bonds on the environment and business financial performance are not covered in this article, which are the major research areas on climate finance and corporate finance literature. In addition, differentiating between institutional and individual investors' effects on market behavior is interesting, particularly for the emerging market.

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