Micro evidence affecting the improvement of carbon accounting information disclosure in China—— taking listed companies in high energy consuming industries as an example

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Abstract: *Nowadays, the contradiction between socio-economic development and environmental governance seems to be the top problem perplexing all countries. In order to effectively develop the economy, low-carbon economy was mentioned as an international topic at the United Nations Climate Change Conference. So far, it has gradually become the mainstream concept of economic development of the times. It has become a new problem how to quantify the adverse impact of enterprises on the environment under the background of low-carbon economy. The new concept of carbon accounting came into being. As China is still in the critical period of economic transformation, its demand for energy is still urgent, and it is facing more severe ecological and environmental problems than other countries. The 14th-five-year-plan once again emphasized the need to speed up the establishment of carbon emission trading market in order to realize the development of economy and people's living environment for long-term. The goal of China's sustainable economic development must be inseparable from the improvement of carbon accounting information disclosure level. Starting with the financial characteristics and relevant indicators of governance mechanism of China's high energy consuming listed companies, this paper explores the correlation between them and the level of carbon accounting information disclosure of the companies, so as to seek reasonable and effective methods to improve the level and quality of carbon accounting information disclosure in China.*

Keywords: *Carbon accounting; Carbon accounting information disclosure; High energy consuming industry*

1. Introduction

The climate issue has been attracting more and more attention from the society, especially at the national level. China has solemnly promised the world to reach the carbon peak in 2030 and to achieve carbon neutrality in 2050. Carbon emission is both an environmental issue and a development issue. It requires not only the attention and participation of the government, but also the attention and participation of enterprises. The willingness and intensity of carbon information disclosure of enterprises is an important manifestation of enterprises' environmental responsibility. To improve the basic framework of carbon accounting disclosure, we need to deeply explore the influencing factors of enterprise carbon accounting information disclosure, especially the high energy consuming industry, which will play a vital role in the establishment of the framework. Starting with the financial characteristics and relevant indicators of governance mechanism of China's high energy consuming listed companies, this paper explores the correlation between them and the level of carbon accounting information disclosure of the company, so as to seek reasonable and effective methods to improve the level and quality of carbon accounting information disclosure in China and promote the realization of the "double carbon" goal on schedule.

2. Research trends, policy background and current situation analysis of carbon accounting information disclosure

2.1. Research trends of carbon accounting information disclosure

Janek Ratnatunga (2008) [1] put forward the concept of carbon accounting and studied its relevant theories and disclosure methods, which has stimulated people's enthusiasm for carbon accounting research. Scholars have been studying the relationship between carbon accounting information disclosure and some economic factors using empirical analysis. Mlilo & Feedman (2019) [2] believe that a higher level of carbon accounting information disclosure can effectively expand investors' demand for corporate securities, improve corporate market recognition, and reduce their risk level. Kleimeier & Viehs (2016)[3] emphasized the importance of information transparency and believed that stakeholders would choose companies that actively disclose the quality of carbon accounting information, but obtain lower financing costs. Li Li et al. (2019) [4] found that the level of carbon accounting information disclosure has an impact on investors' reasonable investment decisions. A high level of disclosure is conducive to investors' reasonable judgment, so as to reduce the company's equity financing cost. Tang Yongjun et al. (2016)[5] proposed that improving the disclosure level of carbon accounting information can effectively reduce the investment risk level of investors and reduce the cost of equity capital to a reasonable range. However, Ge yuan and Cheng Baodong (2021)[6] do not agree that improving the quality of environmental information disclosure can not directly reduce the invested capital. After studying cash flow and discount rate, Cao Zhiwen (2019)[7] proposed that carbon accounting information disclosure will increase the market share of enterprises, reduce the business risk and improve the value of enterprises. In terms of governance mechanism, Li Huiyun and Fu Shaoyan (2018) [8] believe that environmental supervision will affect the level of enterprise carbon accounting information disclosure.

