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Do Green Bonds Enhance Corporate ESG Performance? Micro Data Analysis Based on Chinese Listed Companies

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***A*bstract:** This study researches the benefits of green bonds of Chinese listed enterprises in China and their ESG performance under the carbon peak and neutrality targets proposed in China, focusing on bond issuance scale, use of raised funds, bond maturity, post-issuance corporate profit, carbon dioxide emission reduction, and energy savings. Using panel data to investigate the economic drivers of the benefits of green bonds in Chinese listed enterprises through a panel data with a heterogeneity test. Our results reveal a positive relationship between green bonds and the ESG performance of the enterprises. That means the issuance of green bonds is beneficial to the ESG rating. At the same time, due to the differing nature of enterprises, the issuance of green bonds has different impacts on the enhancement of their ESG scores. Firms with weaker financing constraints experience greater benefits from issuing green bonds in terms of enhanced ESG scores, while enterprises with higher initial ESG scores tend to achieve even higher scores after issuing green bonds. The driving factors of the ESG performance benefits for Chinese listed enterprises are mainly the information disclosure, environmental benefits, and social responsibility. Research results may help Chinese listed enterprises to improve the benefits of green bonds and contribute effectively to the green transformations of enterprises.

Keywords: Green bonds; ESG performance; Carbon peak and neutrality; Heterogeneity test

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1. Introduction

Addressing ecological concerns like global climate change and environmental pollution, and effectively reducing greenhouse gas emissions has become a focal point in today's world. At the enterprise level, carbon reduction measures, and at the national level, energy policy transformations are key response strategies. As one of the world's top carbon emitters and major energy consumers, China faces severe environmental challenges [1]. To address this, China has set a "carbon neutrality and peak carbon" target that aligns with global trends. Green finance plays a pivotal supporting role in achieving this goal. According to data from the National Development and Reform Commission and the China Investment Association, the investment needed for carbon reduction to

achieve China's carbon neutrality goal over the next 40 years ranges between 70 trillion and 139 trillion yuan.

Faced with such a huge financing demand, green finance paved new financing avenues for Chinese enterprises, especially by issuing green bonds to raise funds for corporate carbon reduction projects, which has become a convenient path for public financing [2]. However, the current market size of green finance in China is small and started relatively late, and there is still a considerable gap compared to developed Western countries. Therefore, incentives and support for green investment still need to be strengthened. It is worth noting that green bonds are an important pillar of green finance, crucial for financing green projects and transitioning to a carbon-neutral economy [3]. As shown in **Figure 1**, the green bond market in China commenced in 2015, experiencing steady growth at a certain rate from 2016 to 2019. The total issuance volume reached RMB 2,614.84 billion during this period, with the number of green bond issuances generally showing an upward trend and accelerating in growth from 2019 onwards. Compared to 2016, the issuance volume in 2022 increased by 877.36%, with the number of issuances reaching 518. The future of China's green financial market is favorable.

