Analyzing the Green Premium: A Comparative Study of Green Bond Market in China

by

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**Contents**

[**Acknowledgments**](#_8c2zvph6v3fn)

[**Abstract**](#_oyu6y3hn0awd)

1. [**Introduction**](#_1gc5zvsnuvqb)
2. [**Research Background**](#_dw1hxxf9umrb)

[**2.1 Background of China’s Green Bond Market**](#_r7jrjbtwygc7)

[**2.2 Comparative Analysis of Global Green Bond Markets**](#_7mfju52gfd4l)

[**2.3 Research Hypothesis**](#_rk553oh6pckj)

1. [**Data and Methodology**](#_ukg9mwnlrxuc)

[**3.1 Bond Data**](#_rejxrxo2gf4)

[**3.2 Bond-Matching Method**](#_eprl831x9xlx)

[**3.3 Model & Variables Setup**](#_5p5pj3hksqc2)

1. [**Results**](#_wzjul6s27pe3)

[**4.1 Descriptive statistics of variables**](#_5tfeacra9b7r)

[**4.2 Empirical Regression Results**](#_77mwdxkl10qw)

[**4.3 The Impact of each variables**](#_g5gapyasrokd)

[**4.4 Summary of the Results**](#_2qd0d240e0q5)

1. [**Conclusion & Discussion**](#_y21ymhbimrx)

[**References**](#_9ro1mkp1fpdj)

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### Abstract

With the global shift towards sustainability, green finance has emerged as a critical mechanism to support environmentally friendly projects, with green bonds playing a pivotal role. This research seeks to determine whether the issuance of green bonds in China's policy-driven market results in lower financing costs compared to brown bonds, indicative of a green premium. The study analyzes bond data from 2016 to mid-2023, including both green and corporate bonds. Preliminary findings suggest that green bonds are indeed associated with a negative credit spread, supporting the hypothesis of a green premium. The analysis indicates that non-financial issuers, including small and medium-sized enterprises (SMEs), derive greater advantages from the green premium, benefiting from lower borrowing costs and enhanced sustainability profiles due to the direct application of funds to green projects. In contrast, while state-owned enterprises (SOEs) remain significant players, the influence of SOE status on the green premium is minimal, suggesting that the benefits of green bonds extend across a diverse range of issuer types, beyond the traditional confines of government-backed entities. This study contributes to the understanding of green finance's role in promoting sustainable practices and provides empirical evidence on the financial benefits of issuing green bonds in China.

**Keywords**: Green Bonds, Green Premium, Brown Bonds, China, Bond Market, Sustainable Finance.

### Introduction

Entering the 21st century, with the fast pace of economic development, people’s livelihood has largely increased. Together with the rising economy is the increasing climate issue. The topic of solving climate problems and developing a sustainable and green future has become more and more popular around the world. Under this circumstance, green finance, as a system that balances development and sustainability, has received increasing attention globally. With growing concerns about the risk of economic disruption from sudden climate policy interventions and physical damage from climate change, green finance is a voluntary bottom-up initiative by private investors to address this risk (Glomsrød & Wei 7). As participating in green activities usually require corporations to undertake a higher cost, green finance also acts as an important tool to facilitate the corporations side to improve investment and focus on green projects. Among the important tools of green finance, green bonds (GB) stand out, opening up a new financing channel for enterprises to raise funds through the bond market to support green industry projects.

Since its debut in 2007, the green bond market has continued to grow, attracting the attention of policymakers and investors around the world. Unlike traditional ‘brown’(non-green) bonds, green bonds are distinctive as they exclusively fund environmental projects, presenting a new asset class that enables investors to merge ethical considerations with their investment choices, thereby generating sustainable and financial value (Monk & Perkins 11; Paranque & Revelli 64).

The advent of green bonds represents a significant step forward in environmental finance, creating opportunities for investors and issuers alike to contribute actively to sustainability goals. These instruments not only facilitate substantial capital flows towards sustainable projects but also help in mitigating the risk of stranded assets in the transition to a low-carbon economy. Furthermore, they reflect an increasing appetite among institutional investors for environmentally responsible investment options that align with global efforts to combat climate change (Schumacher 6-7).

Despite their growing popularity, the development of the green bond market faces several challenges, including the need for greater transparency and standardization. The varying definitions of what constitutes a 'green' project and the absence of a universal standard for reporting and verification pose obstacles to the market's integrity and growth (Flammer, Green Bonds 123). Addressing these challenges is essential to ensure the market's expansion and the effective allocation of its financial resources toward genuine green projects.