By combing a large number of papers, we can find that the researches on carbon accounting in China started late, has not formed a theoretical system systematically, the disclosure framework is lacked, and the existing quality of carbon accounting information disclosure is still at a low level. It is of certain practical significance to analyze the current situation of carbon accounting information in China and explore its countermeasures.

2.2. Policy background of carbon accounting information disclosure

Table 1: A list of policies related to carbon information disclosure

Issued	Policies related to carbon accounting disclosure (in China)
2010	*Measures for the administration of China's Clean Development Mechanism Fund*
	Guidelines for environmental disclosure of listed companies (Exposure Draft)
2012	*Special plan for building energy conservation in the 12th Five Year Plan*
	Interim Measures for the administration of voluntary greenhouse gas emission reduction transactions
2015	*Environmental protection law of the People's Republic of China*
	Action plan for clean and efficient utilization of coal in industry
2016	*Interim Provisions on accounting treatment of carbon emission trading pilot (Exposure Draft)*
	The 13th five year plan for coal industry development
2017	*The 13th five year development plan for coal industry*
	The energy guidance of 2017
	Interim Provisions on the administration of pollutant discharge permits
	Technical guide for greenhouse gas accounting of collaborative control of pollutant removal in pollution control facilities of industrial enterprises (Trial)
	Cooperation agreement on jointly carrying out environmental information disclosure of listed companies
2018	*Notice of the National Energy Administration on printing and distributing the 2018 energy guidance*
	Notice of the State Council on printing and distributing the three-year action plan for winning the blue sky defense war
2020	*The Central Economic Work Committee held a special meeting on speeding up the formulation of the action plan for peaking carbon emissions by 2030*
	Measures for the administration of Carbon Emission Trading (Trial)
2021	*Guiding opinions of the State Council on accelerating the establishment and improvement of a green and low-carbon circular economic development system*
	Guidance on coordinating and strengthening work related to climate change and ecological environment protection
	Instructions on strengthening pollution prevention and ecological construction, continuously improving carbon neutralization and strengthening ecological environment treatment in *the 2021 government work report*

China has strengthened the supervision of enterprise environmental problems year by year in order to achieve the purpose of environmental protection and long-term development. A lot of strict legal provisions were issued successively in order to solve the increasingly severe environmental problems.

To effectively restrict the carbon pollution emission of high-carbon industries and build a solid institutional barrier for the "blue sky defense war", the documents issued in recent years are as follows (see Table 1).

2.3. Current situation of carbon accounting information disclosure -- Taking Listed Companies in high energy consuming industries as an example

245 sample companies were selected of the listed companies in high energy consuming industries that have continuously disclosed carbon accounting information in a shares in Shanghai and Shenzhen stock markets from 2015 to 2019 as the research object. The selection is based on 13 categories of high energy consumption and heavy pollution industries including petrochemical, chemical, building materials, iron and steel, nonferrous metals, paper-making, electric power, aviation, mining, fermentation, textile, brewing and pharmaceutical industries covered in *the classified management directory of environmental protection verification industries of listed companies* in 2008 and *the notice of the general office of the National Development and Reform Commission on effectively doing a good job in the key work of starting the national carbon emission trading market* in 2016.

2.3.1. Disclosure method

The main ways of information disclosure in China are usually enterprise annual financial report, social responsibility report, sustainable development report and environmental report. See Table 2 for the changes of carbon accounting disclosure methods in China from 2015 to 2019.

Table 2: Changing of carbon accounting information disclosure mode

Disclosure method	N	2015		2016		2017		2018		2019	
		n	%	n	%	n	%	n	%	n	%
AFR*	245	101	41.22	124	50.61	107	43.67	122	49.80	131	53.47
SRR**	245	121	49.39	138	56.33	131	53.47	134	54.69	137	55.92
ERL***	245	36	14.69	51	20.82	67	27.35	56	22.86	73	29.80
SDR****	245	25	10.20	33	13.47	42	17.14	54	22.04	57	23.27

*Annual financial report **Social Responsibility Report ***Environmental Report Letter ****Sustainable Development Report

