Where's the green bond premium? Evidence from China

Quan Li , Kai Zhang , Li Wang

PII: S1544-6123(22)00197-0
DOI: https://doi.org/10.1016/j.frl.2022.102950
Reference: FRL 102950

To appear in: *Finance Research Letters*

Received date: 16 March 2022
Revised date: 14 April 2022
Accepted date: 2 May 2022

Please cite this article as: Quan Li , Kai Zhang , Li Wang , Where's the green bond premium? Evidence from China, *Finance Research Letters* (2022), doi: https://doi.org/10.1016/j.frl.2022.102950

Where's the green bond premium? Evidence from China

Quan Li[a], Kai Zhang[a], Li Wang[b]*

[a]School of Finance, Nankai University, Tianjin 300350, China

[b]School of Humanities, China University of Political Science and Law, Beijing 102249, China

*Corresponding author.

E-mail addresses: nkdale@126.com (Quan Li), 1120190907@mail.nankai.edu.cn (Kai Zhang), cuplwangli@126.com (Li Wang).

Highlights:

- This study examines the difference in yield spreads between labeled green bonds and non-labeled green bonds in the primary market in China.
- We confirm that only labeled green bonds can significantly reduce issuance spreads.
- This study examines the difference in issuance spreads between the different uses for labeled green bonds and non-labeled green bonds.
- The effect is heterogenous by bonds maturity, bonds rating, and the city's financial pressures.

Abstract

Recently, China has rapidly established the second largest green bond market in the world through a series of policy support measures, and the effects of these policies are the focus of widespread attention. This paper is the first to compare the difference in yield spreads between labeled green bonds and non-labeled green bonds in the primary market in China. We find that although labeled and non-labeled green bonds meet the same green certification standard, green characteristics alone cannot reduce the costs of financing bonds; rather, only officially certified labeled green bonds can effectively reduce the yield spread. Moreover, this paper finds that due to policy guarantee expectations, labeled green bonds can effectively reduce issuance costs in a high-credit-risk environment. Further analysis reveals significant differences in issue pricing between green bonds with different purposes.

Keywords: Yield spread; Labeled green bonds; Non-labeled green bonds; Green pre-

mium

1. Introduction

The market for green bonds, a type of financial instrument dedicated to environmental sustainability, is undergoing rapid growth. In 2020, the total issuance in the global green bond market reached 293.2 billion dollars, and the cumulative issuance exceeded 1 trillion dollars(CBI, 2020). Environmental, social, and governance (ESG) assets exhibit good market performance in response to major shocks such as financial crises, climate risks, and the COVID-19 pandemic (Lins et al., 2017; Krueger et al., 2020; Hacıömeroğlu et al., 2021). The issuance of green bonds indicates the occurrence of environmentally friendly and sustainable development to the outside world (Flammer, 2021), and investors seek green bonds that meet ESG investment criteria (Febi et al., 2018).

Despite rapid growth in the green bond market, however, we know little about this new financial instrument, and existing findings are mixed. According to the analytical framework of Fama and French (2007), investors who prefer to hold green financial assets are willing to accept lower expected returns, with Ehlers and Packer (2017), Baker et al. (2018), Zerbib (2019), Bachelet et al. (2019),and Tang and Zhang (2020) using data to verify that green bonds have lower yields than non-green bonds. Hyun et al. (2020) find that only green bonds certified by third parties have low yields. However, investors are unwilling to pay this green premium (OECD, 2017; Flammer, 2021). Furthermore, the Climate Bonds Initiative (2017), Standard & Poor's (2016), and Larcker and Watts (2020) do not find a difference in pricing between green bonds and other bonds.

Most studies on green bonds focus on the financial markets of developed countries. In contrast, developing countries are still undergoing industrialization and face complex contradictions between low-carbon development and economic growth. As market forces alone cannot make most investors recognize green financial assets in developing countries, strong policy support is needed in the early stage of green bond market development. Although China's green debt market was established as recently as 2016, strong policy support enabled the total amount of green bonds issued in China's domestic and foreign markets to reach 44.07 billion dollars by 2020, making China's cumulative green bond issuance the second largest in the world (CBI, 2020). Therefore, China's green bond market provides an excellent research sample.