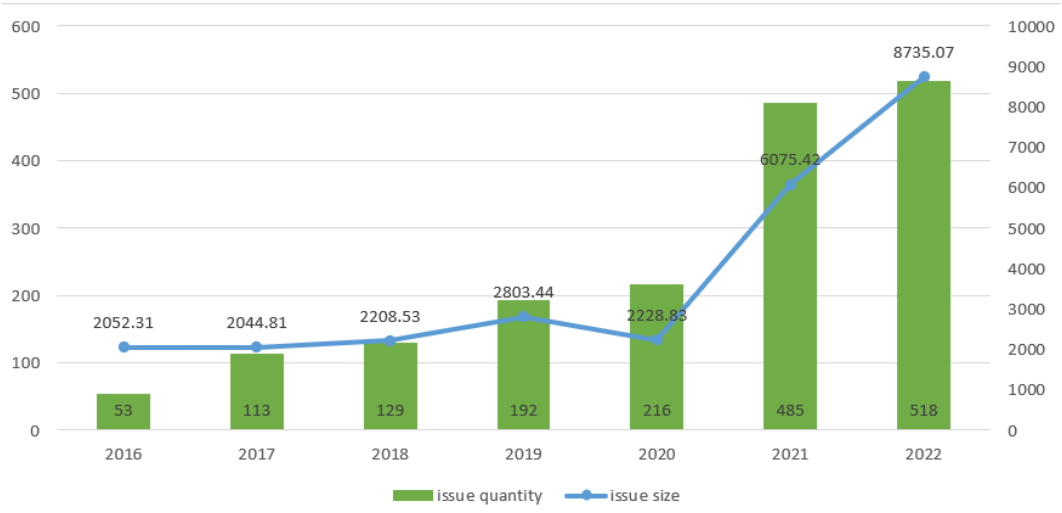

Figure 1. The issuance of green bonds in China from 2016 to 2022

To further explore, this article selects A-share listed companies in the Shanghai and Shenzhen stock markets from 2009 to 2022 as empirical test samples. The data of ST stocks and main board financial industry stocks are excluded from the research sample, and the missing values in the sample are also removed. Finally, 29912 observation data are obtained. In addition, to avoid the influence of extreme values on this study. The financial and governance data utilized in this study are primarily sourced from the CSMAR database and the WIND database. Use econometric models such as bidirectional fixed effects, DID, and mediation effects to conduct analysis. The above analysis indicates that the issuance of green bonds has a significant positive impact on a company's performance in environmental, social, and governance (ESG) aspects.

The marginal contributions of this paper are as follows. Firstly, it incorporates green bonds into the framework of analyzing corporate financing efficiency, establishing a theoretical connection between green bonds and corporate financing efficiency. By introducing an ESG scoring system, it analyzes the significant positive impact of high-rated companies issuing green bonds on their performance in environmental, social, and governance (ESG) aspects. Secondly, in terms of research methodology, this article adopts a bidirectional fixed effects model to control for potential time and industry effects. Additionally, to comprehensively examine the impact of green bond

issuance on corporate ESG ratings, this article introduces multiple control variables, including corporate size, asset liability ratio, number of board members, financial and governance indicators, etc. Furthermore, considering the possibility of omitted variables, this article also conducted multidimensional control to enhance the robustness of the results. Regarding the structure of the remaining parts of the paper, Section 2 reviews the literature, Section 3 presents the research design, Section 4 conducts empirical results analysis, and Section 5 draws conclusions and provides corresponding suggestions.

2. Literature review

In 2007, the European Investment Bank (EIB) issued the world's first green bond to the 27 member states of the European Union, marking the beginning of the global green bond market [4]. Then the United Nations Framework Convention on Climate Change further established the concept of climate financing, and international organizations such as the G20 and the International Monetary Fund (IMF) recognized the important value of green bonds. The OECD and the International Energy Agency (IEA) also advocated for governments to use green bonds to address climate financing challenges. The People's Bank of China announced that it would issue green bonds in the inter-bank market and determine the Catalog of Green Bond Support Projects in 2015, which officially launched China's green bond market. China is now one of the world's top green bond issuers. In 2016, the issuance of China's green bonds exceeded one-third of the global green bond issuance (USD 81 billion), ranking first in the world. Green bonds have lower financing costs or higher prices compared to traditional bonds. Therefore, the market has a higher recognition of green bonds. It has promoted the reduction of enterprise financing costs and the improvement of financing efficiency.

