Research on the Relationships among Carbon Information Disclosure, Property Right Nature and Enterprise Value

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Keywords: Carbon information disclosure; enterprise value; nature of property rights; regulatory effect

Abstract: Based on the analysis of the sample data of 56 A-share mining listed companies in Shanghai and Shenzhen Stock Exchanges from 2014 to 2016, this paper explores the impact of the quality of carbon information disclosure, the nature of property rights and the relationship between enterprise values. The study found that the quality of carbon information disclosure of listed companies in China's mining industry is generally not high, and its quality is significantly positively correlated with corporate value. Further research found that such effects are more significant in state-owned enterprises.

1. Introduction

In recent years, global warming has intensified, and the world, especially China, is facing the challenge of severe climate change. The society is paying more and more attention to the carbon emissions information of enterprises. Carbon information disclosure is one of the main ways for companies to elaborate low-carbon development concepts, demonstrate carbon emissions management, and accept social supervision and emission reduction work. It has played a good role in promoting the implementation of energy saving and emission reduction strategy, and enterprises as profit-making organizations will take into account their disclosure costs. Therefore, while improving the quality of carbon information disclosure, we should also pay attention to the impact of disclosure information on corporate value. However, enterprises with different property rights in China are subject to different government constraints, public concern and social responsibility, so the impact of carbon information disclosure on corporate value may be different. Therefore, on the basis of theoretical research, this paper intends to carry out empirical research on the quality of carbon information disclosure, the nature of property rights and the value of listed companies.

The innovations and contributions of this paper lie in the following aspects: Firstly, previous studies on corporate carbon information disclosure and social value often divide enterprises into disclosure enterprises and undisclosed enterprises by grouping, and draw conclusions through comparison. Now, with the strengthening of corporate social responsibility awareness and the increasing number of enterprises that actively disclose carbon information, the previous research forms cannot better reflect the research objectives at present. Therefore, this paper introduces the regulation variable of property rights nature, and explores the nature of property rights in the relationship between the quality of corporate carbon information disclosure and corporate value. It also broadens the research scope of carbon information application and enriches carbon information disclosure. Second, in the construction of the carbon information disclosure evaluation system, combined with the characteristics of high-pollution industries, the content of carbon information disclosure has been enriched, and the disclosure information has been refined from four quality dimensions. The scoring project involves internal corporate governance and external effects, and comprehensive information can provide new ideas for carbon information disclosure for Chinese enterprises, so as to increase the importance of enterprises on carbon information disclosure. Thereby achieving the sustainable development of the enterprise and the growth of corporate value.

  DOI: 10.25236/ismeem.2019.133

2. Literature review

2.1 Carbon Information Disclosure Research

When it comes to carbon information disclosure, many people's first reaction is environmental information disclosure, and they believe that carbon information disclosure is an environmental information disclosure, which can be reflected in the social responsibility report as part of environmental information. However, due to the establishment of the carbon trading market, carbon emission rights are an asset and have a circulation nature. By trading between enterprises and affecting the financial performance of enterprises, carbon information is fundamentally different from environmental information. It cannot be included in environmental information (Wang Zhongbing, Yan Xiaochao, 2012) [1]. In addition, with regard to carbon information disclosure, the social acceptance is high, and the CDP project is the more reasonable evaluation system. Carbon information disclosure can be summarized into four aspects: opportunities and risks related to climate change and coping strategies, climate change governance, greenhouse gas emissions management, and greenhouse gas emissions accounting (Li Huiyun, Fu Shaoyan and Wang Renfei, 2015)[2].

As an important content, carbon information disclosure needs to be disclosed by enterprises. (Adrian, 2007) Its motivation is as follows: the first is the strong restrictive force of laws and regulations, the second is the binding force of the public and relevant environmental organizations, and the third is the decision-making needs of stakeholders. Among them, the key is the binding force of laws and regulations. The risk assessment and decision-making made by investors before investing also include carbon emissions as a basis for evaluation [3]. The role of carbon information disclosure can not be ignored.

Existing studies show that the quality of global carbon information disclosure is not ideal. As the disclosure of carbon information will increase the cost of enterprises, even the leading companies in the world, only about 9% of them respond to the questionnaire of willingness to disclose carbon information, and the willingness of managers to disclose actively is not strong, and the initiative has little relationship with the size of enterprises (Hamm, 2007) [4]. Under China's unique economic system, although the status of carbon information disclosure of listed companies in China is not satisfactory, listed companies in high-emission industries can begin to actively disclose carbon information, and the quality is gradually rising (Wang Pana, 2014) [5].