In China, the green bonds market was triggered by the strong advocacy of sustainable economic development by the Chinese government. In September 2015, the Communist Party of China Central Committee and the State Council promulgated the "General Plan for the Reform of the Ecological Civilization System", the first proposal to build a green financial system in China. The development of a green bond market is an important element of the plan. In December 2015, the People's Bank of China issued Announcement No. 39, including the "Green Bond Support Project Catalogue", which is the first standardization of the issuance criteria for green bonds, and the China's National Development and Reform Commission promulgated the "Guidelines for Green Bond Issuance," which define the scope of application and key support projects for green corporate bonds. In March and April 2016, the Shanghai Stock Exchange and Shenzhen Stock Exchange respectively issued the "Notice of the Shanghai Stock Exchange on the Piloting of Green Corporate Bonds" and the "Notice

of the Shenzhen Stock Exchange on the Piloting of Green Corporate Bonds" to clarify the criteria for listing green corporate bonds on the respective exchanges. Regulatory authorities have issued corresponding policies to simplify the procedures of green bond issuance[1] and support issuance through specialized guarantee and credit enhancement mechanisms.[2] Chinese local governments at all levels have issued corresponding interest discount policies to support the development of green bonds[3].

Theoretically, on the one hand, these green support policies can reduce the credit risk of green bonds and improve the convenience of green bond issuance. On the other hand, regulators have required green bond issuers to disclose more green information, and higher CSR has cheaper financing cost（Ghoul et al.,2011）. Because of the late start, green bonds in China are mainly circulated in the primary market and still rely on underwriting syndicates to stabilize the issuance scale. Investors are not motivated to allocate additional funds in the secondary market after the issuance of green bonds, and the secondary market spreads are not significantly different from those of non-green bonds (Zhang and Li, 2022). So this paper focuses on the primary market spreads. Existing research on the pricing of green bond issuance in China does not find a significant green premium for green financial bonds (Cao et al.,2021), but green bonds issued by non-financial firms tend to have significantly lower issuance spreads (Wang et al.,2020; Zhang et al., 2021).

Although studies focus on labeled green bonds supported by relevant policies, many unlabeled green bonds in the bond market meet the former criteria ("Guidelines for Green Bond Issuance" and "Green Bond Support Project Catalogue"). Therefore, this paper contributes to the literature through comparing pricing differences between labeled and non-labeled green bonds in the Chinese credit bond market to determine whether a premium exists for green bonds. We then explore whether such a premium is attributable to the green characteristics of the bonds or to policy support. Our results illustrate that currently, the green premium in the Chinese credit bond market is attributable mainly to government support policies and that investors' preference for green attributes is not the sole determinant of the price of green bonds.

The remainder of the paper is organized as follows. The second section describes the data and methodology. The third section presents the empirical results. The last section concludes the paper.

2. Data and method

2.1 Yield spread determinants, model setting, and variable definitions

To examine the effects of all types of green bonds on issuance spreads, we construct a multivariate regression model as follows:

[1] In March 2017, the China Securities Regulatory Commission (CSRC) issued the "Guidance on Supporting the Development of Green Bonds," which clearly stipulates that the acceptance and review of green corporate bond declarations will be carried out by "dedicated docking and special review" and that the "immediate review" policy will be applied. The CSRC continues to improve its green channel institutional arrangement for green corporate bond access management and enhance the convenience of green bond issuance by enterprises.

[2] In June 2018, the People's Bank of China included green bonds with a minimum rating of AA within medium-term lending facilities' (MLF) collateral.

[3] For example, in September 2018, Jiangsu Province issued "Implementation Opinions on Deepening Green Financial Services for the High-Quality Development of the Ecological Environment," which subsidizes 30% of the actual annual interest paid by non-financial enterprises that successfully issue green bonds for a period of 2 years, with the maximum annual discount for a single bond not exceeding 2 million yuan.

$$Spread_{i,\ t} = \alpha_0 + \alpha_1 green_i + \sum bond\_controls_{i,t} + \sum firm\_controls_{i,t-1} + \sum city\_controls_{i,t-1} + \epsilon_{i,t} \quad (1)$$

where $Spread_{i,t}$ refers to the yield spread at issue for bond i; $green_i$ is a dummy variable that comprises all types of green bonds; $bond\_controls_{i,t}$ is a list of bond characteristics, such as credit rating, the bond face value, bond maturity and so on. Following Wang et al. (2020) and Zhang et al. (2021), $firm\_controls_{i,t-1}$ and $city\_controls_{i,t-1}$ represent the one-year lagged variables of firm and city characteristics respectively, including Size, Leverage, ROA, Turnover, Cash/debt, Quickratio, GDP growth and Financial pressure. Table 1 defines all variables used in the paper.