This paper focuses on the Chinese green bond market, exploring how these global trends manifest in a context shaped by strong governmental influence and rapid market growth. It aims to assess whether green bonds in China offer a financial premium—termed as the "green premium"—over their non-green counterparts, considering factors such as issuer type and policy environment. Such analysis not only enriches the academic discussion on green finance but also offers practical insights for policymakers and investors looking to enhance the efficacy and reach of green bonds.

### 

### Research Background

### 2.1 Background of China’s Green Bond Market

In September 2015, China released the ‘Integrated Reform Plan For Promoting Ecological Progress’, which proposed the establishment of a green financial system, with green bonds as one of its key elements (Xinhua). In 2016, China officially launched its green bond market. After the 3060 Carbon Goal was initiated by President Xi at the general debate of the 76th session of the United Nations General Assembly in 2021, the development of green finance and green bonds has also entered a new stage of improving quality and quantity (Ministry of Foreign Affairs of the People's Republic of China). From the China Green Bond Market Report of 2021, by 2022, the scale of green bond issuance in China’s green bond market has increased up to 300% since its debut in 2016 (3). Also, China overtakes the United States as the world's largest green bond issuing market in terms of Climate Bonds Initiative (CBI)-compliant green bonds in 2022 (CBI, China Sustainable Debt 2022 5).

Currently, more and more private companies are now starting to participate in China's green bond market. Before 2022, Chinese state-owned enterprises (SOEs) (both central-level SOEs and local-level SOEs) have been the main issuers of green bonds, accounting for up to 97% of all issuers. In 2022, this proportion has decreased significantly, with only about 84% of green bonds coming from SOEs (CBI, China Sustainable Debt 2022 7). Non-SOEs have been much more active in green bond issuance. Meanwhile, in 2022, more than half of green bond issuance comes from first-time green bond issuers, of which financial institutions account for a major proportion. This wider range of issuer categories in China's green bond market contributes to a higher market diversification and future development potential.

In terms of the investment activities of the bond project, renewable energy remains the main targeting area, attracting half of China's onshore green bond financing. This is followed by the low-carbon transportation sector, which accounts for 27% of the funds (CBI, China Sustainable Debt 2022 7). With the rapid development of China's electric vehicle industry, the issuance of green bonds and green asset-backed securities from this industry chain is expected to grow accordingly.

In recent years, China has successively introduced a series of key policies to support green finance, further unifying domestic green bond standards, optimizing the issuance system, and aligning with the international market. The China Green Bond Standard Committee released the China Green Bond Principles in July 2022, defining green bonds as “bond instruments that raise funds specifically to support green industries, green projects or green economic activities that meet the prescribed conditions. And the principal and interest are repaid as agreed  
” (9). This principle is not only a self-regulatory rule, but also an important step in China's efforts to harmonize the definition and practice of docking standards in the domestic and global green bond markets.

On one hand, the continuous improvement of financial regulation and rules will help to incentivize the market and attract more players into related projects. On the other hand, as the supplier of green project funds, market investors' may also face a lack of reference when identifying credible transformation activities and investment opportunities, and a more comprehensive and transparent disclosure mechanism is needed to safeguard investor rights and interests. Some scholars have pointed out that compared with traditional debt, green bond issuers usually obtain lower financing costs and higher stock returns, in other words, they have a "green premium" (Zerbib 51). "Green premium" can be calculated by subtracting the matched brown bond yield spread from the green bond yield spread. This spread is usually negative, which implies that investors are willing to buy green bonds at lower yields compared to brown bonds, thus implying lower financing costs for green bond issuers.

### 2.2 Comparative Analysis of Global Green Bond Markets

While China's green bond market has seen remarkable growth, a comparative analysis with other major markets, especially Europe and the United States, reveals distinct differences and similarities in market dynamics, regulatory frameworks, and investor engagement. Europe has been at the forefront of the green bond market, driven by strong policy support and investor demand for sustainable investments. European markets are characterized by high levels of transparency and strict certification standards, which have been crucial in fostering investor trust and market growth (Grishunin, Sergei, et al 4). For instance, the Green Bond Principles established by the International Capital Market Association have been widely adopted in European countries, setting a benchmark for transparency and disclosure.

In contrast, the United States has experienced a more fragmented development of the green bond market. Despite this, the market has grown significantly due to increasing awareness among investors and the rise of private sector initiatives. Unlike China’s state-driven approach, the U.S. market is highly diversified, with municipal green bonds playing a significant role alongside corporate issuers (China Sustainable Debt State of the Market Report 2022 5; Saravade, Vasundhara, et al. 97). This diversity reflects the decentralized nature of U.S. financial markets and the lack of a unified national policy on green finance.