It can be seen from table 2 that the forms of carbon accounting information disclosure of 245 listed companies in high energy consuming industries are mainly annual report and social responsibility report, and these two forms of disclosure have always maintained a large proportion from 2015 to 2019. Therefore, it can be seen that social responsibility report and annual financial report are the main forms of carbon accounting information disclosure at present. At the same time, under the national awareness of vigorously advocating energy conservation and emission reduction and low-carbon environmental protection. In order to implement the 13th five year plan for national economic and social development of the People's Republic of China, all companies responded positively and began to pay more attention to the environment. As reflected in Table 2, since 2016, Listed companies in high energy consuming industries have increased the number of companies that disclose the current situation of carbon accounting information in their annual reports and social responsibility reports; At the same time, environmental report and sustainable development report are more and more accepted by information users, reflecting that the form of carbon accounting information disclosure in China's high energy consuming industries is more systematic, standardized and reasonable.

2.3.1. Disclosure contents

Table 3: The classification of disclosure contents

Disclosure item	Item No.
Setting up Green development management department	Item 1
Education and training on Green environmental protection	Item 2
Low carbon contribution into performance appraisal	Item 3
Setting up carbon emission reduction rules and regulations or guarantee mechanism	Item 4
Performing relevant policies, laws and regulations	Item 5
Annual carbon emissions	Item 6
Prediction of low-carbon environmental change in the future and development strategy	Item 7
Energy conservation and emission reduction meeting national requirements or relevant standards	Item 8
Improving resource utilization and energy efficiency	Item 9
Technological transformation and R & D results of developing low-carbon economy	Item 10
Investment cost of developing low-carbon economy and carbon emission reduction	Item 11
Benefits and subsidies from developing low-carbon economy	Item 12
Information about participating in carbon emission trading	Item 13
Disclosure of participation in the clean development mechanism	Item 14

There are 14 (disclosure) items classified from contents disclosed by 245 listed companies in high energy consuming industries. Table 3 is the classification and Table 4 is the statistics distribution.

Table 4: Statistics of carbon accounting information disclosure

Disclosure item	N	2015		2016		2017		2018		2019	
		n	%	n	%	n	%	n	%	n	%
Item 1	245	107	43.67	114	46.53	119	48.57	121	49.39	137	55.92
Item 2	245	121	49.39	127	51.84	122	49.80	136	55.51	141	57.55
Item 3	245	56	22.86	61	24.90	65	26.53	84	34.29	87	35.51
Item 4	245	78	31.84	89	36.33	93	37.96	105	42.86	107	43.67
Item 5	245	104	42.45	127	51.84	133	54.29	138	56.33	127	51.84
Item 6	245	74	30.20	135	55.10	133	54.29	104	42.45	86	35.10
Item 7	245	76	31.02	83	33.88	86	35.10	97	39.59	95	38.78
Item 8	245	86	35.10	77	31.43	90	36.73	95	38.78	117	47.76
Item 9	245	85	34.69	94	38.37	103	42.04	121	49.39	116	47.35
Item 10	245	44	17.96	64	26.12	47	19.18	45	18.37	38	15.51
Item 11	245	67	27.35	12	4.90	9	3.67	7	2.86	12	4.90
Item 12	245	32	13.06	46	18.78	42	17.14	62	25.31	55	22.45
Item 13	245	16	6.53	26	10.61	44	17.96	45	18.37	72	29.39
Item 14	245	91	37.14	95	38.78	112	45.71	116	47.35	116	47.35

It can be seen from table 4 that companies have different preferences for carbon accounting information disclosure. Due to confidential issues such as enterprise internal management, the data are reluctant to be made public. However, in recent years, the number of carbon accounting information disclosure of Listed Companies in high energy consuming industries has increased significantly, showing an upward trend as a whole.

3. Theoretical analysis and research hypothesis

The business activities carried out by enterprises are the main reflection of the company's behavior and strategy. The disclosure of carbon accounting information is also based on the exclusive feedback of the company's business activities on carbon information. Therefore, we can analyze the influencing factors related to carbon accounting information disclosure from the aspects of financial status, operating results, cash flow and corporate governance level of high carbon consuming listed enterprises, and put forward research hypotheses.