Table 1
Variable definitions.

Variable	Definition
Spread	Yield spread (%); the difference between the yield spread at issue for bond and the yield on a Treasury security of comparable maturity.
Green	Dummy variable; equals 1 if the bond meets the the green bond recognition criteria and 0 otherwise.
Labeled Green	Dummy variable; equals 1 if the bond is a labeled green bond and 0 otherwise.
Non-labeled Green	Dummy variable; equals 1 if the bond is a non-labeled green bond and 0 otherwise.
LGFP	Dummy variable; equals 1 if the issuer is a local government finance platform and 0 otherwise.
Public	Dummy variable; equals 1 if the issuer is a public corporation and 0 otherwise.
Issuance	Issue amount (in billion CNY).
Maturity	Original time to maturity of the bond (in years).
Rating	Equal to 1, 2, 3, or 4 for less than AA, AA, AA+, and AAA ratings, respectively.
Market	Dummy variable; equals 1 if the bond is traded on more than one exchange and 0 otherwise.
Guarantee	Dummy variable; equals 1 if the bond has a guarantee clause and 0 otherwise.
Option	Dummy variable; equals 1 if the bond is option-embedded and 0 otherwise.
Size	Firm size; defined as the natural log of total assets.
Lev	Leverage; calculated as the total liabilities divided by the total assets.
Turnover	Calculated as the total operating revenue divided by the total assets.
ROA	Return on assets; calculated as the net income divided by the total assets.
Cash/debt	Calculated as the net cash flows from operating activities divided by the total liabilities.

Quickratio	Calculated as the current assets minus inventories, divided by the current liabilities.
Growth	GDP growth rate of the city where the bond issuer is located.
Financial Pressure	Calculated as the fiscal revenues divided by the fiscal expenditures of the city where the bond issuer is located.

2.2. Data description

As the first green bond was issued in China in 2016, this paper selects credit bonds (enterprise bonds and corporate bonds) issued from 2016 to 2020 as the research sample. We analyze only fixed-rate bonds; floating-rate bonds are excluded from the sample. Data on the characteristics of the bonds and the financial information of the issuers are obtained from the China Stock Market & Accounting Research (CSMAR) and Wind databases. Macro data on the cities where the issuers are located are obtained from the China City Statistical Yearbook.

A labeled green bond is defined as a credit bond with a green flag. This flag is issued when a bond meets the criteria for identifying green bonds[4] and is approved by regulators. In this paper, the final list of labeled green bonds is composed by collecting and collating data on the issuance of labeled green bonds from the China Financial Information Network and the CSMAR and Wind databases.

A non-labeled green bond is defined as a credit bond that meets the criteria for green bonds but not certified as "green" by regulators. The list of non-labeled green bonds is obtained from the China Bond-Green Bond Environmental Benefit Information Portal.[5] This website makes publicly available the non-labeled green bonds that are evaluated and identified by the China Central Depository and Clearing Co., Ltd. (CCDC) based on publicly disclosed (e.g. bond prospectuses) environmental benefit information.

Table 2 indicates the descriptive statistics of variables employed in our model. We collected 3438 bonds from 2016 to 2020 for the full sample. The average spread of bonds in our sample is 2.181%, the average issue amount is about 1.143 billion yuan, the average maturity of our sample bonds is 5.2 years, and the majority of bond ratings are AAA. As for the issuer characteristics, about 1/3 of bonds are issued by LGFPs, about 12.5% of bonds are issued by listed firms. Green bonds represent 8.6% of the total sample with only 296 bonds in the sample meeting the criteria for green bond recognition, of which 133 are labeled and 163 are non-labeled green bonds.

Table 2
Descriptive statistics.