China's green bond market, predominantly influenced by governmental policies and driven by the agenda of state-owned enterprises, contrasts sharply with these models. The Chinese government's role in defining what qualifies as a green bond and its direct influence on market operations is unique. While this top-down approach has accelerated market growth and alignment with national environmental goals, it has also raised concerns about the consistency of standards with global norms, potentially limiting international investor participation (Lin and Hong 165-166).

Moreover, while European and American markets have matured with a focus on broadening investor bases and integrating with international standards, China’s market is still evolving, with recent efforts focused on expanding the diversity of issuers beyond SOEs and aligning more closely with global green bond criteria. These efforts are critical as China seeks to leverage green bonds to finance its ambitious carbon neutrality goals while fostering global investor confidence (Tang and Zhang 17-18).

This comparative analysis highlights that while the green bond markets in China, Europe, and the United States are all moving towards the common goal of supporting sustainable development, differences in regulatory approaches, market maturity, and the role of government significantly influence their trajectories. Understanding these differences is essential for policymakers, investors, and issuers aiming to engage effectively in the global green bond markets.

### 2.3 Research Hypothesis

For China, the biggest difference with the international green bond market is that its green bond market is driven by policies and rules set by the public sector (Qi 131). The unique institutional backgrounds has made SOEs the mainly green bond issuers, which usually represents a high credit level as SOEs have the government as the final guarantor. So, is there a green premium in China's top-down driven green bond market development model? If so, why is the financing cost of green bonds lower than that of brown bonds? Based on the above discussion, this research puts forward the following hypothesis:

Controlling variables including industry effect, year effect, issuer properties and bond characteristics, green bonds in China's market exhibit a 'green premium,' characterized by lower credit spreads compared to brown bonds.

This research endeavors to dissect the intricate relationship between green bonds and credit spreads in China's primary market, employing an OLS model. Since green bonds in China are mainly circulated in the primary market, this study will focus on China’s primary market of green bonds to investigate the main influence factors on the pricing of green bonds and seek evidence of green premiums. Focused on the period from 2016 to mid-2023, the study aims to unravel the factors influencing green bond pricing, explore evidence of green premiums, and assess the impact of corporate social responsibility on credit spreads for state-owned and non-state-owned enterprises. By doing so, it seeks to contribute empirical insights into how varying corporate structures navigate sustainability objectives amidst China's transitioning economy, ultimately shedding light on the role of green bonds in promoting sustainable financial practices.

Under this background, this research focuses on the Chinese bond market to explore how the green attributes of bonds affect the pricing mechanism of the bond market, which is of practical significance for further understanding and recognizing the green attributes of bonds as well as constructing a green financial system.

### Data and Methodology

### 3.1 Bond Data

The primary dataset used in this research includes green bonds (GB) and brown bonds (CB) issued in domestic China from 2016 to the first half of 2023. The selected time frame, spanning from 2016 to mid-2023, is strategically chosen to encapsulate a pivotal era in China's green bond market evolution, where the government not only reinforced its commitment to environmental sustainability but also introduced policies to incentivize green investments. The initiation of the study from 2016 aligns with a notable surge in green finance initiatives in China. By encompassing data up to mid-2023, the study aims to provide insights into the latest dynamics of China's green bond market and ensures the incorporation of recent developments and trends in the market, accounting for changes in regulatory frameworks, market sentiment, and investor behaviors.

This research obtained the initial green bonds and corporate bonds data from WIND database, which is a leading financial terminal platform focusing on the Chinese market. Given that this research mainly focuses on whether different attributes of bonds will affect the bond premium, the following screening procedures were proceeded on the initial samples:

1. removing samples without the important financial data of coupon rate and bond scale,
2. removing samples without other important bond data, including the ratings from official rating agents and issuing date

After restriction and cleaning of data, there are 537 green bonds and 7851 brown bonds left.

### 3.2 Bond-Matching Method

A model-free technique can be used to analyze the specificity of a financial instrument by pairing a benchmark instrument with other controlling characteristics to highlight the effect of the variable of interest (Hyun et al. 79). Zerbib employs the model-free approach in his research and matches one green bond with one comparable brown bond, except for the attribute that requires evaluation (42). This leaves the only variable that varies in the interim to be the bond label (whether this bond is green or not) and allows the researcher to analyze the real performance impact of brown and green bonds since bond pairs with comparable attributes—aside from bond type—are being examined.

Based on the basic method of Zerbib (42-43), this paper followed a similar matching method with the existing studies by Flammar (Corporate Green Bonds 500) to find one brown bond (CB) to match for each green bond (GB). The specific matching steps are as follows:

1. Initial Issuer Match: Preference is given to matching green bonds with brown bonds issued by the same issuer within the study period. The primary criteria for selection are the closest match in bond rating and maturity date, ensuring similar financial health and investment time horizon.
2. Extended Characteristic Match: If a suitable brown bond from the same issuer is not available, the method extends to brown bonds from different issuers. The match is then determined based on the most aligned characteristics:
   1. Logarithm of the issuance amount,
   2. Bond duration,
   3. Coupon rate,
   4. Maturity.

