

## Does Carbon Disclosure Affect the Cost of Bank Loans?

—Based on the empirical research of listed companies in heavy pollution industry in China

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**Keywords:** Carbon information disclosure, Cost of bank loans, Media attention, Heavy polluters, Information asymmetry

**Abstract:** With the introduction of the “double carbon” target and the further implementation of the green credit policy, will carbon information disclosure have a significant impact on the cost of bank loans for enterprises? This is of great importance for corporate financing nowadays. In this paper, a multiple linear regression model is used to empirically analyze the impact of carbon information disclosure on the cost of bank loans for companies listed in China's A-share heavy pollution industry from 2018 to 2020. The results of the study show that the degree of carbon information disclosure of enterprises shows a negative relationship with bank loan costs, which shows that the higher the degree of carbon information disclosure, the lower the bank loan costs that enterprises have to bear; further study finds that the positive media attention weakens the negative relationship between carbon information disclosure and bank loan costs.

### 1. Introduction

On September 22, 2020, President Xi Jinping first proposed the “double carbon” target at the 75th session of the United Nations General Assembly: China will increase its national contribution, adopt stronger policies and measures, and strive to reach peak CO<sub>2</sub> emissions by 2030 and achieve carbon neutrality by 2060. Carbon reduction has been elevated to the level of national strategy, and the disclosure of carbon information has become a priority and key matter for corporate ESG management.

With the vigorous implementation of green credit policy, the disclosure of corporate environmental information can effectively reduce the risk and cost of bank loans (Li Wanchao et al., 2022)<sup>[1]</sup>. According to the statistics of China Banking and Insurance Regulatory Commission in 2021<sup>[2]</sup>, the scale of green loans in China reached 11.95 trillion yuan, and the environmental benefits of green credit are increasingly prominent. The introduction of “green credit” has raised the threshold for enterprise loans by making compliance with environmental testing standards, pollution treatment effects and ecological protection important prerequisites for credit approval. This has prompted heavy polluters to strengthen pollution control and improve their environmental performance. And can the disclosure of carbon information, as an important indicator of environmental information, reduce the cost of bank loans for enterprises? There is little research on the relationship between the two in China.

The media is an important external regulatory body in the capital market, and media exposure of corporate behavior can reduce the information asymmetry between enterprises and banks and assist banks in evaluating the carbon performance of enterprises. Media coverage of favorable corporate information can potentially influence banks' credit decisions. However, few domestic scholars have included media attention in the research system of influencing banks' lending costs. Therefore, this paper also incorporates media attention into the discussion to specifically explore how the positive nature of media coverage affects the relationship between carbon information disclosure and bank lending costs. This paper aims to answer the following questions: (1) How does the disclosure of carbon information affect the cost of bank loans? (2) What is the effect of positive media attention on this effect?

## 2. Literature Review and Research Hypothesis

### 2.1 Literature Review

Foreign research on carbon information disclosure dates back to the 1990s. Foreign scholars verified by means of empirical tests that carbon information disclosure can effectively reduce the cost of bond financing for enterprises. Juhyun Jung et al. (2018)<sup>[3]</sup> argued that lenders incorporate the carbon risk faced by enterprises into their lending decisions, while enterprises can reduce the risk of default arising from administrative penalties that creditors expect from enterprises due to pollution problems by disclosing carbon information and using the reputation mechanism. Kleimeier et al.<sup>[4]</sup> argue that lenders value the transparency of corporate information, and that firms that voluntarily disclose carbon information tend to enjoy more favorable loan terms, while firms with opaque information are subject to a certain environmental premium.

