

# Green Bond Issuance and Corporate's Environmental Performance: Evidence from China

Xia Chen<sup>1</sup>, Md. Atikur Rahaman<sup>2</sup>

<sup>1</sup>Lecturer, School of Management, Jiujiang University, Jiujiang, China

<sup>2</sup>Associate Professor, School of Management, Jiujiang University, Jiujiang, China

**Abstract:** Through a comparative study of listed non-financial companies in China that issued green bonds and ordinary bonds between 2016 and 2021, it was found that the company's green development strategy is an important factor in promoting issuance of green bonds. In addition, public companies and companies with low asset-liability ratios tend to issue more green bonds. Based on the PSM-DID model, it was also found that the green bond can actually improve the environmental performance of the company after its issuance, thus confirming the important role of the company's green development strategy in the promoting the issuance of green bonds. Finally, policy recommendations are made to encourage the issuance of green bonds.

**Keywords:** Corporate, Green bond, Issuance, Green development strategy, Environmental performance.

## 1. Introduction

Since green finance was first placed on the agenda of the G20 summit in 2016, China's green bond market has developed rapidly as a tool to serve China's green development strategy and transformation and upgrade company green's aim. As a new type of debt financing instrument, green bonds have significant green label characteristics compared to traditional bonds. However, the literature conclusions are controversial as to whether the funding cost of a green bond is more advantageous than that of ordinary bonds (Sangiorgi and Schopohl 2021b; Zhang et al. 2021). What attracts companies to issue green bonds and the individual characteristics of the green bond issuer are stimulating topics in academia. Therefore, this paper analyzes the individual characteristics, motivations and environmental performance impacts of corporate green bond issuance and examines the issuance mechanism.

## 2. Current Status of Corporate's Green Bond Issuance in China

In 2015, the People's Bank of China issued the "Catalogue of Green Bond Support Projects (2015 Edition)" and activated China's green bond market at the institutional level. In the same year, the National Development and Reform Commission of China also released the "Green Bond Issuance Guidelines". The main views on supporting the development of green bonds have formed a model of three responsible departments of the People's Bank of China, the National Development and Reform Commission and the China Securities Regulatory Commission. By 2021, the People's Bank of China, the National Development and Reform Commission and the China Securities Regulatory Commission will jointly publish the "Green Bond Support Project Catalog (2021 Edition)", which has formed a unified national regulatory document. The green bond support projects are in the energy saving and environmental protection industries. In the six areas of clean manufacturing, clean energy, green environment, green infrastructure improvement and green services, clean use of coal and other fossil energies have been removed from the green bond

backing area to achieve consistency with standards international municipalities.

According to data from the Climate Bonds Initiative and the China Bond R&D Center of China Central Depository and Clearing Co., Ltd, China has issued a total of \$327 billion in green bonds through 2021, of which nearly \$200 billion will meet the CBI's green bond standard. China has become the second largest green bond market in the world. In addition, China's green bonds also have the following characteristics: (1) in addition to financial institutions, non-financial institutions are becoming increasingly active in issuing green bonds as the main institution, accounting for nearly half of the issue volume; (2) Green bond issuers are mainly composed of public companies; (3) Nearly 90% of the funds raised via green bonds are used for renewable energy, low-carbon transport and low-carbon buildings; (4) Green bond issuers are mainly active in sectors such as utilities, finance and manufacturing (Climate Bonds Initiative and the China Bond R&D Center of China Central Depository and Clearing Co., Ltd 2022).

## 3. Theoretical Analysis and Research Hypothesis

With the emphasis on environmental issues in various countries and the implementation of the concept of corporate social responsibility, environmental responsibility has become an important requirement for traditional institutional investors for investment purposes (Sparkes and Cowton 2004), companies in the field of environmental performance or green development. differences in strategy to reduce investment risk. However, corporate-level environmental governance information is diversified and complex, and investors usually do not have sufficient sources of information to assess the environmental performance of companies, resulting in severe information gaps between companies and investors on environmental governance. asymmetrical. Information asymmetry is an important reason for rising transaction costs and misallocation of resources (Akerlof 1970).

Hence, companies may have the incentive to send specific signals that imitators need expensive imitations to differentiate themselves from other competitors in order to reduce information asymmetry (Riley 1979). The issuance of

corporate green bonds can be seen as a specific outward signal for environmental protection and green development, to reduce the information asymmetry of environmental performance. The reasons are as follows: (1) under bond issuance requirements, companies issuing green bonds must invest some or even all of the money raised in specific green projects rather than high-polluting projects; (2) Although third-party certification of green bonds is not mandatory, however, as an industry practice, most green bond issuers have introduced third-party certification to ensure that their projects are included in the backed project catalog. green bonds; (3) Green bond issuers should regularly disclose information about bonds, including benefits, as well as qualitative or quantitative environmental indicators and assumptions made in quantifying environmental benefits, etc. on the issue of enterprises that can't commit to green development, so they have the function of signal transmission.