This approach ensures that each green bond is compared to a brown bond under nearly identical conditions, aside from their classification as green or brown. The dataset for this analysis comprises 413 meticulously matched pairs, enhancing the reliability of the comparative insights derived from the study.

### 3.3 Model & Variables Setup

The study intends to employ an Ordinary Least Squares (OLS) model to examine the relationship between green bonds and credit spreads. Drawing inspiration from Flammer (Corporate Green Bonds 511), Zhou and Zhou (5), and other pertinent literature, the model will incorporate variables encompassing bond characteristics, financial attributes of the bond issuer, and corporate governance features. This can effectively exclude the influence of factors other than "green" attributes on bond spread, which can more accurately identify the impact of green attributes. Additionally, the model will control for annual effects (Year) and industry effects (Industry), ensuring a comprehensive analysis that considers the influence of these factors on the observed relationship.

**a. Dependent variable**

Credit spread of the corporate bond (CreditSpread) is the dependent variable of this model. Referring to current analysis on bond premium (Qi and Liu 135; Zhou Hong et al. 19), this paper measures the credit spread (Creditspread) by the difference between the bond coupon rate and the maturity yield of government bonds issued in the same period and with the same maturity.

Specifically, it is the difference between the yield to maturity of the government bond in year t minus the yield to maturity of the corporate bond in year t of the government bond issued at the same time and with the same maturity period as the corporate bond. For remaining maturities that are not exactly matched, I use weighted averages methods to match the remaining maturities of corporate and government bonds and derive the corresponding credit spreads.

**b. Explanatory variable**

The green attribute of a corporate bond (Green) is set as the explanatory dummy variable in this model. If it is a green bond, Green = 1, and if it is a brown bond, Green = 0. Whether a certain corporate bond belongs to the green bond sector is decided according to the classification and database of Wind.

**c. Control variable**

Drawing on the research of Zhou and Zhou (5) and Qi and Liu (136), this article controls a series of attributes both on bond level and issuer level. Bond-level variables includes:

* Official rating of the corporate bonds (**Rating**): There are five main ratings assigned on the sample bonds by Chinese bond rating agencies: AAA, AA+, AA, A+, and BB+. From the highest debt rating to lowest, this paper assigns the value from 5 to 1 respectively. For example, the "AA" rating means the variable has a value of 3.
* Bond scale (**Bondscale**): the scale is measured by the natural logarithm of the bond issuance amount. The purpose of taking logarithms of variables is to reduce absolute differences between data and avoid the influence of individual extreme values.

Issuer-level variables includes:

* The equity nature of the enterprise (**SOE**): In China, state-owned enterprises (SOEs) have implicit guarantees, the risk of default is relatively low, the risk premium required by investors is small, and the financing cost of debt is relatively low. This paper set the equity nature variable as SOE. If the enterprise is a central state-owned enterprise, then SOE = 2. If it is a local state-owned enterprise, then SOE = 1. If it is a non-state-owned enterprise, then SOE = 0;
* Listed company (**Listed**): This paper categorizes the listed and unlisted corporation issuer based on the data from Wind. The listed bond issuer is more likely to attract more investors as it has lower risk and higher information transparency compared unlisted issuers.
* Enterprise liability ratio (**Leverage**): The leverage ratio is defined as the total liabilities at the end of the year divided by the total assets at the end of the year. The greater the corporate leverage ratio, the greater the credit risk and the larger the bond spread. Therefore, it is expected that the corporate leverage ratio should be positively correlated with the bond credit spread.
* Return on assets (ROA) of the bond issuer (**ROA**): The return on total assets (ROA) shows the comprehensive effect and profitability of asset utilization of the issuer, measured by using the operating income of an issuer as a percentage of its total assets. This indicator excludes the influence of financial leverage on the rate of return and can be used to compare the profitability among different companies in the same industry.
* Growth (**Growth**): measured by the operating income growth rate of the bond issuer;
* Cash Ratio (**Cash**): Issuer’s cash flow generated from operating activities/total assets.

In addition, this paper also controls for year fixed effects (**YEAR**) and industry fixed effects (**INDUSTRY**).