The reasons for the current low quality of corporate carbon information disclosure are as follows: First, there is no uniform standard among countries, and the gap between the quantity and quality of carbon information disclosure in China and Europe and the United States is large. Moreover, the degree and standard of disclosure required are different, and there is a lack of comparability (Huang Le, 2016) [6] (Wang Yutong, Wang Ruihua, 2014) [7]. Secondly, information disclosure of carbon emission trading in China still belongs to the category of voluntary information disclosure (Wu Xun, Xu Xinge, 2014) [8]. Even in recent years, the awareness of carbon information disclosure of Chinese enterprises has gradually increased and the carbon information has gradually become transparent, but the carbon information disclosure system is still imperfect and the willingness to disclose actively is not strong (Liu Yu, 2015) [9]. China has a long way to go in the practice and theoretical research of carbon information disclosure (Zhao Voters, Zhang Yiqiong, 2015) [10].

2.2 Research on the Relevance of Carbon Information Disclosure and Enterprise Value

In today's academic research, there are different opinions on whether carbon information disclosure will affect the change of enterprise value.

Some studies believe that the disclosure of carbon information by enterprises is not only high cost, but also small benefit, and cannot significantly promote the increase of enterprise value. Some research results show that the level of carbon disclosure has a significant negative effect on corporate value (Xu Weida, 2016) [11], (Li Li Li, Liu Quanqi, 2015) [12]. In addition, the total amount of carbon emissions disclosed by enterprises also has a significant negative effect on corporate value. Although quality has a positive effect on corporate value, its significance is not

obvious (Zhang Qiaoliang, 2013) [13].

Some studies have shown that companies with high carbon disclosure quality have higher market value. By studying the initiative and quality of corporate disclosure of carbon information, it will have a positive impact on corporate value. The reasons are summarized as follows: First, carbon information disclosure can reduce the legal pressure of enterprises and reduce the capital cost of enterprises. Thus affecting corporate value (He Yu, Tang Qingliang and Wang Kaitian 2014) [14]. Secondly, enterprises can enhance the value of enterprises by improving the level of social responsibility information disclosure to gain public recognition and increase the competitive advantage of products (Zhang Zhengyong, 2012) [15]. Thirdly, the increase of carbon information disclosure will raise social attention, send positive signals to the public, and bring good reputation to enterprises in order to reduce operating costs (Sun Zhimei, 2016) [16].

2.3 Literature review

Through literature research, it is found that the current research direction of carbon information disclosure mainly focuses on the content and depth of disclosure, although there are many studies on the corporate value of carbon information disclosure. However, most of them focus on the research of carbon information disclosure and non-disclosure, and fail to make empirical analysis based on China's unique national conditions and economic system. The research also has the following shortcomings: First, due to the lack of mandatory disclosure requirements in relevant laws and regulations, it is difficult to collect data in relevant research. Second, the evaluation system of carbon information disclosure quality is not completely unified. The research conclusions on the impact of carbon information disclosure on corporate value are more controversial and cannot effectively demonstrate the value of corporate disclosure of carbon information activities.

Based on the previous research, this paper will build a carbon information disclosure index and use Tobin Q to reflect the enterprise value. And introduce the nature of property rights as a regulatory variable, and more comprehensive and reasonable evidence of the correlation between carbon information disclosure and corporate value, to enrich the empirical research related to the quality of carbon information disclosure at this stage.

3. Research hypothesis

Under the influence of the theory of excess disclosure of income and the theory of signal transmission, enterprises with good development and large scale have higher enterprise value, have better technology and funds to quantify carbon emission information, and carry out upgrading and transformation of energy conservation and emission reduction technologies. They are more willing to disclose relevant carbon information to shape the corporate image of social responsibility. The more comprehensive the information received by investors, the easier it will be to attract more investment. In addition, these enterprises have invested a lot of advanced technology and funds in energy-saving and emission reduction transformation, and enterprises are more inclined to disclose carbon information of products to the society to meet the increasingly stringent environmental protection threshold requirements of the market. However, if the enterprise is in a loss state, it will mainly increase the profits of the enterprise and improve the operation of the enterprise as the main objective of development, and the investment in energy conservation and emission reduction will inevitably be reduced. Therefore, it is concluded that the quality of carbon information disclosure of Listed Companies in China will reflect the value of enterprises. The higher the level of carbon information companies is willing to disclose, the greater the positive impact on corporate value. Accordingly, the first hypothesis of this paper is put forward:

Hypothesis 1: Under the same other conditions, the quality of carbon information disclosure is positively correlated with enterprise value.