Consequently, when a company issues a green bond, the transmission of the signal can have the following impacts on the economic and environmental impacts of the issuer: (1) Economic impacts of the green bond issuance. The signals sent by companies through the issuance of green bonds will help external investors to distinguish between companies engaged in green development strategies and non-green development strategies, reduce information asymmetry and optimize resource allocation. Existing studies have shown that corporate issuance of green bonds can attract investors with green preferences, broaden corporate funding channels, and reduce bond financing costs (Zhang et al. 2021). However, Sangiorgi and Schopohl (2021a) find that there is no significant difference in the interest rate differential between the issuance of green bonds and ordinary bonds. "Main rationale; (2) The environmental governance impact of green bond issuance. Stakeholder theory states that stakeholders provide resources relevant to business survival and development, but also share environmental risks and negative externalities of pollution. Therefore, stakeholders have the incentive to compel companies to assume appropriate environmental responsibilities through contracts and form a joint stakeholder governance model (Spitzeck & Hansen Erik, 2010). The issuance of green bonds is a signal for the green development of companies to the outside world. On the one hand, it attracts investors with a green preference, on the other hand, it also attracts public attention and promotes corporate environmental governance by stakeholders. Additionally, issuing green corporate bonds has established a green reputation for the company's green commitment. The green reputation further limits opportunistic pollution behavior by companies. Flammer's (2021) research on US companies found that companies had higher environmental ratings and lower carbon emissions intensity after issuing green bonds.

Due to the impact of the economic effects of green bond issuance, especially the impact of bond issue costs, there is controversy, which is directly related to whether companies have the motivation to use the policy channel of green bonds to "go green". when issuing green bonds. For this reason, this paper adopts a different perspective and focuses on the environmental management effect of green bond issuance. If the environmental governance effect of enterprises is improved after issuing green bonds, it means that the motivation of enterprises to issue green bonds is mainly their orientation to green development strategy, not the motivation of "green driving". In addition, for the robustness of the research results, this paper also analyzes the individual

characteristics influencing corporate green bond issuance, focusing on whether the company's green development strategy is the most important driver of green bond issuance, to further influence research findings with the environmental governance effect of green bond issuance Echoes.

The original intention of establishing green bonds is to reduce information asymmetry, attract preferred green investors, and guide companies in transforming and upgrading their green development. Business strategy directly affects the company's investment and financing decisions. Combined with the aforementioned theoretical analysis of green bond issuance to reduce information asymmetry, this paper first proposes research hypothesis 1:

Hypothesis 1: The strategic orientation of green corporate development increases the propensity to issue corporate green bonds.

Based on the aforementioned analysis of the environmental governance effects of green bond issuance, this paper proposes research hypothesis 2:

Hypothesis 2: The issuance of green bonds can contribute to improving the environmental performance of companies.

## 4. Research Design

### 4.1. Model specification

To examine the individual characteristics of green bond issuers and test Hypothesis 1, this article references research by Flammer (2021) to create a logit model affecting corporate green bond issuance:

$$G_{i,t} = \alpha_0 + \alpha_1 \text{Size}_{i,t-1} + \alpha_2 \text{Tobin}'Q_{i,t-1} + \alpha_3 \text{Roa}_{i,t-1} + \alpha_4 \text{Lev}_{i,t-1} + \alpha_5 \text{Esg}_{i,t-1} + \alpha_6 \text{Gs}_{i,t-1} + \alpha_7 \text{Soe}_{i,t} + \text{Ind} + \text{Year} + \varepsilon_{i,t} \quad (1)$$

Dependent variable  $G_{i,t}$  is whether company  $i$  issues green bonds in year  $t$ , if issued it is 1, otherwise it is 0. The independent variables in model (1) include the size of the company (Size), the Q value of Tobin (Tobin' Q), return on net assets (Roa), asset-to-liability ratio (Lev), corporate ESG rating (Esg), corporate green development strategy (Gs) and property rights (Soe), etc. Among them, the company's ESG rating data is from Huazheng's ESG rating, and the lowest "C" rating is set to 1, the highest "AAA" rating is set to 9, and the other ratings are ranked into under this order; the company's green development strategy data is from the management's discussion and analysis in the company's annual report, through Python text analysis, to determine whether it has established a green development strategy if it is 1, otherwise it is 0 Except for the nature of the rights real estate sector, the values of the single characteristic variables of the aforementioned issuers are all predetermined with a period in advance to avoid endogenous problems. Furthermore, formula (1) also controls the dummy variables for the industry and year. This article focuses on whether the coefficients of the individual characteristic variables above are statistically significant.

