

The Impact of Carbon Emissions Trading on Corporate Financing Costs

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Abstract. Being a representative market-based environmental regulation tool, how carbon emissions trading affects corporate financing costs and its transmission mechanism represent key topics in green finance literature. With China's carbon emission trading pilot programs taken as a quasi-natural experiment framework, the research draws on A-share listed enterprises as its sample. It examines how the carbon trading mechanism affects corporate debt financing expenses and how financing structure and carbon information disclosure moderate this relationship. Results show that inclusion in the carbon trading market significantly reduces firms' debt financing costs by improving carbon information transparency and alleviating bank-firm information asymmetry. Financing structure plays a positive moderating role: firms with a higher share of long-term liabilities experience a larger reduction in financing costs. Meanwhile, carbon information disclosure quality negatively moderates the above relationship. This paper clarifies the transmission mechanism of carbon emissions trading on corporate financing costs from the perspectives of financing structure and information disclosure, and provides policy implications for carbon market system design and financial resource allocation.

Keywords: carbon emissions trading, financing cost, financing structure

1. Introduction

Debt financing serves as a key source of external capital, and its cost is significantly affected by environmental regulation. Existing literature indicates that mandatory regulation raises the debt financing costs of high-carbon enterprises, whereas carbon emissions trading, as a market-based regulatory instrument, may exert the opposite effect. Since China's carbon trading pilot launched in 2011, studies have found that carbon trading stimulates green innovation, improves productivity, enhances carbon disclosure, and coordinates environmental governance with economic growth via price signals [1]. Debt maturity affects creditors' sensitivity to long-term environmental risks, and the quality of carbon disclosure directly influences whether carbon trading signals can be reasonably priced by financial markets. This paper aims to answer the following questions: in which ways does the carbon pilot policy influence enterprises' debt financing expenses, and how do the differences in financing structure and carbon information disclosure play a regulatory role in it?

Existing literature mainly analyzes the economic consequences of carbon emissions trading from the perspectives of environmental regulation types, corporate technological innovation, and productivity changes. However, research gaps remain regarding the joint moderating mechanism of financing structure differences and carbon information disclosure on debt financing costs [2]. Against the institutional background of China's carbon trading pilot policy, this paper systematically tests how carbon emissions trading actually affects corporate debt financing costs and analyzes the moderating roles of financing structure and carbon information disclosure quality. This paper clarifies the structural transmission path through which carbon emissions trading affects financing costs. Theoretically, this paper reveals the micro-mechanism through which market-based environmental regulation affects corporate financing decisions via financing structure and information channels, and enriches the interdisciplinary research of environmental economics and corporate finance. In practice, the findings provide a reference for improving the national carbon market system design, guiding financial institutions to implement differentiated carbon risk pricing, and formulating targeted green credit policies. They help achieve the coordinated optimization of environmental governance and financial resource allocation.

2. Theoretical mechanism and research hypothesis

Carbon emission trading affects the financing cost of enterprises through two channels. First, carbon emission trading guides enterprises to optimize their carbon emission behaviors via price signals. Enterprises with lower emission reduction costs can gain additional revenue by selling quotas, which enhances cash flow stability and solvency and reduces default risk expectations. Enterprises with higher emission reduction costs gain compliance flexibility by purchasing quotas to avoid business interruptions caused by administrative penalties or production suspension for rectification, thereby curbing creditors' risk premium demands [3]. The carbon emissions trading system can significantly reduce enterprises' equity financing costs by mitigating information asymmetry and transmitting positive signals, and this effect also applies to the debt financing market [4]. Second, the carbon trading mechanism mandates enterprises to conduct carbon emission accounting and third-party verification. The transparency and credibility of corporate environmental information are thereby enhanced, bank-firm information asymmetry is alleviated, and the risk premium demanded by creditors due to information disadvantages is reduced [5]. Financing costs are largely determined by capital structure and information transparency, and the reduction of information asymmetry will help enterprises obtain more favorable financing conditions. Optimizing the financing structure and improving information transparency are also important ways to reduce the financing cost of enterprises. Accordingly, this study proposes the hypotheses below:

H1: Corporate financing costs are reduced by the carbon emissions trading pilot policy.