3.1. The financial status of enterprises affects the level of carbon information disclosure

The financial situation can reflect the information of enterprise scale, solvency and risk level. Usually, the larger the scale of the enterprise, the more it needs to take the initiative to assume greater responsibilities and obligations. The attention of the outside world to an enterprise will increase with its scale. In order to establish a good corporate image in the society, the company must disclose relevant enterprise information to the outside world, which naturally includes carbon information disclosure related to environmental governance. Therefore, H1a is proposed.

H1a: There is a positive correlation between the level of carbon accounting information disclosure and the size of the company.

Under the principal-agent theory, enterprises that take the initiative to disclose more detailed and comprehensive information to the society tend to have a generally high degree of debt, because it will ease the contradiction with creditors. At the same time, under the state's strong guidance of the financial industry to implement the policy of "green credit" for high-carbon industries, enterprises will have stronger financing ability. At the same time, it can also reduce the expectations of the outside world for the overall risk of the company, so as to attract more investment and financing, so that China's carbon accounting information level and the company can develop at the same time. Therefore, H1b is proposed.

H1b: There is a positive correlation between the level of carbon accounting information disclosure and solvency.

When an enterprise faces great risks, its operating and financial risks are often for many reasons, and the enterprise usually chooses to give priority to resolving financial risks, such as issuing stocks, creditor's rights and decentralized investment forms, and then invest in what it likes and formulate sales strategies according to local conditions to resolve operating risks, rather than putting money into the development of low-carbon economy first. In a word, when facing a high level of risk, enterprises bear the brunt of the survival problems that should be solved, so they often ignore the development of carbon

accounting information disclosure. Therefore, H1c is proposed.

H1c: there is a negative correlation between carbon accounting information disclosure level and risk level.

3.2. The profitability of enterprises affects the level of carbon information disclosure

The profit status can show the information of the enterprise's profit level, development ability and market recognition. According to the enterprise signal transmission theory, a company with strong profitability and a company with weak profitability will invest a lot of funds in R & D projects. In addition, high energy consuming industries have a great impact on the environment and produce more pollution in the production process. Therefore, external investors will pay more attention to the sustainable development ability of the enterprise, of which carbon accounting information disclosure is the embodiment of this ability. At the same time, enterprises with strong profitability will invest in energy-saving and emission reduction technology research and development independently, and are more willing to invest a lot of human, material and financial resources from the perspective of environmental governance for long-term sustainable development. Therefore, H2a is proposed.

H2a: There is a positive correlation between carbon accounting information disclosure level and profitability.

Under the theory of sustainable economic development, enterprises with better development trend tend to pay more attention to the stability of their development, while taking into account the balance between economic development and environmental sustainability. In today's low-carbon economy is highly valued, if an enterprise sacrifices the environment for short-term benefits, it will not go far. If an enterprise wants to get better development and occupy a larger market share, it can only achieve its beautiful vision by first winning the support and recognition of investors, consumers, the public and relevant departments and actively disclosing carbon accounting information about environmental protection. Therefore, H2b is proposed.

H2b: There is a positive correlation between the level of carbon accounting information disclosure and development ability.

The company's share price will rise with the improvement of market recognition. Therefore, the company's earnings per share will rise compared with the past. At this time, the company will have sufficient capital reserves to invest in energy conservation and emission reduction projects. At the same time, maintaining sustainable development and actively disclosing information about carbon accounting are also the only way for high-carbon industries to stabilize the market and obtain social support. Therefore, H2c is proposed.

H2c: there is a positive correlation between the level of carbon accounting information disclosure and market recognition.

3.3. The cash flow of enterprises affects the level of carbon information disclosure

As the cash flow is prepared on the cash basis, which is different from the accrual basis of the balance sheet, it is less likely to be affected by human factors and more objective. It can truly reflect the production and operation status of the enterprise, so as to help investors make reasonable judgments. When a company has more cash flow, the enterprise will have excess funds to inject into low-carbon and environmental protection scientific research projects. With the increasing emphasis on low-carbon economy, enterprises with stronger cash liquidity tend to actively invest in green and low-carbon scientific research and timely disclose carbon accounting information to obtain the support of relevant investors, so as to continuously improve their sustainable development level. Therefore, H3 is put forward.