To examine the impact of green bond issuance on post-issuance environmental performance and to test research hypothesis 2, this paper uses a multi-time point DID model for impact analysis. First, PSM propensity matching is performed on the green bond issued samples (treatment group) to obtain the control group. Since the companies in the treatment group issued green bonds in different years, the year in which the companies in each treatment group issued green bonds was selected as the trigger point for the research green

bond issuance. For this reason, this article constructs two dummy variables, one is whether it is a treatment group variable (whether it issued a green bond) *Treat*, i.e. the value of *Treat* is 1 for companies issuing green bonds from 2016 to 2021, otherwise during this period The value is 0 for companies that have issued only ordinary bonds; the second is the dummy variable *Time* of the green bond issuance year, i.e. its value is 1 in the year and later in which the green bond is issued by the treatment group, and 0 otherwise. The control group was treated in the same way as the treatment group by matching them. The multi-time point DID model is as follows:

$$Ep_{i,t} = \alpha_0 + \alpha_1 \text{Treat}_{i,t} + \alpha_2 \text{Time}_{i,t} + \alpha_3 \text{Treat}_{i,t} + \alpha_4 \text{Control Variables}_{i,t} + \epsilon_{i,t} \quad (2)$$

Dependent variable *Ep* is the company's environmental performance. Given the availability of data, this paper uses the company's disclosure in the CSMAR database of whether it received any environmental awards or honors during the year as a proxy for environmental performance. *Treat* is the dummy variable for the treatment group and *Time* is the dummy variable for the year the green bonds were issued. Control variables are control variables at the individual level of the organization. This article focuses on the question whether the interaction coefficient  $\alpha_1$  of *Treat* and *Time* is significant in assessing the impact on environmental performance of green bond issuance.

## 4.2. Samples and data sources

The Chinese green bond market was launched in 2016, so the first research sample period is from 2016 to 2021. In order to make the comparison between green bonds and ordinary bonds comparable and to obtain the data from listed companies, this paper narrows the sample to non-listed financial companies that issued corporate bonds, corporate bonds and medium-term bonds from 2016 to 2021. If a company issues multiple green bonds and common bonds in a given year, only the first green bond record is kept; if multiple common bonds are issued in a given year, only one common bond register is maintained. Ultimately, this paper obtained a total of 582 corporate bond issuance records from 2016 to 2021, including 39 companies that issued green bonds and 543 companies that issued common bonds, which together form an analysis of the characteristics of green bond issuers. green bonds. of samples.

To overcome endogenous problems, the study use PSM to match the companies that issue green bonds and those issue

ordinary bonds. The matching process of the specific control group is as follows: (1) Listed companies that have issued ordinary bonds instead of green bonds; (2) companies in the same industry as the treatment group companies and the year they issued ordinary bonds is the same as the year the treatment group issued green bonds; (3) according to Flammer (2021), setting covariates at the individual firm level such as firm size, Tobin's Q-value, return on total assets, asset-to-liability ratio, firm's ESG rating, etc. ., and the values of the above variables are All are the values of the previous number. By means of the PSM matching above, the business year records of the treatment group and control group in the period before and after the release year are further processed in the sample, and finally 160 samples of business years are obtained.

Bond issue data and Esg data of listed companies in this document are sourced from WIND database, financial data, industry classification data and ownership data are sourced from WIND database. company's green development strategy data comes from analyzing the annual report text of listed companies with Python.

## 5. Empirical Results and Analysis

### 5.1. Descriptive statistics

Table 1 presents the descriptive statistics of the total sample. Considering that some companies have issued bonds repeatedly, this paper selects only non-financial companies that issued ordinary bonds or green bonds for the first time this year-year as the first sample. From 2016 to 2021, a total of 39 non-financial companies issued green bonds (excluding samples that were issued multiple times in a given year). 543 companies only issued ordinary bonds (without models that were issued several times in a given year) but did not issue any green bonds. In this article, samples of companies issuing only regular bonds are used as a control group and companies issuing green bonds are used as a treatment group to compare the differences between the two as a whole. Table 1 shows that there are significant differences between the control group and the treatment group, mainly in the return on net assets (Roa), the ratio of assets to liabilities (Lev) and the company's green development strategy (Greenstrategy ). Compared with regular bond issuing companies, green bond issuing companies have better profitability, lower asset-to-liability ratios, and stronger strategic preferences for green development, tentatively confirming research hypothesis 1.