The financing structure determines the sensitivity of creditors and shareholders to corporate environmental risk exposure. For highly leveraged corporates, creditors pay more attention to the fluctuation of cash flow and policy uncertainty caused by carbon trading because they bear the main consequences of the risk of carbon transformation of enterprises. Therefore, the positive signal released by carbon trading through improving the information environment and operational stability has a more significant impact on the risk pricing of such creditors, and the financing cost has declined further. On the contrary, for enterprises with a higher proportion of equity financing, the financing cost depends more on the expected return of equity investors, who are more sensitive to the long-term value revaluation brought about by carbon trading, and the transmission of short-term debt risk premium is weak. The difference in financing structure will significantly affect the response of enterprises to external policy shocks, and when highly indebted enterprises face

environmental regulation, their financing costs are more sensitive to policy signals [6]. Accordingly, this study proposes the following hypotheses:

H2: The debt financing ratio positively influences how carbon emission trading affects its financing costs.

The carbon trading mechanism only mandates that enterprises account for and report carbon emission data. However, the disclosure of voluntary information such as carbon management strategies, emission reduction measures, and transition plans is highly heterogeneous across enterprises [7]. Enterprises with higher quality of carbon information disclosure can transmit more sufficient and verifiable carbon risk control signals to creditors, enhance creditors' confidence in the long-term operational stability of enterprises, and thus strengthen the reduction effect of carbon trading on financing costs [8]. However, some studies show that how carbon information disclosure affects corporate financing costs is not unidirectional, and high-quality information disclosure may also expose the risk of carbon transformation of enterprises and trigger a prudent response from creditors. The linkage between carbon disclosure and financing costs is regulated by external governance mechanisms, and enterprises with a higher quality of information disclosure do not always enjoy the dividends of reducing financing costs [9]. High-quality carbon information disclosure requires enterprises to invest additional costs and may expose the carbon transformation risks and compliance pressures faced by enterprises, thus weakening the financing cost reduction associated with carbon trading [10]. On the contrary, even if enterprises with low quality of CID participate in carbon trading, creditors still maintain high risk premium requirements due to opaque information. Accordingly, this paper proposes the hypotheses below:

H3: The quality of CID plays a negative moderating role in the nexus between carbon emission trading policy and financing costs.

3. Research design

3.1. Samples and data sources

The research sample is built on A-share-listed corporations traded on China's Shanghai and Shenzhen, covering the period from 2013 to 2024. The sample spans the full timeline surrounding the implementation of China's carbon trading pilot, meeting the data requirements of the quasi-natural experiment and moderating effect tests. Financial and insurance listed companies are excluded because their financial characteristics and financing structure are highly heterogeneous and inconsistent with the research scope. Excluding listed companies with abnormal financial conditions, such as ST and PT, and delisting risk warnings, can avoid extreme business disturbances. To eliminate biases from extreme outliers, all continuous indicators are processed via 1%-99% tail winsorization treatment.

3.2. Model construction and variable setting

Detailed definitions for all the empirical variables are listed within Table 1. The measurement methods of explained variables and explanatory variables are as follows: corporate debt funding is calculated as the proportion of annual interest spending against total corporate liabilities. The following methods are used for the virtual variables of carbon trading participation. If the enterprise is included in the pilot year of carbon emissions trading and after, it is taken as 1, it is 0.

Table 1. Variable definition

Variable name	Variable symbol	Variable definition
Debt financing costs	$Cost_{it}$	Equal to the ratio of enterprise interest expenditure to total liabilities
Carbon trading participation virtual variable	$Treat_{it}$	Equals 1 for the year a firm enters the pilot and thereafter, otherwise 0
Debt financing ratio	$debt_ratio$	Computed by dividing year-end total liabilities by total corporate assets
Equity financing ratio	$equity_ratio$	Equal to the ratio of owner's equity to total assets at the end of the year
Quality of Carbon Disclosure	CID	Based on the score of the enterprise's carbon information disclosure content
Enterprise size	size	Equal to the natural log of the year-end total assets
Asset-liability ratio	lev	Year-end total liabilities divided by total assets
Corporate age	age	Log of years since listing
Return on total assets	roa	Net profit divided by total assets
interaction term	$Treat_{it_debt}$	Equal to $Treat_{it} \times debt_ratio$
interaction term	$Treat_{it_CID}$	Equal to $Treat_{it} \times CID$