H3: there is a positive correlation between carbon accounting information disclosure level and cash flow.

4. Corporate governance mechanism affects the level of carbon information disclosure

The corporate governance mechanism is reflected in the proportion of independent directors, the size of the board of directors, the size of the board of supervisors, the concentration of equity, the integration of two positions and the characteristics of equity. Independent directors do not hold any position within

the enterprise and are not responsible for business transactions, so they can give objective evaluation and independent judgment more objectively and fairly. There are often great agency risks in the division of enterprise ownership and management rights according to the principal-agent theory. But independent directors have the responsibility of external supervision and can put forward reasonable analysis and countermeasures for the development of the company with their independence and professionalism view, so as to promote the improvement of the quality of enterprise carbon accounting information disclosure. Therefore, H4a is proposed.

H4a: there is a positive correlation between the level of carbon accounting information disclosure and the proportion of independent directors.

The board of directors is the information transmitter between the company and the external environment, and also plays an obvious role in alleviating the contradictions and conflicts within the company. At present, the society pays more and more attention to low-carbon environmental protection. Therefore, government agencies, the outside world and the company have an increasing demand for carbon information. However, in the current situation, there are still shareholders who ignore the long-term development by abandoning the basics. At this time, the board of directors can coordinate the relationship to prevent the behavior of putting the cart before the horse, so as to promote the development of information disclosure level including carbon information. Therefore, H4b is proposed.

H4b: There is a positive correlation between the level of carbon accounting information disclosure and the size of the board of directors.

The board of supervisors is mainly responsible for handling the daily business activities of the company and supervising and correcting the decision-making opinions of the management. China's relevant regulations require that the number of the board of supervisors should not be less than three. The effective impact of the size of the board of supervisors on the supervision power can be seen. In the market that increasingly emphasizes energy conservation and emission reduction and green development, the scale may have a certain impact on the adequacy of the supervisory function of the board of supervisors, which is conducive to improving the level of carbon accounting information disclosure. Therefore, H4c is proposed.

H4c: There is a positive correlation between the level of carbon accounting information disclosure and the size of the board of supervisors.

Under the theory of information asymmetry, it will be more obvious that major shareholders guarantee their own interests at the expense of minority shareholders when the ownership concentration of a company is higher. In this case it is obviously unfavorable to disclose the internal information of the enterprise. At the same time, the business strategy formulated from the long-term development can effectively reduce the agency cost of enterprises and realize the sustainable development of enterprises; In order to reduce the agency cost of the enterprise, the client hopes that the agent will formulate the company strategy from a long-term perspective to achieve sustainable development; If some shareholders put more emphasis on short-term income, it will lead to the deterioration of internal contradictions. At this time, enterprises with dispersed equity can better balance the interests and needs of all parties, and then reverse promote the development of enterprise carbon accounting information disclosure level. Therefore, H4d is proposed.

H4d: There is a positive correlation between the level of carbon accounting information disclosure and ownership concentration.

When the same person holds the positions of chairman and general manager in an enterprise, it is called the combination of two positions. In such cases, senior executives are given too much authority, and the supervision function of the board of directors can not be brought into full play, resulting in the unreasonable phenomenon of the company's internal governance structure. In addition, the disclosure of whether the chairman and general manager are concurrently held is not mandatory in China's relevant policies, so it is impossible to carry out reasonable and effective supervision. In this state, enterprises' investment in energy conservation and emission reduction will also give priority to personal preferences, which will largely affect the level of carbon accounting information disclosure of the company. Therefore, H4e is proposed.

H4e: There is a positive correlation between the level of carbon accounting information disclosure and the integration of two jobs.