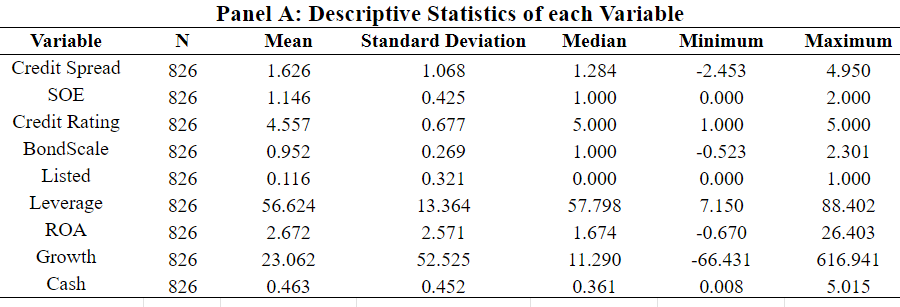
CreditSpread *i,t* = β0 + β1\*Green *i,t* + β2\*SOE*i,t* +β3\*Rating + β4\*BondScale*i,t*  + β5\*Listed *i,t* + β6\*Leverage *i,t* + β7\*ROA*i,t +* β8\*Growth *i,t* + β9\*Cash + ∑ YEAR + ∑ INDUSTRY + ε *i,t*

**Table 1: The Basic Setting of the Variables in the Model**

|  |  |
| --- | --- |
| **Variables** | **Explanation Definition** |
| CreditSpread | Measured by the difference in bond spread between the corporate bond and the government bond with the same maturity. |
| Green | If the sample bond is a green bond, Green = 1; for brown bonds, Green = 0. |
| SOE | If the sample bond issuer is a national-level state-owned enterprise (SOE), SOE=2; for local-level SOE issuer, SOE = 1; for private bond issuer, SOE=0. |
| Rating | If the sample bond receives a rating of AAA, Rating = 5; for AA+ bond rating, Rating = 4; for AA bond rating, Rating = 3; for A+ bond rating, Rating = 2; and for BB+ bond rating, Rating =1. |
| BondScale | Measured by the natural logarithm of the bond issuance amount (in billions of Chinese Yuan) |
| Listed | If the sample bond issuer is a listed company, Listed=1; if not, Listed=0. |
| Leverage | Measured by dividing the total liabilities of the bond issuer by its total assets. |
| ROA | Measured by the income as a percentage of the total assets of the bond issuer. |
| Growth | Measured by the growth rate of the bond issuer in its operating income. |
| Cash | Measured by the cash flow of bond issuer generated from operating activities as a percentage of its total assets |
| YEAR | Control for bond issuance year. |
| INDUSTRY | Control for industry effects. |

### 4 Results

### 4.1 Descriptive Statistics of Variables



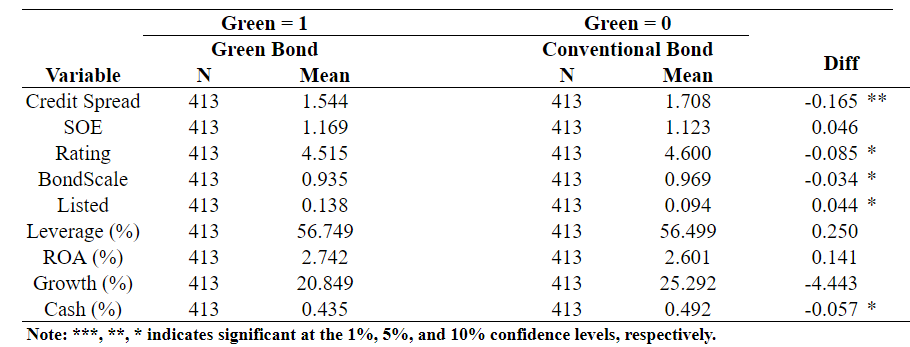
Note: Table 2 reports the descriptive statistics of the sample bond data on the dependent variable Credit Spread and control variables of the regression model. N represents the number of bond samples used in these statistics. Mean, Standard Deviation, Median, Minimum, and Maximum represents the corresponding statistics value of the sample data.

The time range of the sample bond data is from January 2016 to June 2023, with 413 green bonds and 413 brown bonds, so in total, there are 816 bond observations used in these descriptive statistics. The bond attribute values and issuer characteristics data are sourced from Wind.

**Table 2: Descriptive Statistics of each Variable**

Table 2 is the descriptive statistics of the variables in the model. From the above Panel A Table, we can find that the mean and median of the bond credit spread (Credit Spread) are 1.626 and 1.284 respectively, and the maximum and minimum values are 4.950 and -2.453 respectively. This indicates that there are large differences in credit spreads of different bonds, and the variability of the values is conducive to the further regression analysis of this paper.