Although the market size of green bonds in China is large, the quality of green bonds issued by different companies varies greatly [5]. Because of the significant gap in the quality of green bonds, research has also focused on the benefits of Chinese companies issuing green bonds. One side believes that China's green bond market is still in the development stage, and it is necessary to stimulate the development of this emerging product in the current limited degree of liberalization of China's bond market [6]. As an innovative financial instrument, green bonds are fundamentally aimed at raising capital for environmentally friendly, climate-adaptive, and sustainable projects. The issuance of green bonds by enterprises not only facilitates the fundraising for environmental protection and sustainable development projects but also significantly enhances their ESG performance. Our research starts from the differences in the quality of green bonds to observe whether the enhancement of ESG performance resulting from the issuance of green bonds differs among enterprises based on their nature, it is necessary to further explore the factors that contribute to the improvement in ESG performance due to green bonds, as well as the deeper causes underlying the variability in these impacts. Based on the above analysis, the first hypothesis is proposed:

H1: Issuing green bonds can improve the enterprise's ESG performance.

The issuance of green bonds, as a practice of financial innovation, typically entails stricter transparency requirements and more rigorous external oversight compared to traditional bonds [7]. This characteristic necessitates enterprises to provide detailed and accurate information across various aspects, including financial disclosure, project progress, and fund utilization, to undergo stringent scrutiny by multiple stakeholders, including investors, regulatory bodies, and environmental organizations. Such external pressures oblige enterprises to scrutinize and enhance their internal governance mechanisms by establishing robust internal control systems, strengthening risk management and compliance, thereby enhancing the ESG rating, standardization, and transparency of their

decision-making processes. To ensure that the ESG projects supported by green bonds can effectively achieve their predetermined objectives and align closely with the long-term development strategies of the enterprises, they must undertake deep integration in crucial areas such as strategic planning, resource allocation, and performance evaluation, forming a comprehensive management system that incorporates ESG factors. This not only contributes to enhancing the enterprises' sustainable development capabilities but also bolsters their market competitiveness, earning the trust and support of more stakeholders [8].

The issuance of green bonds has a positive impact on enhancing corporate ESG scores. However, when delving deeper into this positive effect, it is imperative to acknowledge that the magnitude of this enhancement is not uniform across all enterprises, but rather exhibits notable variations among enterprises of different natures. The roots of this variability lie in the differing starting points of enterprises of various natures in terms of the environmental, social, and governance dimensions, as well as in their varying degrees of emphasis and implementation efforts towards the ESG concept. Additionally, when selecting projects to fund through green bonds, enterprises also prioritize based on their own nature, industry characteristics, and market positioning. This variability in project selection similarly influences the effectiveness of green bonds in enhancing corporate ESG scores. Based on the above analysis, the second hypothesis is proposed:

H2: The enhancement of a corporation's ESG performance through green bond issuance can be attributed to information disclosure.

The issuance of green bonds requires enterprises to adhere to stringent disclosure standards, encompassing details on the issuance of green bonds, the utilization of raised funds, the progress and environmental benefits of green projects, as well as the management of these funds. Through regular reporting and disclosure during the bond's lifetime, enterprises are able to communicate their commitment to green transformation and tangible achievements to the market [9]. This enhanced transparency serves to bolster investor confidence while also facilitating oversight by regulatory bodies and the public. Furthermore, the issuance of green bonds prompts enterprises to establish more robust green financial management systems, thereby further elevating their ESG management capabilities. The funds raised through green bond issuance are primarily utilized to support green projects such as environmental protection, energy conservation, and emission reduction. The implementation of these projects can significantly reduce carbon emissions and environmental pollution from enterprises, while enhancing resource utilization efficiency. For instance, enterprises can invest the proceeds from green bonds in renewable energy projects and energy-saving and emission-reduction technologies, thereby achieving notable improvements in environmental performance. This, in turn, creates a more favorable social environment and development space for enterprises [10].

3. Research design

3.1. Data and variables

The financial data of enterprises and green bond data used in this paper primarily originate from the CSMAR database, while the corporate ESG score data are sourced from the WIND database. For empirical testing, this paper selects A-share listed companies from the Shanghai and Shenzhen stock exchanges between 2009 and 2022 as the sample. Within the research sample, ST stocks and data from stocks in the main board financial industry are excluded to mitigate the influence of outliers on the study. Furthermore, to avoid the impact of extreme values on this study, the continuous variables have undergone a 1% Winsorize treatment.