Domestic research on the relationship between carbon information disclosure and corporate performance began in 2012. Many scholars believe that there is heterogeneity in corporate carbon information disclosure due to industry differences<sup>[5]</sup>. Scholars also began to study the inherent logical relationship between carbon information disclosure and internal operations and external financing. In terms of internal operation, Zhao Xuanmin and Yan Guanqiong (2014)<sup>[6]</sup> empirically tested the positive relationship between operational performance and carbon information disclosure level by taking listed companies in heavy pollution industries as the research object. In terms of external financing, He Yu et al. (2014)<sup>[7]</sup> predicted through voluntary theory and empirically tested that: carbon information disclosure is a rational choice of enterprises, and the cost of capital is negatively related to carbon information disclosure. Based on this, Xue-ting Li et al. (2017)<sup>[8]</sup> concluded that the degree of carbon information disclosure of Chinese enterprises has a positive correlation with enterprise value, and the correlation between carbon information disclosure and enterprise value is more significant in enterprises of high carbon emission industries.

In recent years, with the introduction of the “double carbon” target, the research on corporate carbon information disclosure has been flourishing in China. The main features of this period are: (1) the research on the influencing factors of carbon information disclosure has been enriched. The influencing factors of carbon information mainly include financial aspects such as financial performance (Ye Shaoliang, 2018)<sup>[9]</sup>, and non-financial aspects such as political connections (Li Huiyun et al., 2021)<sup>[10]</sup>, internal corporate governance (Liao Wang, Wang Weiming, 2020)<sup>[11]</sup> and external environmental legitimacy pressure (Mei Xiaohong et al., 2020)<sup>[12]</sup>. (2) More attention has been paid to the economic consequences of carbon information disclosure in the cost of debt financing, especially in the cost of green bond financing. Changkui Liu and Jiya Bian (2020)<sup>[13]</sup> argue that the level of carbon information disclosure is negatively related to the cost of debt, and the improvement of external government governance will further reduce the cost of corporate debt financing. Wang Mengjie (2021)<sup>[14]</sup> argued that the higher the quality of carbon information disclosure of enterprises, the lower their green bond financing costs.

The measurement methods and research findings adopted by domestic and foreign scholars on media attention are broadly similar. They all measure the strength of media attention by the number of media reports and believe that media attention has an impact on financing costs<sup>[15][16][17][26]</sup>. Bushee et al. (2010)<sup>[18]</sup> argue that media attention can reduce the cost of debt financing by improving the transparency of information of listed companies. Li Peigong (2010)<sup>[19]</sup> argues that by increasing the exposure of the problems of companies, the media can lead to the intervention of the regulatory authorities and promote the improvement of corporate governance, which in turn reduces the potential risks faced by creditors and lowers the cost of debt financing for companies. Shao, Zhihao, and Cai, Guowei (2020)<sup>[20]</sup> concluded empirically that the increase of positive media coverage has a boosting effect on the increase of external financing scale of enterprises; Wang, Xinyuan (2020)<sup>[21]</sup> argued that positive media coverage makes investors receive positive information, which affects investors' sentiment and indirectly influences the cost of debt of enterprises, and at the same time, positive media coverage weakens the impact of carbon risk on At the same time, the positive media coverage weakens the impact of carbon risk on the cost of debt of

enterprises.

In summary, most domestic studies on carbon information disclosure and debt financing cost are focused on the bond market or cursory studies on the impact of environmental information disclosure on bank credit cost, but few scholars have studied the relationship between carbon information disclosure and bank loan cost. As an important way of debt financing, bank loans have certain special characteristics compared with other debt financing methods. And carbon information as a key indicator of environmental information, it is also important to study it separately. In addition, the mediating role of media attention on the relationship between carbon information disclosure and bank credit cost has not received enough attention, and this paper will also conduct an in-depth study on this effect.

## **2.2 Carbon Information Disclosure and Bank Loan Costs**

Stakeholder theory suggests that companies should be responsible to both internal and external information users, and that companies should weigh the interests of all parties to maximize company value. The environment is a typical public resource, and in the context of the increasingly serious global warming problem, enterprises should disclose their greenhouse gas emissions to the public and other stakeholders. Heavy polluting enterprises should actively respond to the national “double carbon” policy and disclose carbon emission information consciously to build a good corporate image and enhance the confidence of internal and external stakeholders in the development prospect of the enterprise, thus reducing the financing cost of the enterprise. The fulfillment status of corporate social responsibility has been paid attention by banks and has been gradually incorporated into the tier of bank loan rates (Industrial and Commercial Bank of China, 2016) <sup>[22]</sup>. If enterprises purposefully choose to vaguely disclose information or even not to disclose carbon information, creditors will not be able to understand the true business situation of enterprises, which will, to a certain extent, increase creditors' doubts about the uncertainty of enterprises' future earnings and increase the potential risks that creditors bear, and according to the principle of risk-reward matching, creditors will demand a higher rate of return <sup>[23]</sup>.