To examine how carbon emission trading affects corporate financing costs, the following Model (1) is constructed:

$$Cost_{it} = \alpha + \beta Treat_{it} + \gamma_1 size + \gamma_2 roa + \gamma_3 lev + \gamma_4 age + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Here, Cost denotes corporate debt financing cost, Treat is the dummy variable for carbon trading participation, and μ stands for industry-level fixed effects, while λ captures annual fixed effects in this regression specification. To examine the moderating roles of financing structure and CID, the baseline model is extended by adding interaction terms between carbon trading and both the debt financing ratio and CID.

4. Empirical outcomes and analytical findings

4.1. Descriptive characteristics of core variables

Table 2 summarizes the key variables used in this study. As shown, corporate debt financing costs vary considerably across firms, standing at a mean of 5.30 and spanning from 4.00 to 6.87. The explanatory variable $Treat_{it}$ averages 0.25, implying that roughly one-quarter of the sample consists of carbon-trading participants. Regarding the moderating variables, the sample exhibits a generally balanced financing structure, with debt and equity financing ratios averaging 0.53 and 0.47, respectively. Meanwhile, the quality of CID differs markedly among enterprises, as reflected by a mean of 4.36 and a range between 1.50 and 7.60.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Treat _{it}	19,001	0.25	0.43	0.00	1.00
Cost _{it}	19,001	5.30	0.71	4.00	6.87
debt_ratio	19,001	0.53	0.12	0.26	0.74
equity_ratio	19,001	0.47	0.12	0.26	0.74
CID	19,001	4.36	1.17	1.50	7.60
size	19,001	21.99	0.87	19.95	24.12
roa	19,001	3.76	0.57	2.18	5.57
lev	19,001	0.53	0.12	0.26	0.74
age	19,001	24.56	6.70	10	39

4.2. Benchmark regression analysis

Table 3. Benchmark regression and adjustment effect test results

Variable	Y(H1)	Y(H2)	Y(H3)
X	-1.287*** (-37.42)	-0.810*** (-4.82)	-1.346*** (-8.89)
Treat _{it} _debt	- (-2.90)	-0.866*** (-2.90)	- (-2.90)
Treat _{it} _CID	- (-2.90)	- (-2.90)	0.011 (3.05)
Roa	0.070** (2.54)	0.070** (2.64)	0.069** (2.56)
Size	-0.007 (-0.51)	-0.003 (-0.18)	-0.008 (-0.43)
Lev	0.290** (2.30)	0.490*** (3.42)	0.290** (2.30)
Age	-0.001 (-0.28)	-0.001 (-0.44)	-0.001 (-0.32)
Constant	5.369*** (14.04)	5.196*** (13.48)	5.398*** (13.85)
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Adj. R2	0.59	0.59	0.59
Obs	19,001	19,001	19,001

Note: Asterisk marks***, **and* represent statistical significance at the 1%, 5%, and 10% critical levels, respectively. Bracketed figures refer to t-statistic values, and this annotation standard is followed throughout the article.

As shown in Table 3, to examine how carbon emission trading affects corporate financing costs, linear regression is carried out with $Treat_{it}$ as the core explanatory variable and $Cost_{it}$ as the explained variable. The regression results show that the coefficient of $Treat_{it}$ is -1.287 and is significantly negative at the 0.01 significance level. Specifically, firms covered by the carbon trading pilot have debt financing costs that are approximately 1.287 percentage points lower than those of non-participants, a statistically significant difference. These findings support Hypothesis H1, that the pilot policy of carbon emission trading will lower corporate financing costs.