China's existing equity nature is roughly composed of state-owned capital holding and non-state-owned capital holding. The former is directly affected by the actual control and intervention of the state.

Enterprises of this nature can play a leading role in promoting the development of green economy, low-carbon energy conservation and industrial transformation. Usually, state-owned enterprises can obey national low-carbon energy-saving policy, continuously improve their long-term sustainable development ability, will take the initiative to pay attention to social impact, ecological environment, climate deterioration, etc. SASAC has required all state-owned enterprises and central enterprises to issue social responsibility reports every year since 2012, which stipulates that there is a summary specifically for environmental information disclosure. Such mandatory measures will not only establish a good corporate image, but also accelerate the research process of high efficiency, energy conservation, clean and low carbon of large state-owned enterprises, and promote the improvement of environmental protection awareness of all sectors of society except state-owned enterprises. Therefore, H4f is proposed.

H4f: There is a positive correlation between the level of carbon accounting information disclosure and equity characteristics.

5. Research design and empirical analysis

5.1. Sample design and data source

According to the sampling method mentioned in Part 2.3 of this article, in order to avoid the potential impact of different listing times on the disclosure level of carbon accounting information, the listed companies and companies with abnormal operating conditions from 2015 to 2019 are excluded. After parallel panel data processing, we get a total of 1225 sample information of 245 valid sample companies in five years. The financial data and the company's annual report are extracted from CSMAR database, cninfo.com, esset.cn financial database and eastmoney.com. The carbon accounting information disclosure data are crawled from the relevant consulting websites and the official websites of major companies by means of crawlers. At the same time, they are also manually collected from the social responsibility reports and sustainable development reports of high energy consuming listed companies in Goldenbee China social responsibility report database. The data was sorted through SPSS25.0 software.

5.2. Research design

5.2.1. Variable definition

5.2.1.1. Explained variable

The data compiled in this paper are extracted from the annual financial report, social responsibility report, sustainable development report, environmental report, special audit report on green development in the special audit of the government and the data in the China Report on carbon information disclosure under CDP organization, because there is no special database or research website related to the level of carbon accounting information disclosure,

Table 5: Classification and standards of carbon accounting information disclosure

Disclosure items	Score description
Setting up green development management department	Yes is 1，no is 0
Education and training on Green environmental protection	Ditto
Low carbon contribution into performance appraisal	Ditto
Setting up carbon emission reduction rules and regulations or guarantee mechanism	Ditto
Performing relevant policies, laws and regulations	Ditto
Annual carbon emissions	Description both qualitative and quantitative is 2, single is 1, otherwise 0
Prediction of low-carbon environmental change in the future and development strategy	Ditto
Energy conservation and emission reduction meeting national requirements or relevant standards	Ditto
Improving resource utilization and energy efficiency	Ditto
Technological transformation and R & D results of developing low-carbon economy	Ditto
Investment cost of developing low-carbon economy and carbon emission reduction	Ditto
Benefits and subsidies from developing low-carbon economy	Ditto
Information about participating in carbon emission trading	Ditto
Disclosure of participation in the clean development mechanism	Ditto

After referring to various research reports and learning and research materials, this paper refers to the description standards recognized by many mathematicians at home and abroad. And the classification standards of China report (CDP) of Carbon Accounting Information Disclosure Project from 2010 to 2015, combined with the research on the content of carbon accounting information disclosure level by

domestic scholars Liu Yiping and Yang Peiru (2017)[9]. The final sorting scoring standards are shown in Table 5.

Under the above description criteria, the classification results can make the data more objective, authentic and extensive to the greatest extent, and avoid biased data results due to human subjective reasons. Using the disclosure items in Article 14 of the table as the basis for description, this link gives the same weight to each disclosure content, and the scores are accumulated and summed through the direct summary method, that is, the same weights are summed up. The final score reflects the level of carbon accounting information disclosure.

The formula of carbon accounting information disclosure level is: $RCDLi = \Sigma CDLi/MCDL$.