State-owned enterprises have dual attributes of Commerce and public welfare. They are strongly bound by the government. The will and interests of the government determine the behavior of state-owned enterprises. Under the background of vigorously promoting the strategy of energy saving and emission reduction in the whole society, state-owned enterprises have been given greater

expectations and assumed more responsibility for emission reduction. Based on stakeholder theory, carbon information disclosure by state-owned enterprises is a necessary activity to meet the needs of social concern. Under the goal of eliminating backward production capacity, upgrading industry and reducing carbon dioxide emissions per unit GDP, the government prefers state-owned enterprises with more environmentally friendly production process, more specific carbon emission quantification and more timely and accurate carbon information disclosure. In the process of resource allocation, state-owned enterprises will be given priority, and they will have relatively more resources, and the value of enterprises will also increase. For non-state-owned enterprises, they face more brutal competition. Development mainly focuses on the realization of economic goals. They always insist on increasing corporate value as their core goal, and their investment in carbon information disclosure will be relatively small. Based on the assumption that the quality of carbon information disclosure is positively related to corporate value, for highly polluting industries such as mining, the disclosure of higher quality carbon information tends to result in lower corporate value. Due to the principle of information asymmetry, in order to maximize the benefits of non-state-owned enterprises, the willingness to disclose is generally not strong, and the quality of disclosure is generally low. From this, it can be judged that the quality of carbon information disclosure of state-owned enterprises will have a greater impact on the value of enterprises than non-state-owned enterprises. Based on this, the second hypothesis of this paper is proposed:

Hypothesis 2: Compared with non-state-owned enterprises, the quality of carbon information disclosure of state-owned enterprises has a more significant impact on corporate value.

4. Data source, variable selection and model construction

4.1 Data Sources

This paper selects the listed companies of A-share mining industry in Shanghai and Shenzhen stock markets from 2014 to 2016 as research samples. The unqualified samples of ST and *ST companies with incomplete or abnormal financial data were excluded, and 56 qualified sample companies were obtained. In addition, according to the research results of Li Zhicai (2015) [17], it is considered that the impact of carbon information disclosure on corporate value has a temporal difference. Therefore, this paper selects the sample enterprises' annual report and social responsibility report from 2014 to 2016 to score the carbon Information Disclosure Evaluation in the sustainable development report, while the financial data and other variables adopt the data lagging one year.

In summary, 241 research samples were obtained from 2014 to 2016. The annual report, social responsibility report and sustainable development report all come from the official website of Shanghai and Shenzhen Stock Exchange and the official website of enterprises. Other financial data are collected from the CSMAR database.

4.2 Variable selection

Interpreted variables. Referring to the research of Chi Guohua (2013) [18], this paper takes Tobin Q value as dependent variable to measure enterprise value. Tobin Q value not only reflects the business performance and development potential of enterprises, but also as a relative value, it is not easily affected by stock market fluctuations, so it has good comparability and reliability.

Explanatory variables. Based on the carbon information disclosure scoring system established by Li Huiyun (2015) [19], this paper re-defines the detailed carbon information disclosure score Table from the four quality dimensions of timeliness, reliability, comparability and integrity. 1 is shown. The carbon information disclosure index is used to evaluate the quality of corporate carbon information disclosure. The formula is as follows:

Carbon Disclosure Quality (CDI) = Actual Disclosure Project Score / Total Project Disclosure (27)