Finally, we get 29912 valid data points. All control variables at the enterprise level are also taken from the CSMAR database. All listed enterprises in China's A-share market from 2009 to 2022 were selected as the initial research sample, and "financial institutions," "ST," and "ST*" samples were excluded. The data were eventually deflated at the 1% and 99% levels to mitigate the effects of potential outliers.

The research variables involved in this paper are as follows:

(1) Dependent variable: Corporate ESG Score

(2) Independent variable: Issuance of Green Bonds

(3) Control variables: Firm Size (SIZE), Debt-to-Asset Ratio (LEV), Return on Assets (ROA), Cash Flow Ratio (CASHFLOW), Revenue Growth (GROWTH), Number of Board Members (BOARD), Proportion of Independent Directors (INDEP), Shareholding Ratio of the Top Five Shareholders (TOP5), Firm Age (LISTAGE), as well as industry dummy variables and year dummy variables.

All the variables are shown in **Table 1**.

Table 1. Variable description

Variable type	Variable symbol	Variable name	Variable measurement method
Dependent variable	Corporate ESG Score	*ESG*	Wind ESG rating, scored from 1 to 8
Independent variable	Issuance of Green Bonds	*DID*	1 if green bonds were issued in the current year, 0 otherwise
Control variables	Firm Size	*Size*	Logarithm of total assets
	Return on Assets	*Roa*	Net profit /Average total assets
	Debt-to-Asset Ratio	*Lev*	Total liabilities/ Total assets
	Cash Flow Ratio	*Cashflow*	(Revenue-previous year's revenue)/Previous year's revenue
	Revenue Growth Rate	*Growth*	(Cash + Cash equivalents)/Current liabilities
	Board Members	*Board*	Logarithm of the number of board members
	Independent Directors Ratio	*Indep*	Number of independent directors divided/number of board members
	Shareholding Ratio of the Top Five Shareholders	*Top5*	Sum of the shareholding ratios of the top five shareholders
	Firm Age	*Listage*	Calculated from the year of listing, excluding years of delisting

3.2. Model establishment

This paper establishes a two-way fixed effects model to explore the impact of green bond issuance on corporate ESG scores. The model is formulated as follows:

$$ESG_{it} = \beta_0 + \beta_1 DID_{it} + \beta_2 control_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

Based on the relevant data, the descriptive statistical analysis results obtained in this paper are presented in **Table 2**.

Table 2. Variable summary

Variable	Obs	Mean	Std. Dev.	Min	Max
ESG	29912	4.113	.952	1	8
DID	29912	.008	.089	0	1
Size	29912	22.113	1.275	19.415	26.43
Lev	29912	.407	.204	.027	.925
ROA	29912	.041	.069	-.375	.254
Cashflow	29912	.047	.069	-.224	.283
Growth	29912	.164	.385	-.653	3.808
Board	29912	2.109	.195	1.609	2.708
Indep	29912	37.736	5.407	25	60
Top5	29912	.534	.152	.177	.892
ListAge	29912	2.036	.901	0	3.401

As shown in the table above, this paper conducted a descriptive statistical analysis of all research variables in Regression Model 1. The basic situation of each indicator variable, as revealed by the descriptive statistical analysis, is as follows:

(1) Corporate ESG Score: The maximum value is 8, the minimum value is 1, the mean is 4.133, and the standard deviation is 0.952. This indicates that the overall ESG performance of the sample listed companies is around the average, with significant individual differences in ESG scores among the sample companies.

(2) Bond Issuance: The mean is 0.008, indicating that only 0.8% of the sample listed companies have issued green bonds.

4. Empirical results

4.1. Benchmark regression

Pairwise correlation analysis primarily serves to measure the linear relationship between two economic variables. By calculating the correlation coefficient, it clarifies whether the variables are positively correlated, negatively correlated, or uncorrelated, thereby revealing the interactions and influences among different variables in economic phenomena. This method not only aids in the construction of economic models by screening and identifying key variables, but also enhances the accuracy and reliability of these models.