Variable	N	Mean	Std. Dev.	P50	Min	Max
Spread	3438	2.181	1.199	1.807	0.113	6.092
Green	3438	0.086	0.281	0.000	0.000	1.000
Labeled green	3438	0.039	0.193	0.000	0.000	1.000
Non-labeled green	3438	0.047	0.213	0.000	0.000	1.000
LGFP	3438	0.307	0.461	0.000	0.000	1.000
Public	3438	0.125	0.331	0.000	0.000	1.000
Issuance	3437	1.143	0.804	1.000	0.030	8.000
Maturity	3438	5.225	2.295	5.000	0.740	20.000
Rating	3438	3.361	0.817	4.000	1.000	4.000
Market	3438	0.392	0.488	0.000	0.000	1.000

[4] Green bonds meet one of the four criteria for green bonds: the People's Bank of China's "Green Bond Support Project Catalogue (2015 Edition)," the National Development and Reform Commission's "Guidelines for Green Bond Issuance," the "International Capital Markets Association (ICMA) Green Bond Principles 2015," and the Climate Bond Initiative's "Climate Bond Classification Scheme." Additionally, the proportion of funds invested in green industrial projects (or the proportion of the issuer's green main business income) must not be less than 50%.

[5] Data source: https://www.chinabond.com.cn/greenbond/.

Guarantee	3438	0.299	0.458	0.000	0.000	1.000
Option	3438	0.607	0.488	1.000	0.000	1.000
Size	3418	24.626	1.698	24.335	16.008	29.990
Lev	3415	0.568	0.174	0.591	0.123	0.905
Turnover	3392	0.238	0.345	0.090	0.006	2.039
Roa	3413	0.017	0.014	0.013	0.000	0.077
Cash/debt	3410	-0.011	0.144	0.013	-0.567	0.335
Quickratio	3312	1.498	1.482	1.031	0.203	9.859
Growth	3395	7.450	2.360	7.070	-3.237	14.940
Financial Pressure	3416	0.667	0.231	0.730	0.080	6.251

This table provides summary statistics for all of the variables used in the estimation. The sample comprises all fixed-rate enterprise and corporate bonds issued in China from 2016 to 2020. All of the variables are defined in Table 1.

Table 3
Univariate analysis: Comparison of green and non-green bonds.

Variable	Type	Mean	t-test for difference-in-means	Median	Wilcoxon test for difference-in-medians
Spreads	Non-green bonds	2.202%	3.233***	1.834%	3.965***
	Green bonds	1.966%		1.508%	

This table reports the results of difference-in-means and difference-in-medians tests of the yield spreads at issue for green and non-green bonds. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

As shown in Table 3, we find a significant difference in the issuance spreads between green and non-green bonds in the sample, with green bonds having a lower average issuance spread by 23.6 bps. This finding provides preliminary evidence of a green premium in the primary market for green bonds.

3. Empirical results

Table 4
Estimated premiums for different types of green bonds

	(1) Full	(2) Labeled green	(3) Non-labeled green	(4) Full
Green	-0.084**			
	(-2.09)			
Labeled green		-0.120**		-0.117**
		(-2.07)		(-2.06)
Non-labeled green			-0.058	-0.056
			(-1.12)	(-1.09)
LGFP	-0.079**	-0.082**	-0.071**	-0.079**
	(-2.44)	(-2.38)	(-2.12)	(-2.44)
Public	-0.061	-0.051	-0.060	-0.062
	(-1.36)	(-1.05)	(-1.29)	(-1.37)