The mean value of state-owned enterprises (SOE) is 1.146, which indicates that the main issuers of the sample bonds are still local or above state-owned enterprises. And there is huge potential space in China's bond market for private companies to develop. The mean value of bond rating (Rating) is 4.557, with a median value of 5. According to the model variable setting in the previous section, it reflects that most of the bonds are rated AA+ and above, so the quality of the sample bonds is good. The mean value of listed bond issuer (Listed) is 0.116, indicating that only 11.6% of the issuers of the sample bonds are listed companies. This demonstrates that the motivation of listed companies in China to finance projects with bonds or green bonds needs to be improved. The standard deviation of the growth of issuer (Growth) is large, which shows that the issuers of the sample bonds are more diversified and at different stages of enterprise development. The descriptive statistics of other control variables with no obvious characteristics.



Note: Table 3 reports the result of matching between green bonds and brown bonds on the credit spread, bond-level variables and issuer-level variables. N represents the number of bond samples used in these statistics. Mean represents the mean value of a certain variable in the sample. Diff represents the difference between green bond and brown bond in the mean value of the same variable. The p-value of the difference-in-means test is represented by \*, \*\*, and \*\*\*, which denotes significance at the 10%, 5%, and 1% level, respectively.

The time range of the sample bond data is from January 2016 to June 2023, with 413 green bonds and 413 brown bonds observations. The bond attribute values and issuer characteristics data are sourced from Wind.

**Table 3: Matching Results Between Green Bonds and brown Bonds**

Table 3 presents the results of the comparison of the difference in means when the sample bonds are grouped by their green attribute. The results show that the credit spread for the green bond samples (Green = 1) is significantly lower at the 5% level compared to the brown bond samples (Green = 0), which is a preliminary indication that green bonds are associated with negative credit spreads. The mean value of the listed attribute of bond issuer (Listed) is higher than that of the regular bond sample at the 10% level. However, at the same time, the mean values of scale of bond (BondScale), bond credit rating (Rating) and the cash ratio of bond issuer (Cash) are lower at the 10% level for green bonds compared to brown bonds. These characteristics may indicate that although green bonds are riskier in terms of issue size and issuer characteristics, the issuer and the policies related to green bonds reduce the level of risk of the bonds to investors by being more transparent and credible as listed corporations, which helps to increase the probability of successful issuance of green bonds. There are also some differences in the means of the other control variables, which are beneficial to the subsequent regression analysis of the paper.

### 4.2 Empirical Regression Results



Note: Table 4 reports the regression results of credit spread difference between brown bond and green bond measures on the bond-level and issuer-level variables. The dependent variable from columns (1) to (6) is the Credit Spread, which is the difference between the bond coupon rate and the maturity yield of government bonds issued in the same period and with the same maturity, using weighted average for bonds without exact matching period. A higher Credit Spread means that the bond issuer offers a higher yield to investors. The explanatory variables represent the green attribute of a bond. If it is a green bond, Green = 1, and if it is a brown bond, Green = 0. Whether a certain corporate bond belongs to the green bond sector is decided according to the classification and database of Wind.

Regression from Column (1) to (5) include industry fixed effects and year fixed effects. Column (6) includes year x industry two-way fixed effects. The t-statistics are in parentheses. The p-value of the difference-in-means test. \*, \*\*, and \*\*\* denotes significance at the 10%, 5%, and 1% level, respectively.

The time range of the sample bond data is from January 2016 to June 2023, with 413 green bonds and 413 brown bonds data, so in total 816 observations. The bond attribute values and issuer characteristics data are sourced from Wind.

**Table 4: Regression Results based on Model and Hypothesis Designed**

In order to examine whether there is a green premium for green bonds, regressions are conducted based on the designed model. Table 4 represents the regression results, with column (1) showing the regression results without control variables and column (2) showing the regression results with the control variables of bond characteristics – Green BondScale, Credit Rating in this paper. Column (3) shows the regression results with all control variables.

The results show that the regression coefficients between the green bond dummy variable (Green) and explained variable (CreditSpread) are negative to different significant degrees after controlling for year and industry fixed benefits. This indicates that after controlling for other factors (i.e., after bond matching), the credit spread of green bonds is lower than that of brown bonds, which supports the hypothesis put forward by this paper. The existence of a green premium under the top-down development mode of the green bond market in China is verified.

The regression result in column (3) shows that the regression coefficient of green is -0.251. This indicates that on average, the credit spread of green bonds is 25.1 percentage points lower than that of brown bonds at a significant level of 1%. Since the total size of green bonds in the sample is 453.79 billion yuan, which is close to the size of brown bonds of 442.09 billion yuan, the regression results indicate that issuing green bonds can save a certain amount of interest cost per year compared with brown bonds, which makes economic sense for issuers.

From the regression results of the other control variables in column (3), it can be said that bond characteristics such as debt rating, bond size, and firms' operating conditions are also important factors affecting credit spreads. The higher the value of bond credit rating, the higher the credit spreads, and the better the financial liquidity condition and the higher return ratio of the issuers, the lower the credit spreads.