As shown in **Table 3**, the impact of green bond issuance on corporate ESG scores is statistically significant at the 1% level, indicating that green bond issuance can improve corporate ESG scores. The impacts of the remaining variables on corporate ESG scores are statistically significant at levels above 5%. This aligns with the previous hypotheses. Therefore, we can conduct further modeling to analyze the relationships between these variables.

Table 3. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) ESG	1.000										
(2) DID	0.054***	1.000									
(3) Size	0.180***	0.185***	1.000								
(4) Lev	-0.109***	0.087***	0.506***	1.000							
(5) ROA	0.239***	-0.010*	-0.016***	-0.374***	1.000						
(6) Cashflow	0.090***	0.018***	0.081***	-0.150***	0.383***	1.000					
(7) Growth	0.014**	-0.004	0.040***	0.027***	0.275***	0.031***	1.000				
(8) Board	0.015***	0.045***	0.235***	0.128***	0.026***	0.043***	0.002	1.000			
(9) Indep	0.071***	-0.003	-0.006	-0.008	-0.020***	-0.006	-0.005	-0.568***	1.000		
(10) Top5	0.150***	0.037***	0.069***	-0.098***	0.240***	0.105***	0.057***	0.001	0.029***	1.000	
(11) ListAge	-0.117***	0.072***	0.492***	0.392***	-0.256***	0.028***	-0.075***	0.139***	-0.006	-0.341***	1.000

***$P < 0.01$, **$P < 0.05$, *$P < 0.1$

In terms of research methodology, we used a two-way fixed effects model to control for potential time and industry effects. Additionally, to comprehensively examine the impact of green bond issuance on corporate ESG scores, multiple control variables are introduced, including firm size, debt-to-asset ratio, board size, and financial and governance indicators. Furthermore, to address potential omitted variable issues, multidimensional controls are implemented to enhance the robustness of the results.

Table 4 presents the regression results of the two-way fixed effects model. Specifically, column (1) displays the regression results without control variables, while column (2) shows the results with control variables included. As evident from **Table 4**, regardless of whether control variables are included, the impact of green bond issuance on corporate ESG scores is statistically significant and positive at the 1% level. This implies that the issuance of green bonds has a significant positive impact on a company's ESG performance. Specifically, by raising funds through the issuance of green bonds to support environmental protection or sustainable development projects, companies enhance their ESG scores. ESG scores are crucial indicators of a company's performance in sustainable development, often scrutinized by investors and regulatory bodies. After incorporating control variables such as firm size, industry, and financial condition, the results remain significantly positive, indicating that the positive impact of green bond issuance on corporate ESG scores is robust and not altered by other potential factors. Therefore, Hypothesis 1 is verified. These findings suggest that green bonds not only facilitate the transition of companies towards sustainable development but also elevate their image among investors and in the market, potentially leading to more investment opportunities and favorable financing conditions.

Table 4. DID regression results

	(1)	(2)
DID	0.603***	0.215***
	(9.87)	(3.79)
Size		0.284***
		(49.69)
Lev		-0.863***
		(-25.89)
ROA		1.960***
		(21.32)
Cashflow		0.092
		(1.13)
Growth		-0.108***
		(-7.86)
Board		0.137***
		(4.16)
Indep		0.015***
		(13.72)
Top5		0.116**
		(3.05)
ListAge		-0.198***
		(-25.89)
ind	yes	yes
year	yes	yes
N	29912	29912
R^2	0.063	0.214
adj. R^2	0.06	0.21

t statistics in parentheses; *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

4.2. Heterogeneity test

To delve deeper into the impact of green bond issuance on corporate ESG scores and their variability across different enterprises, this study further conducted heterogeneity tests. We classified the samples based on the ownership nature of enterprises and whether they were audited by the Big Four international accounting firms, and analyzed the specific effects of green bond issuance on ESG scores for various types of enterprises. As shown in **Table 5**, column (1) shows non-state-owned enterprises, column (2) represents state-owned enterprises, column (3) displays enterprises that have not been audited by the Big Four accounting firms, and column (4) represents enterprises audited by the Big Four accounting firms.