Issuance	-0.007***	-0.007***	-0.007***	-0.007***
	(-4.01)	(-3.87)	(-4.05)	(-4.01)
Maturity	0.042***	0.044***	0.043***	0.042***
	(6.14)	(6.12)	(6.01)	(6.17)
Market	-0.285***	-0.331***	-0.292***	-0.287***
	(-6.45)	(-7.16)	(-6.27)	(-6.47)
Guarantee	0.360***	0.359***	0.368***	0.362***
	(7.11)	(6.90)	(7.03)	(7.14)
Rating	-0.506***	-0.510***	-0.503***	-0.507***
	(-13.67)	(-13.51)	(-13.23)	(-13.68)
Option	0.331***	0.334***	0.342***	0.332***
	(9.92)	(9.49)	(9.98)	(9.92)
Size	-0.166***	-0.175***	-0.168***	-0.165***
	(-8.30)	(-8.26)	(-8.18)	(-8.26)
Lev	0.594***	0.638***	0.631***	0.591***
	(4.69)	(4.82)	(4.84)	(4.67)
Turnover	0.069*	0.060	0.063	0.071*
	(1.70)	(1.45)	(1.55)	(1.73)
Roa	-1.572	-1.281	-1.401	-1.581
	(-0.92)	(-0.72)	(-0.80)	(-0.92)
Cash/debt	-0.028	0.010	-0.045	-0.027
	(-0.25)	(0.08)	(-0.39)	(-0.24)
Quickratio	-0.000	-0.001*	-0.000	-0.000
	(-1.54)	(-1.85)	(-1.42)	(-1.55)
Growth	-0.009**	-0.009**	-0.009**	-0.009**
	(-2.19)	(-2.18)	(-2.16)	(-2.19)
Financial pressure	-0.216*	-0.197*	-0.215*	-0.217*
	(-1.77)	(-1.71)	(-1.72)	(-1.77)
Constant	7.363***	7.604***	7.372***	7.352***
	(6.51)	(6.74)	(6.45)	(6.50)
Year FE	YES	YES	YES	YES
Region FE	YES	YES	YES	YES
Observations	3,256	3,094	3,129	3,256
R-squared	0.743	0.740	0.743	0.744

This table reports the results of the regression of bond spreads on the green bond, labeled green bond, and non-labeled green bond dummy variables together with other bonds-level, firms-level, and cities-level characteristic variables, including year and region fixed effects. Columns (1) and (4) show the results obtained using the full sample. Column (2) shows the results with non-labeled green bonds excluded. Column (3) shows the results with labeled green bonds excluded. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

In Table 4, column (1) shows that green bonds significantly reduce issuance spreads by 8.4 bps, which corroborates the results of the univariate analysis in the previous section. We

next divide the green bonds into labeled and non-labeled green bonds. A comparison of columns (2) and (4) shows that the coefficients of labeled green bonds are significantly negative, indicating that these bonds have an issuance spread about 12 bps lower than that of general credit bonds and thus a more significant financing advantage. A comparison of columns (3) and (4) shows no significant difference in issuance spreads between non-labeled green bonds and general credit class bonds. The observation that only labeled green bonds can significantly reduce the cost of issuance is the main finding of this paper.

Table 5
PSM robustness test.

	Plane A			Plane B		
	(1)	(2)	(3)	(4)	(5)	(6)
Green	-0.063			-0.043		
	(-0.77)			(-0.61)		
Labeled green		-0.552**			-0.186**	
		(-2.34)			(-2.20)	
Non-labeled green			-0.191			-0.135
			(-1.33)			(-1.38)
Control	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES
Observations	468	235	257	736	852	601
R-squared	0.940	0.955	0.918	0.899	0.910	0.954

Propensity score matching (PSM) is used to generate control groups similar to all types of green bonds. Panel A shows the empirical results when the nearest neighbors matching method is used. Panel B shows the empirical results when the Kernel matching method is used. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The green bonds and non-green bonds may have differences in firm-level and bond-level traits and it is possible that sample selectivity problem exists. To eliminate the problem, we used a propensity score matching (PSM) method to find a control group similar to all types of green bonds group. In this study, we used the logistic regression model , nearest neighbours and Kernel matching method .We further treated the green, labeled green and non-labeled green dummy variable as the dependent variable with Public, Issuance, Maturity, Market, Guarantee, Rating, Option, Size, Lev, Turnover, Roa, Cash/debt and Quickratio as the covariates. The regression results are shown in Table 5. After matching, columns (1) and (3) show that the coefficients of green bonds and non-labeled green bonds are negative but are not statistically significant, and the same results are obtained in Plane B. Column (2) and (5) show that the significant negative effects of labeled green bonds on issuance spreads in the nearest neighbors matching method and kernel matching method, respectively. The findings in this table also support our finding that only labeled green bonds effectively reduce issuance spreads in Table 4.