**Table 1.** Descriptive statistics

variable	Control group (ordinary bond)		Treatment group ( green bond)		Difference mean of T test
	Number of samples	average	Number of samples	average	
size	543	24.75	39	24.57	0.183
To bin'Q	543	1.146	39	1.209	-0.0630
Roa	543	0.0310	39	0.0400	-0.009 *
Lev	543	0.630	39	0.568	0.062**
Esg	543	5.227	39	5.051	0.175
Gs	543	0.337	39	0.564	-0.227***
soe	543	0.711	39	0.821	-0.110

Notes: \*\*\*, \*\*, and \* denote statistical significance at 1%, 5%, and 10% levels respectively.

### 5.2. Regression Analysis

Table 2 shows the results of logit regression using equation (1). Dependent variable *Gbissue* is whether company *i* issues

green bonds in year *t*. Column (1) of Table 2 does not control for industry and year factors, while column (2) includes industry and year factors. Table 2 shows that the main factors influencing the issuance of green bonds are the asset-liability

ratio (Lev), the company's green development strategy (Gs) and the type of ownership (Soe). The coefficient of the asset-liability ratio is negative, suggesting that companies with lower debt ratios are more inclined to issue green bonds and indicating that the financial health of companies is an important factor affecting the impacts of green investments and socially responsible companies (Seifert et al. 2004). The coefficient of the Gs is significantly positive, indicating that the company's green strategic directly affects the direction of the company's green investment. In summary, the result

support the hypothesis 1.

Additionally, coefficient of the type of ownership is also significantly positive, suggesting that state-owned enterprises tend to issue more green bonds than non-state enterprises, which is in line with the statistical results of Climate Bonds Initiative and the China Bond R&D Center of China Central Depository and Clearing Co., Ltd (2022). The result also reflect that the investment and financing behaviors are politically oriented for state-owned enterprises.

**Table 2.** Logit regression analysis of the main characteristics of green bond issuer

Variable	(1)	(2)
size	0.070 (0.464)	0.154 (0.836)
Tobin' Q	-0.044 (-0.123)	0.257 (0.595)
Roa	6.812 (1.021)	10.07 (1.157)
Lev	-2.379 ** (-1.998)	-1.679 * (-1.735)
Esg	-0.201 (-1.313)	0.038 (0.185)
Gs	0.997*** (2.912)	0.696*** (2.693)
Soe	0.785*** (2.775)	0.299** (1.981)
_cons	-3.161 (-0.919)	-36.09 (-0.014)
Ind	No	Yes
Year	No	Yes
N	582	496
Pseudo R <sup>2</sup>	0.067	0.270

Note: (1) Since the value indicating whether samples issue green bonds in certain industries (Treat) remains unchanged, it is automatically canceled during the logit regression, so the sample size is reduced;(2) The t-values are in parentheses. \*, \*\*, and \*\*\*denote significance at the 10%, 5%, and 1% levels, respectively.

Table 3 shows the results of a 1:1 matching based on PSM neighbors. Compared to before matching, the difference in

covariates such as asset-liability ratio and company green development strategy decreased significantly after matching. The T-test results showed that after PSM propensity matching, the covariates between the treatment group and the control group were very close to each other and to the sample. The selectivity bias is reduced, thus satisfying the comparability requirements.

**Table 3.** Propensity score matching results

variable	sample	treatment group	control group	Deviation (%)	Deviation reduction (%)	t	p>t	V(T)/V(C)
size	before matching	24.565	24.81	-18.0		-1.05	0.294	0.88
	after matching	24.537	24.899	-26.6	-48.0	-0.75	0.457	0.99
Tobin' Q	before matching	1.209	1.140	15.2		0.87	0.384	0.80
	after matching	1.117	0.965	33.8	-122.5	1.56	0.107	4.48*
Roa	before matching	0.0404	0.032	28.1		1.58	0.114	0.73
	after matching	0.040	0.033	22.7	19.2	0.89	0.382	5.52*
Lev	before matching	0.567	0.630	-45.6		-2.40	0.017	0.49*
	after matching	0.575	0.596	-15.5	65.9	-0.53	0.597	1.09
Esg	before matching	5.051	5.277	-20.0		-1.19	0.235	0.96
	after matching	4.814	4.777	3.3	83.7	0.08	0.934	1.16
Gs	before matching	0.564	0.332	47.5		2.93	0.004	.
	after matching	0.518	0.555	-7.6	84.0	-0.19	0.852	.
soe	before matching	0.820	0.713	25.4		1.43	0.152	.
	after matching	0.814	0.888	-17.6	30.9	-0.50	0.618	.