The research results revealed that the enhancing effect of green bond issuance on corporate ESG scores was particularly pronounced among non-state-owned enterprises and those not audited by the Big Four. Non-state-owned enterprises tend to pay greater attention to environmental and social responsibilities in the market and seek to enhance their competitiveness through differentiation strategies. The issuance of green bonds aligns well with this strategy, serving as a means to convey to the market and investors the enterprise's commitment to fulfilling environmental and social responsibilities. This signaling has a positive effect on elevating the enterprise's ESG

score and significantly boosting its ESG performance. Concurrently, for enterprises not audited by the Big Four international accounting firms, the issuance of green bonds also exhibited a significant positive impact on ESG scores. This may be related to these enterprises' tendency to utilize green bonds to demonstrate their commitment and determination towards sustainable development.

Table 5. Heterogeneity regression results

	(1)	(2)	(3)	(4)
DID	0.382***	0.113	0.172**	0.082
	(3.86)	(1.64)	(2.67)	(0.74)
Size	0.262***	0.310***	0.270***	0.323***
	(35.95)	(32.21)	(43.95)	(14.78)
Lev	-0.841***	-0.910***	-0.836***	-0.696***
	(-20.60)	(-15.26)	(-24.60)	(-3.60)
ROA	1.888***	1.941***	2.015***	1.058*
	(17.85)	(10.44)	(21.57)	(2.03)
Cashflow	0.224*	0.002	0.090	0.644
	(2.30)	(0.02)	(1.09)	(1.58)
Growth	-0.090***	-0.108***	-0.109***	-0.096
	(-5.52)	(-4.35)	(-7.79)	(-1.41)
Board	0.100*	0.076	0.125***	0.127
	(2.42)	(1.35)	(3.68)	(1.02)
Indep	0.014***	0.015***	0.014***	0.025***
	(9.51)	(7.94)	(12.37)	(5.50)
Top5	0.048	0.003	0.058	0.380*
	(1.01)	(0.04)	(1.47)	(2.33)
ListAge	-0.253***	-0.114***	-0.205***	-0.042
	(-26.30)	(-7.75)	(-26.17)	(-1.18)
ind	yes	yes	yes	yes
year	yes	yes	yes	yes
N	20252	9658	28480	1430
R^2	0.213	0.266	0.201	0.416
adj. R^2	0.21	0.26	0.20	0.38

t statistics in parentheses; *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

4.3. Mechanism verification

To explore the impact pathway of green bond issuance on corporate ESG scores, this study selected information disclosure quality as a mediator and employed a three-step mediation effect method for mechanism testing. As shown in **Table 6**, column (1) represents the regression model where the ESG score serves as the dependent variable, with the generated dummy variable DID acting as the explanatory variable. Column (2), on the other

hand, presents the regression model between the dummy variable DID and the mediator variable information disclosure quality. Column (3) signifies the regression model in which the dummy variable DID and information disclosure quality are the explanatory variables, while the ESG score is the dependent variable.

The result showed that the impact of green bond issuance on corporate information disclosure quality was statistically significant at the 1% level. In the regression results incorporating the DID dummy variable, the significance remained unchanged, and the dummy variable DID was significantly positive. This indicates that the issuance of green bonds by enterprises can significantly improve their information disclosure quality and further enhance their ESG scores. We can find that the issuance of green bonds by enterprises can significantly improve their information disclosure quality, which in turn further promotes the improvement of their ESG scores. Therefore, Hypothesis 2 is verified. This discovery not only reveals the positive impact pathway of green bond issuance on corporate ESG scores but also provides important references and insights for investors, regulatory agencies, and enterprises themselves.