Table 4 column (4) shows the regression results for green bonds issued by non-financial issuers only (excluding green bonds issued by financial institutions). The regression coefficient for the green dummy variable (Green) is -0.255 at an 1% significant level. This number is not significantly different from the result in column (3) where the regression includes green bonds green from all types of issuers, both of which indicate the existence of a green premium. However, in comparison, column (3) demonstrates a slightly higher degree of green premium than column (4). This may be due to the fact that compared to financial institution issuers, non-financial institution issuers are mostly corporations, and the funds raised by the bonds are intended to meet the needs of corporations engaged in the green activities and projects, with a clear use of the funds and a high degree of efficiency in their utilization (Zhang 31). Instead of directly investing in specific green projects, financial institutions issue green bonds and determine the final green projects through screening, identification, and decision-making processes, and indirectly invest in green projects of lending companies through green industry loans (Qi and Liu 138). Although the aggregation of funds is efficient, the investment is dispersed, which may imply a series of additional costs and lengthen the idle cycle of funds (Zhang 31). It may lead to lower consumer confidence and demand for higher risk premium.

This paper also conducts a test according to the different equity nature of the issuers, and investigates the impact of the nature of SOEs on the credit spreads of the green bonds market. This is due to the high credibility of Chinese SOEs and the special mechanism of state guarantee, aided by the dominant presence of SOE issuers in China's green bond market. Table 4 column (5) is the regression result based on the bond issued by SOEs only. The Green coefficient of -0.235 is significant at the 1% level, indicating the existence of a green premium. In comparison with column (3), the degree of green premium in bonds issued by SOE issuers is slightly lower. This result is consistent with the overall political and institutional characteristics of China, suggesting that investors trust SOEs more and accept lower premiums as a return on investment.

In the column (6) of Table 4, this paper further controls for the two-way fixed effects of *Industry × Year* to see whether the regression coefficients of green bonds (Green) are still significantly different. The result shows the coefficient of -0.316, which is significantly at the 1% level. This indicates that the green bond is still significantly correlated with the negative credit spread after controlling for the differences between industries and year. The regression results of this paper indicate that the significant difference in credit spreads between green bonds and brown bonds in China, green bonds have lower credit spreads, to a certain extent, due to corporate-led and government endorsement to attract green investors.

### 4.3 The Impact of each variable

The regression results provide a comprehensive overview of how various factors affect the green premium in the Chinese green bond market. By evaluating the impact of a one standard deviation increase in each variable, we can quantify their influence on the credit spreads between green and brown bonds. The credit spread difference from the government bond (CreditSpread), as the dependent variable here, represents a higher level of green premium when it decreases with the independent variable, and vice versa. The detailed breakdown is as follows:

* Bond Green Attribute:

A one standard deviation increase in the 'Green' attribute is associated with a decrease in the credit spread by approximately 0.1176 standard deviations. This suggests that green bonds generally have lower credit spreads than brown bonds, affirming the existence of green premium and financial attractiveness of sustainable investment options.

* Issuer’s Equity Attribute (SOE):

A one standard deviation increases in the variable representing bonds issued by state-owned enterprises is associated with a decline in the credit spread by about 0.1171 standard deviations. This suggests that bonds issued by SOEs have marginally lower credit spreads and enjoy a higher level of bond premium, possibly due to perceived lower risk backed by government support.

* Bond Credit Rating (Rating):

A one standard deviation increase in bond ratings contributes to an increase in the credit spread by 1.6257 standard deviations. Higher ratings, indicating better creditworthiness, can decrease the level of green premium, possibly due to higher investor demand for safer, highly-rated bonds.

* Logarithmic Bond Scale (BondScale):

A one standard deviation increases in the scale of the bond in the form of logarithmic leads to a decrease in the credit spread by 0.2304 standard deviations. This suggests that larger bond issues, perhaps due to increased liquidity, tend to have a higher level of green premium.

* Issuer’s Listed Status: (Listed)

A one standard deviation increases in whether the bond is issued by a listed company is associated with a decline in the credit spread by 0.0186 standard deviations. The impact is minor, suggesting that being listed does not significantly alter the credit spread relative to unlisted bonds. But transparency and regulatory scrutiny associated with listed companies still slightly enhance their appeal in terms of a higher level of green premium.

* Issuer’s Leverage Ratio (Leverage):

A one standard deviation increase in the leverage ratio of the issuing firm leads to a decrease in the credit spread by 0.1502 standard deviations, indicating that higher leveraged firms are viewed as riskier, thereby slightly lowering their bond spread.