Table 1 Carbon disclosure score sheet

Quality dimension	Primary indicator	Secondary indicators	Description
Timeliness	Disclosure time	Carbon Information (Social Responsibility Report, Sustainability Report) is regularly disclosed	Carbon Information (Social Responsibility Report, Sustainability Report) disclosed 2 points before or at the same time as the annual report, and then disclosed 1 point and 0 points not disclosed.
Reliability	Carbon certification	Independent third party assurance	Not mentioned 0 points, there is an independent third party agency to obtain 1 point for identification and certification
Comparability	Vertical ratio	Base year setting	0 points are not mentioned, 1 point is set for the base year
	Lateral ratio	Refer to the GRI Sustainability Reporting Guidelines	No reference to 0 points, reference scored 1 point
		Disclosure of the environment and sustainable development	0 points not disclosed, 1 point disclosed
Integrity	Low carbon strategy	Climate change risk or opportunity identification	Not mentioned 0 points, able to identify 1 risk and opportunity brought by climate change
		Put forward the concept of low carbon, emission reduction and sustainable development	Did not mention 0 points, 1 point for describing the idea
		Support low carbon emission reduction policies	Not mentioned 0 points, expressed 1 point for support of policy
	Low carbon management	Carbon information disclosure	1 point for the annual report and 1 point for the social responsibility report
		Carbon emission reduction management institution or system	Did not mention 0 points, the company set up a relevant environmental protection and energy saving management institutions or system system scored 1 point
		Carbon emission reduction incentive mechanism	Did not mention 0 points, set a reward and punishment incentive mechanism scored 1 point
	Low carbon action	Carbon emission reduction target planning	0 points not mentioned, 1 point for the target plan
		Carbon reduction initiatives	Not mentioned 0 points, 1 point for the emission reduction measures in the report year
		Participate in carbon emissions trading	Not mentioned 0 points, 1 point for participation in carbon trading, 2 points for quantitative information
		Low carbon products or services	0 points not mentioned, 1 point for the description of low carbon products or services used
	Low carbon accounting	Carbon emissions data	0 points are not mentioned, 1 point is qualitatively described, and 2 points are quantitatively described.
	Low carbon cost	Energy saving and emission reduction investment	Not mentioned 0 points, 1 point for low carbon technology research and development or investment, 2 points for quantitative information
	Low carbon communicatio n	Low carbon promotion	Not mentioned 0 points, the company has 1 point for internal or external low carbon promotion
	Low carbon performance	Carbon emission reduction target benefit	Not mentioned 0 points, qualitative description of the company to achieve carbon reduction by 1 point according to the target, 2 points for quantitative information
		Carbon emission reduction social benefits	Not mentioned 0 points, qualitative description of the company's social reputation, friendly image, or direct or indirect economic benefits to the enterprise due to carbon emission reduction, 1 point, there are 2 points for quantitative information
		Government or environmental protection department rewards and punishments	Not mentioned 0 points, 1 point for the award penalty

Moderator. This paper chooses the nature of corporate property rights as a dummy variable, which is taken as 1 by state-owned enterprises and 0 by non-state-owned enterprises.

Control variables. This paper draws on the research methods of Zhang Shuhui et al. (2011) [20], Liang Jie et al. (2011) [21], Zhang Qiaoliang et al. (2013) [22], and selects the following variables as control variables: firm size (SIZE), time to market (TIME)), profitability (PRO), debt level (LEV), corporate growth (GROW), equity concentration (OC).

The names, symbols and definitions of all research variables are shown in Table 2.

Table 2 Research Variable Definition Table

Variable type	Variable name	variable Code	Computing method
Explained variable	Enterprise value	TQ	Tobin Q = market value / end-of-term total assets
Explain Variable	Quality of Carbon Information Disclosure	CDI	Manual sorting and grading
Control Variable	Enterprise size	SIZE	The natural logarithm of total assets at the end of the year
	Listing time	TIME	The number of years from the year of listing to the end of this year
	Profitability	PRO	Net interest rate of total assets = net profit / average total assets
	Debt level	LEV	Asset-liability ratio = total end-of-period liabilities/total end-of-period assets
	Enterprise Growth	GROW	Sales Income Growth Rate= (Sales Income in Current Year - Sales Income in Last Year) / Sales Income in Last Year
	Equity concentration	OC	Sum of the Top Ten Shareholders' Shareholding Proportions
Adjust Variable	Nature of Property Rights	SOE	The virtual variable is 1 for SOEs and 0 for non-SOEs.