Table 6. Mediating regression results

	(1)	(2)	(3)
DID	0.215***	0.173***	0.156*
	(3.79)	(4.67)	(2.38)
Size	0.284***	0.142***	0.235***
	(49.69)	(38.22)	(22.67)
Lev	-0.863***	-0.369***	-0.737***
	(-25.89)	(-16.97)	(-12.99)
ROA	1.960***	2.451***	1.122***
	(21.32)	(40.87)	(8.63)
Cashflow	0.092	0.170**	0.034
	(1.13)	(3.21)	(0.34)
Growth	-0.108***	-0.017	-0.102***
	(-7.86)	(-1.88)	(-7.28)
Board	0.137***	0.150***	0.085
	(4.16)	(7.01)	(1.48)
Indep	0.015***	0.002*	0.015***
	(13.72)	(2.21)	(7.93)
Top5	0.116**	0.260***	0.027
	(3.05)	(10.50)	(0.39)
ListAge	-0.198***	-0.013**	-0.194***
	(-25.89)	(-2.65)	(-15.28)
Information			0.342***
			(26.92)
ind	yes	yes	yes
year	yes	yes	yes
N	29912	29912	29912
R^2	0.214	0.200	0.253
adj. R^2	0.21	0.20	0.25

t statistics in parentheses; *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

4.4. Robustness tests

To ensure the accuracy of the results, this paper conducted robustness checks by replacing the original dependent variable with the Chinese numerical value of ESG scores and altered the cluster error adjustment to align the regression model with individual-level adjustments (**Table 7**). Column (1) presents the robustness check results after replacing the original variable, while column (2) displays the outcomes of the cluster error adjustment.

Following the robustness checks, this paper found a significant positive correlation between green bond issuance and corporate ESG scores. At the 5% statistical significance level, green bond issuance was found to significantly enhance corporate ESG scores. This result further validates the positive impact of green bond issuance on corporate ESG scores and demonstrates the reliability of the baseline regression conclusions.

Table 7. Robust regression results

	(1)	(2)
DID	0.197***	0.215**
	(3.31)	(3.20)
Size	0.283***	0.284***
	(47.24)	(25.97)
Lev	-0.860***	-0.863***
	(-24.60)	(-14.43)
ROA	2.004***	1.960***
	(20.79)	(14.13)
Cashflow	0.088	0.092
	(1.03)	(0.89)
Growth	-0.102***	-0.108***
	(-7.06)	(-7.42)
Board	0.132***	0.137*
	(3.82)	(2.26)
Indep	0.015***	0.015***
	(12.89)	(7.85)
Top5	0.093*	0.116
	(2.34)	(1.61)
ListAge	-0.193***	-0.198***
	(-24.12)	(-14.88)
ind	yes	yes
year	yes	yes
N	29912	29912
R^2	0.196	0.214
adj. R^2	0.19	0.21

t statistics in parentheses; *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

5. Conclusion and suggestions

5.1. Conclusion

Under the guidance of China's dual-carbon goals (carbon peaking and carbon neutrality), how enterprises can undergo green transformation while overcoming financing challenges has always been a critical issue. China has also made numerous efforts to improve the green financial market, carbon trading market, and related legal policies in order to achieve the goal of green transformation. With the introduction of policies encouraging enterprises' green transformation and the development of green industries in China, as well as the increasing practical demands for corporate financing and technological research and development, green bonds are ushering in an opportunity for development. This paper investigates the ESG performance of China's A-share listed enterprises based on the data from 2016 to 2023. We find that the green bonds have improved corporate ESG performance in the short term after establishing green bonds, and as the green projects invested in through green bonds mature over time, the technology spillover effect can lead to an improvement in the ESG scores of the industry in which the enterprise belongs. These results align with the findings of previous research. However, we systematically incorporated various inter-firm difference factors in this study from the perspective of financing constraints into a comprehensive examination framework, with the objective of conducting a more thorough analysis of ESG rating increment derived from green bond issuance for listed companies in China's A-share market [11]. Through empirical analysis of relevant data from A-share listed companies in China, we observed that the issuance of green bonds not only generates substantial financial benefits for these enterprises but also yields positive societal benefits to raise ESG performance. Furthermore, we identified that the issuance of green bonds by enterprises effectively enhances their ESG scores by improving the quality of information disclosure. Comprehensive information disclosure enables stakeholders, including investors, regulatory bodies, and the public, to gain a thorough understanding of the enterprises' environmental and social performance, thereby assessing their progress in achieving sustainable development goals. By reporting on the utilization of funds raised through green bonds, reductions in carbon emissions, or increases in renewable energy capacity, enterprises can elevate their ESG scores, gain the trust of investors, and attract more investors who prioritize ESG factors in their investment decisions. These conclusions provide policy references for China's green bond financial policies and offer financial guidance for enterprises' green transformation strategies.