Information asymmetry theory suggests that in market transactions, the two parties to the transaction have different abilities to obtain information. In the activity of disclosing carbon information by enterprises, enterprises are on the advantageous side of information, while other stakeholders such as creditors are on the disadvantageous side of information because they are not directly involved in the daily operation and management activities of enterprises. In contrast, the disclosure of carbon information can reduce the information asymmetry between enterprises and creditors <sup>[24]</sup>, and banks can also make reasonable predictions about the possibility of recovering loans and interest from enterprises in the future, which further reduces the cost of bank loans.

Based on the above analysis, this paper proposes the following research hypotheses:

Hypothesis 1: Qualifying other conditions, corporate disclosure of carbon information helps reduce the cost of bank loans.

## **2.3 Moderating Effect of Positive Media Attention**

From the perspective of information asymmetry theory, positive media coverage of enterprises gives creditors a convenient channel to obtain information, reducing the interference of information asymmetry and greatly reducing the cost of information acquisition for creditors, enabling creditors to make more accurate judgments about enterprises' business performance, financial risks and cash flows, indirectly reducing the cost of bank credit.

From the perspective of signaling theory, positive media reports on enterprises will release signals to external stakeholders that enterprises have a good reputation, and this soft asset will provide implicit guarantees for enterprises in credit, and banks prefer to give loans with lower interest rates to enterprises with good reputation.

Given the above two analyses, increased positive media attention will effectively reduce the cost of bank credit from. Since the carbon emissions of heavy polluters are large and most of the disclosed carbon information is negative, positive media attention can, to a certain extent, mitigate the impact of such negative information on the public. From the perspective of substitution effect,

positive media reports on other aspects of environmental protection, social responsibility, and governance performance of heavy polluters have a certain substitution effect on the disclosure of carbon information by enterprises, and when enterprises have not yet disclosed carbon information or when enterprises disclose carbon information in insufficient detail, these positive media reports will mitigate the impact of undisclosed carbon information on the cost of bank credit <sup>[16]</sup>.

Based on the above analysis, this paper proposes the following research hypotheses:

Hypothesis 2: Positive media attention will weaken the negative effect of carbon disclosure on banks' lending costs.

### 3. Study Design

#### 3.1 Research Sample

This paper takes A-share listed companies in China's heavy pollution industry from 2018 to 2020 as the initial research object, and screens them according to the following conditions: (1) excluding ST and ST\* category companies; (2) excluding companies in the financial and insurance industry; (3) excluding companies without bank loans (loan cost equals to 0); (4) excluding missing data; and (5) excluding abnormal data. To eliminate the possible effects of extreme values, Winsorize the upper and lower 1% quartiles of all continuous variables other than carbon disclosure variables. The final sample of 943 observations was obtained. The definition of heavy polluting industries was obtained from the Guidelines on Industry Classification of Listed Companies (revised in 2012) issued by the China Securities Regulatory Commission and the Guidelines on Environmental Information Disclosure of Listed Companies (Draft for Public Comments) issued by the Ministry of Environmental Protection of the People's Republic of China in September 2010. The data about carbon information disclosure in this paper are obtained from annual reports of listed companies, social responsibility reports, carbon disclosure data of listed companies, the report “Carbon Information Transparency of Listed Companies in China 2021”, etc. The above documents are manually compiled from the official websites of companies, R&L database, Juchao information and the website of Public Environment Research Center, and all other data are obtained from Guotaian database (CSMAR).