4.3 Model building

Based on Yan Huahong' s [23]research method, this paper constructs two multiple linear regression models to test the above hypothesis. The model is set as follows:

$$TQ_{i,t} = \beta 0 + \beta 1 CDI_{i,t-1} + \beta 2 SIZE_{i,t} + \beta 3 TIME_{i,t} + \beta 5 LEV_{i,t} + \beta 6 GROW_{i,t} + \varepsilon \quad (1)$$

$$TQ_{i,t} = \beta 0 + \beta 1 CDI_{i,t-1} + \beta 2 SOE_{i,t} + \beta 3 CDI_{i,t-1} * SOE_{i,t} + \beta 4 SIZE_{i,t} + \beta 5 TIME_{i,t} + \beta 6 PRO_{i,t} + \beta 7 LEV_{i,t} + \beta 8 GROW_{i,t} + \varepsilon \quad (2)$$

Among them: TQi, T represents the enterprise value of enterprise t year, CDIi, T-1 represents the carbon information in enterprise T-1 year report and social responsibility report, with beta 0 as a constant, beta 1-beta 8 as a coefficient and E as a random perturbation term.

5. Empirical test

5.1 Descriptive statistics

The results of descriptive grouping statistics according to the nature of property rights are shown in Table 3.

Table 3 Descriptive Statistics of Grouped Samples

Statistic	State-owned enterprise		Non-state-owned Enterprises	
	TQ	CDI	TQ	CDI
Maximum	6.235	0.926	27.625	0.630
Minimum value	0.301	0.000	0.420	0.000
Average value	1.054	0.452	3.976	0.191
Standard deviation	1.007	0.258	4.921	0.161
Sample size	105	105	63	63

The average quality of carbon information disclosure of state-owned enterprises is obviously higher than that of non-state-owned enterprises, which shows that state-owned enterprises have a strong sense of social responsibility and a strong willingness to actively disclose carbon information, and can actively implement the national energy saving and emission reduction strategy. By comparing the TQ values of state-owned enterprises and non-state-owned enterprises, it is found

that the standard deviation of TQ of state-owned enterprises is 1.007, while that of TQ of non-state-owned enterprises is 4.921, which indicates that the value of state-owned enterprises is more stable and the value gap between non-state-owned enterprises is larger.

The descriptive statistical results of the total sample are shown in Table 4.

Table 4 Descriptive Statistics of Major Variables

Variable	Sample size	Minimum value	Maximum	Average value	Standard deviation
TQ	168	0.301	27.625	2.150	3.411
CDI	168	0	0.926	0.354	0.259
SIZE	168	18.902	28.509	23.429	1.828
TIME	168	1	24	12.768	5.77
PRO	168	-0.187	0.344	0.023	0.062
LEV	168	0.044	0.778	0.459	0.188
GROW	168	-0.640	21.704	0.468	2.392
OC	168	0.231	0.986	0.644	0.179

The average value of TQ is 2.150, which ranges from 0.301 to 27.625, and the standard deviation is 3.411. This shows that the value of each sample enterprise is quite different and the development is not balanced. The total score of carbon information disclosure of explanatory variables is 27 points. The range of the score varies from 0 to 0.926, that is, the lowest score of CDI is 0, and the highest score is 25 points. This shows that the quality gap of carbon information disclosure of sample enterprises is very large. The average score of carbon information is 9.6, which is only one third of the total score. This shows that the quality of carbon information disclosure of sample enterprises is generally low, and cannot be timely and perfect disclosure.

In terms of control variables, the maximum and minimum values of firm size are 18.902 and 28.509, with an average value of 23, which indicates that the sample enterprises have a low degree of overall dispersion and relatively uniform asset size distribution. The average time of listing of enterprises is 12.77 years, which indicates that the sample enterprises are mature enterprises with an average development of about 13 years. The maximum and minimum value of corporate profitability are 0.344 and -0.187, respectively, indicating that some sample companies are in a negative profit status, but the average value of 0.023 indicates that the average profitability of sample companies is positive. The average corporate debt level is 0.459, and the standard deviation is 0.188, indicating that the sample companies have appropriate leverage and good debt levels. The growth of the company fluctuated between -0.640 and 21.704. The gap was relatively large, and the growth stage was inconsistent. The average value was 0.468, indicating that the overall growth of the company was not high. The average value of corporate equity concentration is 0.644, and the maximum and minimum values are 0.231 and 0.986, indicating that the corporate governance ownership structure is relatively concentrated.

5.2 Correlation analysis

The correlation coefficients between variables are tested as shown in Table 5.

Table 5 PEARSON correlation coefficient of each variable

Variable	TQ	CDI	SIZE	TIME	PRO	LEV	GROW	OC
TQ	1							
CDI	0.521**	1						
SIZE	-0.792**	0.722**	1					
TIME	0.002	0.056	-0.057	1				
PRO	0.261**	-0.047	-0.079	0.163*	1			
LEV	-0.532**	0.323**	0.412**	0.110	-0.220**	1		
GROW	0.001	-0.148	-0.032	0.073	0.033	0.012	1	
OC	-0.256**	0.362**	0.526**	-0.055	0.198*	0.065	0.088	1

Note: ** and * indicate significant levels at 0.01 and 0.05, respectively.