In order to test the regulatory effect of financing structure, this paper introduces the interactive term $Treat_{it_debt}$ of $Treat_{it}$ and $debt_ratio$ into the benchmark model. The findings reveal that the interactive term $Treat_{it_debt}$ yields a regression coefficient of - 0.866, which passes significance testing under the 1% statistic threshold. This shows that for every additional unit of debt ratio of enterprises participating in carbon trading, the financing cost is reduced by about 0.866 percentage points. It verifies that, assuming H2, the proportion of debt financing positively regulates the link between carbon trading and financing costs. To further explore how carbon information disclosure exerts moderating impacts, the interactive term $Treat_{it_CID}$ of $Treat_{it}$ and CID is introduced into the benchmark model. As presented in the regression outcomes, the interaction variable $Treat_{it_CID}$ obtains a coefficient value of 0.011, and it is statistically meaningful at the 1% significance level. Such a regression result proves that carbon disclosure quality imposes a negative moderating influence on the linkage of carbon market participation and corporate financing expenditure: the higher the quality of carbon information disclosure, the weaker the extent to which carbon trading lowers financing costs, that is, carbon information disclosure alleviates the rise of financing costs. It verifies that, assuming H3, the quality of carbon information disclosure negatively regulates the relationship between carbon trading and financing costs.

4.3. Robustness test

As seen in Table 4, to verify the robustness of the findings, this study uses the enterprise-level cluster robust standard error re-estimation benchmark model and the adjustment effect model to control the correlation of error terms in different years of the same enterprise. First, in the benchmark model, $Treat_{it}$ obtains a regression coefficient of -0.91 with a p-value of 0.000, passing statistical inspection under the 1% critical threshold, which is consistent with the conclusion that $Treat_{it}$ is significantly negative in the benchmark regression. Second, the cross item $Treat_{it_debt}$ carries a -0.70 coefficient and is statistically meaningful at the 10% level. Such outcomes align with baseline regression outcomes and verify the debt ratio's positive moderating influence. Thirdly, in terms of the regulatory effect of carbon information disclosure, the interactive term $Treat_{it_CID}$ is estimated as 0.08 and gains marginal significance at the 10% level. The result is directionally consistent with the baseline estimates, which supports the conclusion that carbon information disclosure negatively regulates the link between carbon trading and financing costs.

Table 4. Summary of robustness test results

Model	Core variable	Coefficient	Significance	Conclusion
Benchmark model	$Treat_{it}$	-0.91	$p < 0.01$	Significant
H2 regulatory effect	$Treat_{it_debt}$	-0.70	$p < 0.10$	Marginal significant
H3 regulatory effect	$Treat_{it_CID}$	0.08	$p < 0.10$	Marginal significant

5. Conclusion

Starting from the quasi-natural experiment of the carbon emissions trading pilot project, this paper investigates the impact of carbon trading on corporate financing costs, the difference in financing structure, and the regulatory effect of CID. The study finds that the launch of pilot carbon trading policies can significantly reduce corporate debt financing costs, and corporate financing expenses participating in carbon trading can be reduced by about 1.29 percentage points on average. The financing structure plays an obvious positive regulatory role in it. Firms with a larger debt share tend to enjoy more prominent cost-reduction benefits brought by the carbon emission trading scheme. Carbon information disclosure quality serves as a negative moderator. Higher carbon information disclosure quality weakens the financing cost reduction effect of carbon emissions trading. The above conclusions show that the carbon trading mechanism guides enterprises to optimize carbon emission behavior and enhance the transparency of environmental information through price signals, which effectively reduces the risk premium requirements of creditors. Highly indebted enterprises benefit more significantly from this process, while enterprises with high carbon information disclosure quality benefit less.

This paper brings two core academic contributions. First, from the perspective of financing cost, the research boundary of the economic consequences of carbon emissions trading has been expanded. The existing literature examines how carbon trading affects enterprise emission reduction behavior and technological innovation. This paper focuses on the risk pricing mechanism of creditors, which enriches the theoretical framework of the study of the micro effects of carbon trading. Secondly, it reveals the differentiated adjustment mechanism of financing structure and carbon information disclosure in the path of carbon trading, affecting financing cost, which makes up for the lack of attention to the interaction between them in existing studies. This study is conducive to regulators to more comprehensively assess the microeconomic effects of carbon trading policies, financial institutions to optimize carbon risk pricing models, and enterprises to formulate more reasonable financing strategies in low-carbon transformation. Future research can explore the dynamic transmission mechanism and long-term effects of carbon emissions trading, information disclosure, and financing costs. The research scope can be extended to the period following the national carbon market's full operation to track how policy effects evolve.

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