#### 3.2 Variable Definition and Model Construction

Since listed companies do not directly disclose information such as bank loan interest rates in their financial reports, for the measurement of the explanatory variable COD of bank loan costs, this paper refers to Zhang, Dany and Zhou, Zeh will (2017) <sup>[25]</sup> and uses corporate interest expenses/(short-term borrowing + long-term borrowing + long-term borrowing due within one year) as a proxy. In this paper, CDI is used to represent the main explanatory variable carbon information disclosure degree (undisclosed = 0, qualitative disclosure = 1, quantitative disclosure = 2). For the measurement of the moderating variable Media attention Media, the number of paper media reports is chosen to measure media attention in this paper, considering the authenticity of media reports. The number of positive paper media reports was collected from the China Research Data Service Platform, an authoritative organization. In this paper, the natural logarithm of the number of positive paper media reports is taken as a proxy for the positive media attention Media.

The specific variable definitions are shown in Table 1:

Table 1 Variable Definition

Variable Type	Variable Name	Variable Symbols	Variable Definition
Explained variables (Explained)	Bank Credit Costs	COD	Interest payable by enterprises / (short-term borrowings + long-term borrowings + long-term borrowings due within one year)
Explanatory variables (Explanatory)	Carbon Information Disclosure	CDI	undisclosed = 0, qualitative disclosure = 1, quantitative disclosure = 2
Adjustment variables (Regulated)	Positive media attention	Media	Natural logarithm of the number of positive reports in paper media retrieved from the China Research Data

			Service Platform database
Control variables (Control)	Nature of ownership	State	State-owned = 1, Non-state = 2
	Return on Net Assets	ROA	Net income / Average balance of shareholders' equity
	Asset Size	Size	Natural logarithm of total assets at the end of the period
	Financial leverage	Lev	(Net income + income tax expense + finance costs)/(Net income + income tax expense)
	Gearing ratio	Ratio	Total liabilities / total assets

To test whether hypothesis 1 is valid, that is, carbon information disclosure is negatively related to the cost of bank loans, model 1 is constructed:

$$COD = \alpha_0 + \alpha_1 CDI + \alpha_2 State + \alpha_3 ROA + \alpha_4 Size + \alpha_5 Lev + \alpha_6 Ratio + \varepsilon$$

To test whether hypothesis 2 holds, i.e., positive media attention weakens the negative correlation between carbon information disclosure and bank lending costs, model 2 is constructed:

$$COD = \alpha_0 + \alpha_1 CDI + \beta_0 Media + \beta_1 CDI \times Media + \alpha_2 State + \alpha_3 ROA + \alpha_4 Size + \alpha_5 Lev + \alpha_6 Ratio + \varepsilon$$

#### 4. Analysis of Empirical Results

Table 2 reports the descriptive statistics results of the main research variables in this paper. As can be seen from Table 1: (1) The mean value of carbon information disclosure CDI of heavy polluting enterprises is 0.3203, with a maximum value of 2 and a minimum value of 0. This indicates that the overall level of carbon information disclosure of heavy polluting listed companies in China is low and there are large differences within industries. (2) The mean value of bank credit cost COD is 0.0087, the maximum value is 0.9233, and the minimum value is 9.014E-08, which indicates the serious polarization of loan costs for heavily polluting listed companies. (3) The mean value of positive media attention to heavy polluters is 2.8615, the minimum value is 0, and the maximum value is 7.0951, which indicates that there is a huge difference in the gaming power of heavy polluters listed companies in the media opinion.

Table 2 Variable Descriptive Statistics

Variable Name	Observations	Mean	Mid	SD	Min	Max
COD	943	0.0087	0.0018	0.0395	9.014E-08	0.9233
CDI	943	0.3203	0.0000	0.6141	0.0000	2.0000
Media	943	2.8615	2.8332	1.3182	0.0000	7.0951
State	943	1.5854	2.0000	0.4929	1.0000	2.0000
ROE	943	0.0776	0.0743	0.0967	-0.4477	0.4674
Size	943	22.6598	22.5047	1.2651	20.3291	26.3656
Lev	943	1.5023	1.1907	0.9632	0.7461	8.1913
Ratio	943	0.4567	0.4581	0.1625	0.1207	0.8630

#### 5. Correlation Analysis of Variables

Table 3 reports the Person coefficients among all variables in this paper. Preliminary analysis reveals that corporate carbon information disclosure CDI, positive media attention Media and bank credit cost COD are significantly negatively correlated at the 5% level (coefficients of -0.07 and -0.08, respectively), and the above results are subject to further testing. In addition, the coefficients among the variables are all less than 0.5, and the VIF value is less than 2, which is very close to 1, which indicates that there is no serious multicollinearity problem in this model.