5.2. Limitations and suggestions for future research

In the selection of data samples, this paper is constrained in that it solely relies on the financial data of A-share listed companies in China based on the current development status of the Chinese carbon financial market. However, Chinese enterprises show unique characteristics that differ from global enterprises in various aspects, such as the green bond development stage, financing channels, and financing regulation. Meanwhile, Chinese investors demonstrate different behaviors when investing in green projects, leading to limitations in sample data selection for this study. Future research directions can focus on the impact of financing constraints on corporate ESG scores. The heterogeneity analysis in this paper merely points out that the intensity of financing constraints (e.g., whether audited by the Big Four international audit firms) affects corporate ESG scores, without conducting an in-depth analysis of the underlying mechanisms. Future studies can expand upon this foundation, broaden the scope of research, and employ a wider range of data in terms of time and space, as well as different models and methodologies.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Li Y, Yu C, Shi J, et al., 2023, How Does Green Bond Issuance Affect Total Factor Productivity? Evidence from Chinese Listed Enterprises. Energy Econ, 123: 106755.

[2] Brammer S, Brooks C, Pavelin S, 2006, Corporate Social Performance and Stock Returns: UK Evidence from Disaggregate Measures. Financ Manage, 35: 97–116.

[3] Nollet J, Filis G, Mitrokostas E, 2016, Corporate Social Responsibility and Financial Performance: A Non-Linear and Disaggregated Approach. Econ Model, 52: 400–407.

[4] Bedendo M, Nocera G, Siming L, 2023, Greening the Financial Sector: Evidence from Bank Green Bonds. J. Bus. Ethics, 188: 259–279.

[5] Russo A, Mariani M, Caragnano A, 2021, Exploring the Determinants of Green Bond Issuance: Going Beyond the Long-Lasting Debate on Performance Consequences. Bus Strat Env, 30: 38–59.

[6] Chen YJ, Sheu JB, 2009, Environmental-Regulation Pricing Strategies for Green Supply Chain Management. Transport. Res. Part E: Logist. Transport. Rev., 45(5): 667–677.

[7] Xu L, Yang L, Li D, et al., 2023, Asymmetric Effects of Heterogeneous Environmental Standards on Green Technology Innovation: Evidence from China. Energy Econ, 117: 106479.

[8] Helmrich R, Jans R, van den Heuvel W, et al., 2015, The Economic Lot-Sizing Problem with an Emission Capacity Constraint. Eur. J. Oper. Res., 241(1): 50–62.

[9] Bai Y, Ding X, Jiang L, 2024, Corporate Environmental Pictures Information Disclosure and Investor Market Reaction: A New Perspective from Large-Scale Pictures Feature Mining. J. Clean. Prod., 437: 140616.

[10] Barrena Martínez J, López Fernández M, Romero Fernández PM, 2016, Corporate Social Responsibility: Evolution through Institutional and Stakeholder Perspectives. Eur J Manag Bus Econ, 25: 8–14.

[11] Orlitzky M, Schmidt FL, Rynes SL, 2003, Corporate Social and Financial Performance: A Meta-Analysis. Organ Stud, 24: 403–441.