Table 6
Robustness test with replacement of variables.

	(1) Labeled green bonds	(2) Non-labeled green bonds
Percentage of green funds	-0.003***	-0.001
	(-2.98)	(-1.48)
Control	YES	YES
Year FE	YES	YES
Region FE	YES	YES
Observations	3,094	3,129
R-squared	0.741	0.743

The main explanatory variable is changed from the green bond dummy variable to the percentage of green funds. Column (1) shows the results without non-labeled green bonds. Column (2) shows the results without labeled green bonds. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Next, we repeat the regression analysis using manually collated information on the use of funds in the green bond prospectus, replacing the green bond dummy variable with the percentage of funds directly used for green projects as a quantitative indicator of the greenness of the bond. In Table 6, column (1) shows that with one percentage point increasing in the proportion of green funds for labeled green bonds, the issuance spread can be significantly reduced by 0.3bps. This indicator is different from the 100% required by the CBI. The regulator allows issuers to use up to half of the funds raised for non-green purposes in China, therefore the percentage of green funds is between 50% and 100%. Specifically, labeled green bonds can reduce issuance spreads by up to 15bps, if the percentage of funds is 100%. Whereas no such finding is observed for non-labeled green bonds. This finding validates the previous conclusion that financial markets only recognize policy-supported labeled green bonds.

Table 7
Impact of different uses of green bonds on spreads.

	(1) Labeled green bonds	(2) Non-labeled green bonds
Non-green	-0.376***	-0.244***
	(-2.88)	(-4.36)
Transportation	-0.025	0.250**
	(-0.23)	(2.12)
Green building	-0.260**	-0.047
	(-2.39)	(-0.42)
Low carbon Industry	0.022	0.046
	(0.18)	(0.17)
Ecological restoration	-0.122	1.569***
	(-0.93)	(7.67)

Control	YES	YES
Year FE	YES	YES
Region FE	YES	YES
Observations	3,094	3129
R-squared	0.741	0.745

This analysis shows the impact of different uses of green bonds on spreads. We classify the use of green bonds into five categories: non-green, transportation, green building, low-carbon industry and ecological restoration. Non-green uses include debt repayment, loan repayment, and liquidity replenishment. Transportation uses include the construction of transportation infrastructure such as roads, railways, and airports. Green building uses include green urban renovation and improvement projects in various fields, such as urban wastewater facilities, energy-efficient heating facilities, and waste treatment plants. Low-carbon industry uses include spending on energy-saving and environmental protection industries such as new energy (wind, solar, water) and waste recycling. Ecological restoration uses include abandoned mine restoration, marine ecological restoration, and forest restoration. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

We next subcategorize green bonds into five categories based on the uses of funds raised in the bond prospectuses: non-green, transportation, green building, low-carbon industry, and ecological restoration. In Table 7, we examine the difference in issuance spreads between the different uses for labeled green bonds and non-labeled green bonds. We find that labeled green bonds used for non-green and green building purposes have significantly lower issuance spreads. We believe that labeled green bonds for green building use often associate with many urban infrastructure projects (e.g. water and sewer projects, "sponge city" projects and "smart city" projects) and the issuers are basically local government finance platforms (LGFP). These projects have reliable economic returns and stronger government guarantees, so the financing costs can be reduced. As for more purely green sectors, green bonds are invested in transportation, low-carbon industry and ecological restoration, we can’t expect higher economic returns in the short term. They have higher market operating risks, and even policy-supported labeled green bonds cannot significantly reduce their financing costs. Among non-labeled green bonds, only those used for non-green needs have lower issuance spreads, whereas those used for transportation and ecological restoration have significantly higher issuance spreads. This finding illustrates the significant differences in pricing between green bonds for different purposes, even among policy-supported labeled green bonds.