Table 3 Person Analysis Of the Main Variables

Variab-les	COD	CDI	Media	State	ROE	Size	Lev	Ratio
COD	1							
CDI	-0.070**	1						
Media	-0.080**	0.0350	1					

State	-0.0410	-0.104***	-0.199***	1				
ROE	-0.0380	0.0420	0.153***	0.00500	1			
Size	-0.0240	0.104***	0.414***	-0.419***	0.180***	1		
Lev	0.0260	-0.0310	0.0420	-0.121***	-0.396***	0.138***	1	
Ratio	0.062*	0.0460	0.138***	-0.247***	-0.081**	0.492***	0.412***	1

Note: \*, \*\*, \*\*\* indicate significant at the 10%, 5%, and 1% levels, respectively.

## 5.1 Regression Results and Their Analysis

Table 4 presents the results of OLS multiple linear regressions of corporate carbon disclosure CDI and bank credit cost COD. Column (1) incorporates only the explanatory variable CDI of corporate carbon information disclosure, and column (2) adds control variables to test hypothesis 1 based on column (1). regression results show that CDI is significantly negative at the 10% level, indicating that the more detailed carbon information disclosed by the heavily polluting listed companies, the lower the cost of bank loans that the companies have to bear, supporting hypothesis 1. column (3) adds the control variables to test hypothesis 1 based on column (2) The regression results show that the interaction coefficient of positive media attention Media and the interaction term CDI×Media between carbon information disclosure and positive media attention are significantly positive at 10% confidence level, which means that positive media attention will weaken the negative effect of carbon information disclosure on bank loan costs, supporting hypothesis 2.

In terms of control variables, the nature of property rights of heavy polluters State significantly affects the cost of bank credit. The regression results show that the bank credit cost of state-owned heavy polluting enterprises is lower than that of non-state-owned heavy polluting enterprises, which also indicates that the government's credit will seek some credit preference for enterprises in bank loans. roe and lev are both negatively related to bank credit cost, i.e., the better the profitability and the lower the financial risk of heavy polluting listed companies, the lower the bank credit cost. And Ratio of assets and liabilities is positively correlated with bank credit cost, i.e. the lower the enterprise, the lower the bank credit cost.

The above study shows that corporate carbon information disclosure is significantly and negatively related to bank credit cost, while its degree of influence is bounded by the positive media attention.

Table 4 Regression Analysis Results

Variables	(1)	(2)	(3)
CDI	-0.0045**(0.0021)	-0.0037*(0.0022)	-0.0126**(0.0055)
Media			-0.0034***(0.0013)
CDI×Media			0.0029*(0.0017)
State		-0.0069**(0.0030)	-0.0077**(0.0031)
ROE		-0.0113(0.0163)	-0.0064(0.0165)
Size		-0.0016(0.0013)	-0.0007(0.0014)
Lev		-0.0002(0.0005)	-0.0001(0.0005)
Ratio		0.0069(0.0098)	0.00424(0.0098)
Year Effect	Control	Control	Control
C	0.0101***(0.0015)	0.0561*(0.0293)	0.0483(0.0304)
N	943	943	943
r <sup>2</sup> <sub>a</sub>	0.0038	0.0037	0.0100

Note: \*, \*\*, \*\*\* indicate significant at the 10%, 5%, and 1% levels, respectively; the numbers in parentheses represent the values of the t-statistic.