* Issuer’s Return on Assets (ROA):

A one standard deviation increase in return on assets results in a decrease in the credit spread by 0.1397 standard deviations. Higher profitability, as measured by ROA, likely signals better financial health and reduced credit risk. As a result, it leads to a higher level of green premium, potentially due to increased investor confidence.

* Issuer’s Growth Rate (Growth):

A one standard deviation increase in the growth rate of the issuer's revenue leads to a decline in the credit spread by 0.0492 standard deviations. This reflects that growth rate of the issuer may have a relatively impact on the green premium.

* Cash Ratio:

A one standard deviation increase in the cash ratio contributes to a decrease in the credit spread by 0.0580 standard deviations, suggesting that higher liquidity is mildly favorable in reducing credit spread risks and thus, giving the issuer confidence to enjoy a higher level of bond premium.

### 4.4 Summary of the Results

The analysis conducted in this study has systematically demonstrated the presence of a "green premium" in China's green bond market. The regression results confirm that green bonds consistently exhibit lower credit spreads than their brown counterparts, highlighting a tangible financial benefit to issuing green bonds. Specifically, the findings reveal that green bonds are associated with credit spreads that are, on average, 25.1 basis points lower than those of brown bonds, a statistically significant reduction that underscores the economic viability of green bonds in the Chinese market.

Notably, although the influence of issuer characteristics, such as being a state-owned enterprise, alter the green premium, the effect is not as significant as the public assume. This suggests that the benefits of issuing green bonds extend across different types of issuers. However, the degree of the green premium varies slightly depending on whether the issuer is a financial or non-financial institution, with non-financial issuers benefitting slightly more. This variance could be attributed to the direct application of proceeds from green bonds in non-financial firms to specific green projects, enhancing transparency and project efficiency.

### 5. Conclusion & Discussion

This paper takes green bonds in China's primary bond market from 2016 to mid-2023 as the main research object. The study examines the existence of credit spread, i.e. green premium, and the related influencing factors in the Chinese green bond market. The results show that, after comparability matching, the credit spreads of green bonds in the sample of 816 bonds are significantly lower than those of brown bonds by 25.1 percentage points, implying that there is a green premium in China’s green bonds market. This finding is significant across various controls and specifications, including issuer characteristics and market conditions. The green premium is evident not only in the overall market but also among non-financial and state-owned enterprise (SOE) issuers, suggesting that both corporate-led initiatives and government endorsements play crucial roles in attracting green investment. The study also finds that bond characteristics, issuer financial health, and corporate governance are important determinants of credit spreads. These results underscore the importance of green finance in promoting sustainable economic development and the effectiveness of policy measures in fostering a favorable environment for green investments in China. By shedding light on the pricing mechanisms and investor preferences in the green bond market, this research contributes valuable insights into the ongoing efforts to align financial markets with environmental sustainability goals.

The current state of China's green bond market, characterized by rapid growth and increasing diversification, reflects the market's acceptance and interest in green finance. The participation of a wide range of issuers, including state-owned, private, and non-state-owned enterprises, enhances the market's robustness. However, issuing green bonds is not devoid of challenges. The pros, such as financial incentives through lower borrowing costs and enhanced market perception due to sustainable practices, are accompanied by cons including the need for strict regulatory compliance and potential market and regulatory risks that could affect the attractiveness of green bonds.

Future issuers, particularly non-financial corporations engaged directly in green projects, stand to benefit significantly from entering the green bond market, given the clear linkage between the use of proceeds and sustainability outcomes. This is particularly relevant for small and medium-sized enterprises (SMEs) and private companies, which could leverage green bonds to attract a broader investor base focused on sustainability, thereby enhancing their competitive advantage.

The future development of this market should focus on further aligning China's green bond standards with international norms to increase global investor confidence. Moreover, improving transparency and the quality of reporting and verification processes will be crucial in maintaining investor trust and ensuring the integrity of the market. Additionally, developing specific incentives and support mechanisms for smaller issuers could help broaden the market base and support China's green finance goals more comprehensively.

In conclusion, China's green bond market holds significant promise for supporting the country's environmental objectives while offering substantial financial benefits to issuers. The sustained growth of this market will depend on continued regulatory enhancements, increased market transparency, and the encouragement of a diverse range of issuer participation, thereby ensuring the sustainable advancement of green finance in China.

While this study provides significant insights, it also encounters limitations that suggest avenues for further research. The reliance on bond data up to mid-2023 means that more recent market developments are not captured. Future studies could extend this analysis as more data become available, potentially exploring the long-term impact of green bonds on corporate performance and sustainability outcomes. Additionally, qualitative research into the decision-making processes of issuers and investors regarding green bonds could complement the quantitative findings presented here.

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