Table 4 presents the regression analysis of the impact of green bond issuance on environmental performance based on the PSM-DID model. The dependent variable in columns (1)

to (3) of Table 4 is the environmental performance (Ep), and the coefficient of the interaction term (Treat\*Time) between the treatment group and the year of exposure is significantly

positive, indicating the issuance of green bonds can actually improve corporate environmental performance. Consequently,

hypothesis 2 is verified.

**Table 4.** Impact of Green Bond Issuance on Environmental Performance

Variable	(1)	(2)	(3)
Treat*Time	0.906** (2.259)	0.298* (1.928)	0.104* (1.695)
Time		1.397** (2.401)	2.192*** (2.805)
Treat		0.250 (0.456)	0.491 (0.725)
Size		0.328 (1.443)	0.263 (0.834)
Tobin'Q		2,386 *** (2,578)	2,043 * (1,793)
roa		-28.20 *** (-3,015)	-31.18 *** (-2,806)
lev		-3,176 (-1,499)	-4,931 * (-1,908)
G's		0.840 ** (2,130)	1,164 ** (2,220)
Soe		0.147 (0.310)	0.300 (0.514)
_cons	-0.966 *** (-4.866)	-10.04 * (-1.817)	-20.54 (-0.009)
Ind	No	No	Yes
year	No	No	Yes
N	160	156	148
Pseudo R <sup>2</sup>	0.025	0.134	0.286

## 6. Conclusion

The green bond is an important financial instrument to accompany the green allocation of share capital and the green development of companies. A comparative study of non-financial listed companies in China that issued green bonds and common bonds between 2016 and 2021 shows that the company's green development strategy is an important factor in promoting corporate green bond issuance. The proprietary rights nature of SOEs and the low asset-to-liability ratio shape the individual characteristics of green bond issuers. It was also found through the PSM-DID model that green bond issuance can effectively improve the post-issuance environmental performance of companies, indicating that the information asymmetry caused by the signal transmission mechanism of green bond issuance is reduced and the green bond green reputation mechanism promotes corporate environmental performance. Environmental management also verified that the company's green development strategy is an important factor influencing the issuance of green bonds. Based on the above findings, this document makes the following policy proposals: (1) it is important to improve the direction of green development strategy at the institutional level, including the level of environmental monitoring and green bonds, and provide guidance for the allocation of green resources by companies; (2) It is also noteworthy to develop green bond market and reduce the cost of green bond financing for enterprises, and then promote the environmental governance effect of green bond.

## Acknowledgment

This work was supported by the Humanities and Social Sciences Research Project of Jiangxi Provincial Department of Education(Grant JC18204) and the Science and

Technology Research Project of Jiangxi Provincial Department of Education(GJJ170958).

## References

- [1] Akerlof, G. A. 1970. The Market for "Lemons": Quality Uncertainty and the Market Mechanism\*. *The Quarterly Journal of Economics* 84(3):488-500.
- [2] Flammer, C. 2021. Corporate green bonds. *Journal of Financial Economics* 142 (2):499-516.
- [3] Climate Bonds Initiative and the China Bond R&D Center of China Central Depository and Clearing Co., Ltd. 2022. *China Green Bond Market Report 2021*.
- [4] Riley, J. G. 1979. Informational equilibrium. *Econometrica: Journal of the Econometric Society*:331-359.
- [5] Sangiorgi, I., and L. Schopohl. 2021a. Explaining green bond issuance using survey evidence: Beyond the greenium. *The British Accounting Review*:101071.
- [6] Sangiorgi, I., and L. Schopohl. 2021b. Why do institutional investors buy green bonds: Evidence from a survey of European asset managers. *International Review of Financial Analysis* 75:101738.
- [7] Seifert, B., S. A. Morris, and B. R. Bartkus. 2004. Having, giving, and getting: Slack resources, corporate philanthropy, and firm financial performance. *Business & Society* 43 (2):135-161.
- [8] Sparkes, R., and C. J. Cowton. 2004. The maturing of socially responsible investment: A review of the developing link with corporate social responsibility. *Journal of Business Ethics* 52 (1):45-57.

- [9] Zhang, R., Y. Li, and Y. Liu. 2021. Green bond issuance and corporate cost of capital. *Pacific-Basin Finance Journal* 69:101626.