First, the correlation coefficient between the variable value enterprise value and the independent variable carbon information disclosure quality is 0.521, which is positively correlated, which is consistent with our expected hypothesis. Corporate value and profitability are significantly positively correlated at the 0.01 level, indicating that companies with better profitability have high corporate value. The correlation coefficient between enterprise value and debt level is - 0.532, which shows that the capital structure with high debt will significantly reduce the enterprise value. At the same time, enterprise value is negatively correlated with enterprise size and ownership concentration. However, there is no significant correlation between the time of listing and the growth of enterprises, so there is little correlation between the time of listing and the value of enterprises.

In addition, if the absolute value of correlation coefficient between variables is greater than 0.8, and is statistically significant, then there may be multiple collinearities among variables, and one of them should be excluded. Among the control variables, only the correlation coefficient between firm size and ownership concentration is 0.526 > 0.5, and the other correlation coefficients are less than 0.5. This shows that there is no obvious multi-collinearity between the control variables, which will not bring adverse effects on the regression model.

5.3 Multivariate regression test

The comparative results of analytic hierarchy process of formula (1) are shown in Table 6.

Table 6 Model 1 Significance Test Contrast Table

Model	R	R^2	After adjustmentR^2	Standard error	F	Sig
1	0.846	0.716	0.705	0.2281456	67.660	0.000
2	0.851	0.724	0.712	0.2256928	59.908	0.000

Firstly, a hierarchical analysis of Formula (1) is carried out to obtain the change of the impact of the quality of carbon information disclosure on enterprise value. For the first time, multiple control variables and dependent variables TQ are put into the regression equation for analysis. After adjustment, R2 = 0.705, Sig = 0.000 < 0.05, which shows that the equation has a high degree of fitness, and the control variables have a significant impact on the interpreted variables. The regression equation has practical significance. The second multiple regression analysis introduced the independent variable CDI. After adjustment, R2=0.724, Sig= 0.000<0.05, indicating that the overall linear fit of the model with the independent variable CDI is better and more significant. The independent variable significantly affects the dependent variable and the regression equation. The overall regression effect is good.

The results of the multiple linear regression of equation (1) are shown in Table 7.

Table 7 Model-regression analysis results

	Non-standard coefficient		Standard coefficient	t	Significant
	B	Standard error	β		
(Constant)	4.755	0.409		11.627	0.000
CDI	0.214	0.101	0.132	2.126	0.035
SIZE	-0.201	0.016	-0.875	-12.236	0.000
TIME	-0.080	0.069	-0.050	-1.157	0.249
PRO	0.927	0.303	0.138	3.064	0.003
LEV	-0.302	0.077	-0.187	-3.901	0.000
GROW	0.003	0.007	0.015	0.354	0.724
OC	0.437	0.162	0.140	2.700	0.008

Dependent variable: TQ.

Secondly, the multiple linear regression of equation (1) shows that the regression coefficient of carbon information disclosure quality is positive and the sig value is 0.035. Carbon disclosure and

corporate value are significantly positively correlated at the 0.05 level, indicating that corporate value will increase significantly as the quality of carbon disclosure increases, assuming that it is verified again. The scale factor of the enterprise is -0.201, which indicates that the size of the enterprise company has a negative disturbance to the value of the enterprise, and the impact is obvious. At the level of 0.01, the profitability and debt level of enterprises are positively and negatively correlated with TQ, which is consistent with the Pearson test. At the level of 0.01, ownership concentration has a positive effect on TQ, which indicates that enterprises with higher ownership concentration have higher value. In addition, there is no significant correlation between TQ and time to market and growth.

Finally, the regression analysis using the property right as the adjusting variable is shown in Table 8.