## 5.2 Robustness Testing

In order to effectively control the endogeneity problem of “mutual causality” between carbon information disclosure and bank credit cost, this paper adopts the instrumental variables method to test the endogeneity, and sets the average carbon information disclosure of other companies in the same industry as the instrumental variable IV, and then performs a two-stage least squares estimation 2SLS method regression based on this variable. The results of regression analysis are

shown in Table 5.

Table 5 2sls Regression Test Based on Instrumental Variables

Variables	(1)	(2)
	Phase I	Phase II
CDI		-0.0172**(-2.0374)
State	-0.0353(-0.7397)	-0.0074**(-2.3533)
ROE	-0.0569(-0.2220)	-0.0118(-0.7216)
Size	0.0461**(2.3009)	-0.0009(-0.5914)
Lev	0.0015(0.1920)	-0.0001(-0.2507)
Ratio	-0.0914(-0.5962)	0.0055(0.5548)
IV	0.4323*** (3.8459)	
Industry	Control	Control
Year Effect	Control	Control
C	-0.7441(-1.6210)	0.0452(1.4107)
N	862	862
r <sup>2</sup> a	0.0323	--
F	26.76***	22.72***

Note: \*, \*\*, \*\*\* indicate significant at the 10%, 5%, and 1% levels, respectively; the numbers in parentheses represent the values of the t-statistic.

In the first stage regression, instrumental variable IV is significantly positive on 1%, indicating similarity in corporate carbon information disclosure among companies in the same industry, which supports the rationality of instrumental variable selection to some extent. In the second-stage regression, the second-stage instrumental variable CDI of carbon information disclosure is significantly negative at 5% (coefficient = -0.0172, t-value = -2.0374), further supporting hypothesis 1.

## 6. Research Findings and Insights

### 6.1 Research Findings

This paper empirically examines the effect of carbon information disclosure on bank loan costs and whether this effect is moderated by media attention, using a sample of Chinese A-share listed companies in the heavy pollution industry from 2018 to 2020. The findings show that the increase in carbon information disclosure by listed companies in the heavy pollution sector can reduce the information asymmetry between enterprises and banks, thus reducing the cost of bank credit. Further study finds that positive media attention has a substitution effect on carbon information disclosure, and positive media attention coverage enhances the reputation of heavy polluters and partially substitutes the effect of carbon information disclosure on corporate reputation, thus weakening the negative relationship between carbon information disclosure and bank loan costs. This paper is a useful addition to the literature in the field of economic consequences of carbon information disclosure.

### 6.2 Policy Insights

The findings of this paper can provide the following policy insights: (1) Since carbon information disclosure of heavy polluters helps reduce bank credit costs, the government should actively build a carbon information disclosure mechanism to promote the continuous improvement of carbon information disclosure of heavy polluters and provide guarantees for efficient financing of heavy polluters. (2) The media has the function of information transmission. In view of the positive attention of the media will weaken the influence of enterprise carbon information disclosure on bank credit cost, so the state should increase the management and supervision of the standard operation of the media, crack down on false information according to the law, and build a clean and healthy media opinion environment. The media should actively assume social responsibility, carry the public knowledge of media people, seek truth from facts and disclose true and reliable information to the society.

### 6.3 Shortcomings and Prospects

There are three main shortcomings in this paper: (1) This paper only considers the moderating effect of positive media attention on the impact of corporate carbon information disclosure on bank credit costs, and further empirical tests can be conducted in the future to examine whether negative media attention and total media attention also play a role in this effect. (2) The measurement of carbon information disclosure of the explanatory variables in this paper mainly adopts the three indicators of non-disclosure, qualitative and quantitative, which are relatively simple. In the future, the quality of carbon information disclosure can be scored comprehensively from multiple dimensions to improve the precision of the measurement. (3) The measurement of the explanatory variable bank credit cost in this paper is the ratio of interest expenses to the total amount of borrowing, but the interest expenses of enterprises include interest expenses of bond financing from other financial institutions in addition to bank interest expenses, and there is a certain measurement error, and a more accurate method for the measurement of this indicator can be thought of in the future, which provides a direction for more in-depth research in the future.

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