We further analyze the heterogeneity of all types of green bonds in Table 8. Column (3) and (11) of Table 8 show that the coefficients of Green are -0.139 and -0.096, which are 5% significantly negative. However, when we divide green bonds into labeled green bonds and non-labeled green bonds, we can clearly see the difference between the two. Column (2), (6) and (10) show that the coefficients of Labeled green are -0.129, -0.183 and -0.176, which are 5% significantly negative. Correspondingly, the coefficient of Non-labeled green is significantly negative only in column (4). We find that labeled green bonds have significant financing advantages over non-labeled green bonds under three high-credit-risk scenarios: longer term bonds (more than five years), lower rating bonds(non-AAA), and cities with

higher financial pressure (constraint). We think this is due to the fact that the government-led approach in issuing labeled green bonds in China. In order that bonds with higher credit risk for green purposes to be quickly recognized by investors, the central and local governments have introduced various forms of subsidies and credit enhancements. So in the higher risk sample, investors have stronger guarantee expectations and thus lower financing costs, which is also an important goal of green support policies.

Table 8
Heterogeneity analysis.

	5+years		1-4years		Non-AAA		AAA		constraint		loosing	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Green	-0.051		-0.139**		-0.124*		-0.031		-0.094		-0.096**	
	(-0.99)		(-2.01)		(-1.72)		(-1.03)		(-1.29)		(-2.24)	
Labeled green		-0.129**		-0.084		-0.182**		-0.006		-0.176**		-0.114
		(-1.97)		(-0.72)		(-2.09)		(-0.13)		(-2.08)		(-1.58)
Non-labeled green		0.034		-0.170**		-0.038		-0.045		0.009		-0.084*
		(0.46)		(-2.39)		(-0.32)		(-1.25)		(0.08)		(-1.88)
Control	YES		YES		YES		YES		YES		YES	
Year FE	YES		YES		YES		YES		YES		YES	
Region FE	YES		YES		YES		YES		YES		YES	
Observations	2,010		1,246		1,875		1,381		1,533		1,723	
R-squared	0.799	0.800	0.697	0.697	0.727	0.727	0.582	0.582	0.762	0.762	0.655	0.655

This table reports the results of regression of bond spreads on labeled and non-labeled green bonds in different subsamples. In columns (1)-(4), we divide the sample into bonds with a maturity of more and less than 5 years, respectively. In columns (5)-(8), we divide the sample according to whether the bond rating is AAA or another rating, respectively. In columns (9)-(12), we divide the sample based on the sample median of financial pressure in the city where the issuer is located. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

4. Conclusion and discussion

This paper shows that the current policies related to green bonds in China achieve the stated goal of ensuring that labeled green bonds have lower financing costs and demonstrates that investors' recognition of green bonds is still based on various expectations of governmental guarantees. Furthermore, we find that the issue of green bonds with green features alone is not sufficient to reduce the issuance costs of green bonds. We believe that government intervention policies in this area are not an end but rather a means to achieve goals (Lin and Hong, 2022). Despite its initial success, China's green bond market faces negative issues such as the concentration of policy resources on large state-owned enterprises and greenwashing; additionally, excessive support efforts can stifle the attractiveness and competitiveness of the green bond market. We suggest that the government should act as a limited participant in the subsequent development of the green bond market and actively guide private sector forces, such as private enterprises, to enter the market. The government should also strengthen the recognition criteria for green bonds and effectively monitor and discipline relevant environmental information disclosures.

Author Statement:

Quan Li： Conceptualization，Writing – original draft. **Kai Zhang:** Data curation, Methodology, Software, Formal analysis, Writing - Original Draft. **Li Wang:** Validation, Writing – review & editing, Conceptualization.

References:

Bachelet, M. J., Becchetti, L., & Manfredonia, S., 2019. The green bonds premium puzzle: The role of issuer characteristics and third-party verification. *Sustainability*. 11(4), 1-22. https://doi.org/10.3390/su11041098.

Baker, M., Bergstresser, D. , Serafeim, G. , & Wurgler, J., 2018. Financing the response to climate change: the pricing and ownership of U.S. green bonds. NBER working paper No. 25194. https://www.nber.org/system/files/working_papers/w25194/w25194.pdf.

Cao, X., Jin, C., & Ma, W., 2021. Motivation of Chinese commercial banks to issue green bonds: Financing costs or regulatory arbitrage? *China Economic Review*. 66, 101582. https://doi.org/10.1016/j.chieco.2020.101582.

Climate Bonds Initiative (CBI)., 2017. Green bonds highlights 2016. https://www.climatebonds.net/files/files/2016%20GB%20Market%20Roundup.pdf, (accessed 11 January 2022).