Table 8 Analysis results of model binary regression

Model		Non-standardization coefficient		Standard coefficient	t	Significance
		B	Standard error	β		
2	(Constant)	43.471	4.487		9.687	0.000
	CDI	3.455	1.141	0.262	3.026	0.003
	SOE	-0.815	0.527	-0.116	-1.547	0.124
	CDI×SOE	5.560	2.215	0.165	2.510	0.013
	SIZE	-1.729	0.182	-0.927	-9.488	0.000
	TIME	-0.220	0.748	-0.017	-0.294	0.769
	PRO	8.360	3.295	0.153	2.538	0.012
	LEV	1.694	0.856	0.129	1.979	0.050
	GROW	0.007	0.081	0.005	0.084	0.933
	OC	5.513	1.765	0.217	3.124	0.002

Dependent variable: TQ.

From the regression results of Formula (2), we can see that the regression coefficients of the interaction between the quality of carbon information disclosure and the nature of property rights and enterprise value are 5.560, sig value is 0.035, less than 0.05, which indicates that there is a significant positive correlation at the level of 5%. This shows that the property nature of state-owned enterprises will enhance the positive impact of the quality of carbon information disclosure on corporate value. Hypothesis 2 is valid.

6. Research conclusion

In the model of carbon information disclosure quality and enterprise value, the results show that the quality of carbon information disclosure is positively correlated with the enterprise value when controlling the variables that may affect the enterprise value, such as enterprise size, total net asset interest rate, asset-liability ratio and so on. Enterprises are willing to disclose more about the planning, actions and carbon emission reduction effects related to carbon information, and prove that enterprises have a good grasp and expectation for their operation and management. At the same time, under the policy of vigorously promoting low-carbon emission reduction, the company promotes the attention of the capital market and the flow of funds by disclosing relevant carbon information, and enhances corporate value.

The empirical analysis after introducing the property rights of regulatory variables shows that compared with non-state-owned enterprises, the quality of carbon information disclosure of state-owned enterprises can significantly affect corporate value. Because for the mining industry, they need to invest more in low-carbon environmental protection. In order to profit and increase corporate value, non-state-owned enterprises will choose to avoid unfavorable factors and reduce carbon information disclosure, which is more profitable. But even if there are adverse factors

brought by high-pollution industries, state-owned enterprises have rich resource allocation, strong sense of social responsibility, more active participation in energy conservation and emission reduction, better quality of carbon information disclosed, and faster value-added enterprises.

7. Policy suggestion

7.1 Suggestions for Enterprises

Firstly, the quality of carbon information disclosure of Listed Companies in China's high-pollution industries needs to be improved continuously. It is suggested that enterprises should use monetized information to describe carbon information intuitively and efficiently, which will help consumers evaluate enterprises correctly and enhance investment motivation. Second, we must increase investment in energy conservation, environmental protection, green emission reduction, etc., strengthen carbon management, and actively participate in carbon trading. In addition, enterprises should raise the level of innovation, develop low-carbon products, low-carbon technology, and use it as a soft power with competitive advantages, which will play a more significant role in enhancing corporate value.

7.2 Advice for government regulatory and policy development agencies

First, the CSRC and the government regulatory authorities should strengthen the supervision of carbon emissions in high-pollution industries. All departments should cooperate with each other to strengthen the monitoring of carbon information of enterprises, regulate the disclosure of carbon information, and provide review opinions for investors' reference. Secondly, the government and relevant departments should take incentives, provide technical support and encourage enterprises to actively participate in the carbon trading market when building the carbon information disclosure system. To formulate a unified carbon emission measurement method, promote enterprises to conduct assessment of carbon information disclosure, and establish an information exchange platform between the government and enterprises.

7.3 Recommendations to stakeholders

For stakeholders, business management, investors and consumers should establish the concept of low-carbon environmental protection and actively promote the realization of the goal of greenhouse gas emission reduction in China. Firstly, as the management of enterprises, we should take the initiative to undertake the responsibility of carbon emission reduction, promote the behavior of low carbon emission reduction, actively carry out carbon information disclosure, and establish a green and low carbon corporate image to the society. Secondly, when investing in investors, it is necessary to consider whether the company practices the national policies and requirements for low-carbon development and understand the investment and achievements of enterprises in low-carbon emission reduction. Finally, for consumers, the production of the company is oriented to the needs of consumers. Therefore, consumers need to establish a green and sustainable thinking, and consider the low-carbon emission reduction effect of sufficient products when consuming. In the long run, companies will also consider environmental issues during production, low-carbon production, and reduce environmental problems in production.

Acknowledgement

National Natural Science Foundation Youth Project, Project Approval No. 71704127, Project Name: Regional Linkages and Cooperative Emission Reduction Mechanisms of Agricultural Carbon Emissions.

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