Climate Bonds Initiative (CBI)., 2020. China green bond market report 2020. https://www.chinabond.com.cn/cb/cn/yjfx/zzfx/nb/20211008/158944535.shtml, (accessed 11 January 2022).

Ehlers, T., & Packer, F., 2017. Green bond finance and certification. *Bank for International Settlements Quarterly Review*. September. https://www.bis.org/publ/qtrpdf/r_qt1709h.pdf.

Fama, E. F., & French, K. R., 2007. Disagreement, tastes, and asset prices. *Journal of Financial Economics*. 83(3), 667–689. https://doi.org/10.1016/J.JFINECO.2006.01.003.

Febi, W., Schäfer, D., Stephan, A., & Sun, C., 2018. The impact of liquidity risk on the yield spread of green bonds. *Finance Research Letters*. 27, 53–59. https://doi.org/10.1016/J.FRL.2018.02.025.

Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*. 142(2), 499–516. https://doi.org/10.1016/j.jfineco.2021.01.010.

Ghoul, S. E. , Guedhami, O. , Kwok, C. , & Mishra, D. R. , 2011. Does corporate social responsibility affect the cost of capital? *Journal of Banking & Finance*, 35(9), 2388-2406. https://doi.org/10.1016/j.jbankfin.2011.02.007.

Hacıömeroğlu, H. A., Danışoğlu, S., & Güner, Z. N., 2021. For the love of the environment: An analysis of green versus brown bonds during the COVID-19 pandemic. *Finance Research Letters*. 102576. https://doi.org/10.1016/j.frl.2021.102576.

Hyun, S., Park, D., & Tian, S., 2020. The price of going green: The role of greenness in green bond markets. *Accounting and Finance*. 60(1), 73–95. https://doi.org/10.1111/acfi.12515.

Krueger, P., Sautner, Z., & Starks, L. T., 2020. The importance of climate risks for institutional investors. *The Review of Financial Studies.* 33(3),1067–1111. https://doi.org/10.1093/rfs/hhz137.

Larcker, D. F., & Watts, E. M., 2020. Where's the greenium? *Journal of Accounting and Economics*. 69(2–3), 101312. https://doi.org/10.1016/j.jacceco.2020.101312.

Lin, L., & Hong, Y., 2022. Developing a green bonds market: Lessons from China. *European Business Organization Law Review*. 23, 143–185. https://doi.org/10.1007/s40804-021-00231-1.

Lins, K. V., Servaes, H., & Tamayo, A., 2017. Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. *Journal of Finance*. 72(4), 1785–1824. https://doi.org/10.1111/jofi.12505.

OECD., 2017. Green bonds: Mobilising bond markets for a low-carbon transition. http://www.oecd.org/env/mobilising-bond-markets-for-a-low-carbon-transition-9789264272323-en.htm, (accessed 14 January 2022).

Standard & Poor's Ratings Services., 2016. The corporate green bond market fizzes as the global economy decarbonizes. https://www.eticanews.it/wp-content/uploads/2016/05/GreenBond_ReportAnnuale_StandardandPoors.pdf, (accessed 14 January 2022).

Tang, D. Y., & Zhang, Y., 2020. Do shareholders benefit from green bonds? *Journal of Corporate Finance*, 61, 101427. https://doi.org/10.1016/j.jcorpfin.2018.12.001.

Wang, J., Chen, X., Li, X., Yu, J., & Zhong, R., 2020. The market reaction to green bond issuance: Evidence from China. *Pacific Basin Finance Journal*, 60, 101294. https://doi.org/10.1016/j.pacfin.2020.101294.

Zhang, C., & Li, H., 2022. A comparative study on the pricing of green bonds between China and foreign countries. *Chinabond*, (2), 78-82.

Zerbib, O. D., 2019. The effect of pro-environmental preferences on bond prices: Evidence from green bonds. *Journal of Banking and Finance*. 98, 39–60. https://doi.org/10.1016/j.jbankfin.2018.10.012.

Zhang, R., Li, Y., & Liu, Y., 2021. Green bond issuance and corporate cost of capital. *Pacific Basin*

Finance Journal. 69, 101626. https://doi.org/10.1016/j.pacfin.2021.101626.