Among them, $RCDLi$ is the relative scores of carbon accounting information disclosure items of the i-th listed company. $\Sigma CDLi$ is the sum of the scores of carbon accounting information disclosure items of the i-th listed company. $MCDL$ is the total score of all disclosure items (the total score is $MCDL = 23$), and the best disclosure level is 1.

5.2.1.2. Explanatory variable

This paper selects 13 factors as explanatory variables, including SIZE, ROE, IDP, HERF, GROWTH, LEV, NCR, EPS, BSS, CEO, CSP, SCALE &DTL, to study the relationship between carbon accounting information disclosure level of high energy consuming listed companies in China. The specific definitions are shown in Table 6 below.

Table 6: Definition of explanatory variables

Variable	Title	Illustration
Explained	RCDL	The measurement of the level of carbon accounting disclosure
Explanatory	SIZE	Logarithm of total assets of the company at the end of the year
	ROE	Return on net assets
	GROWTH	Capital preservation and growth rate
	LEV	Asset liability ratio
	IDP	Proportion of independent directors in the board of directors
	SCALE	Number of directors of the company
	HERF	Proportion of top ten shareholders
	CEO	The chairman served as CEO is 1, otherwise is 0
	CSP	State-owned listed companies is 1, otherwise is 0
	NCR	Net cash flow from operating activities / net profit
	EPS	Current profit of ordinary shares / weighted average number of ordinary shares issued in the current period
	BSS	Number of supervisors
	DTL	Operating leverage * financial leverage

5.2.2. Model design

Using the above variables, the following regression model of influencing factors of carbon accounting information disclosure level is established:

$RCDLi=\beta_0 + \beta_1 SIZE + \beta_2 ROE + \beta_3 GROETH + \beta_4 LEV + \beta_5 IDP + \beta_6 HERF + \beta_7 CEO + \beta_8 CSP + \beta_9 NCR + \beta_{10} EPS + \beta_{11} BSS + \beta_{12} SCALE + \beta_{13} DTL + \varepsilon_i$

Among them, β_0 is a constant independent of the explanatory variable, $\beta_1 \sim \beta_{13}$ is the regression coefficient of the multiple regression model, which is a parameter reflecting the influence of the explanatory variable on the explained variable. Its representative meaning is the change of the explained variable caused by each unit of the explanatory variable, ε_i is a random item.

5.3. Empirical analysis

5.3.1. Descriptive statistical analysis

5.3.1.1. Descriptive statistical analysis of explained variables

Descriptive statistics are made on the carbon accounting information disclosure level of listed companies in China's high energy consuming industries from 2015 to 2019. The calculation results are shown in the table 7.

It can be seen from the data in Table 7 that there is a large gap in the disclosure level of carbon accounting information in China's high energy consuming industries, and the gap in the disclosure level is gradually widening, which is far from the optimal disclosure level. The reason is that the market as a

whole does not pay much attention to carbon accounting information due to the lack of systematic and mandatory disclosure policies in China.

Table 7: Descriptive statistical analysis of RCDL

Year	N	Minimum	Maximum	Average	standard deviation	Skewness	Kurtosis
2015	245	0.044	0.565	0.12045	0.13967	-0.468	-0.44
2016	245	0.087	0.867	0.13800	0.19291	0.118	-0.47
2017	245	0.044	0.867	0.12512	0.19079	0.418	0.706
2018	245	0.087	0.739	0.17359	0.15026	0.379	0.724
2019	245	0.044	0.826	0.23639	0.18386	0.341	-0.015
Total	1225	0.0607	0.77391	0.19871	0.1715	0.1576	0.101

5.3.1.2. Descriptive statistical analysis of explanatory variables

Table 8 shows the descriptive statistical analysis results of carbon accounting information disclosure level of high carbon industry.

Table 8: Descriptive statistical analysis of explanatory variables

variable	N	Minimum	Maximum	Average	Standard deviation
SIZE	1225	0.32369	35.02346	5.83563	6.74877
ROE	1225	-3.116799	1.71355	0.05362751	0.467002
GROWTH	1225	-5.343235	6.483351	1.11796035	0.8377569
LEV	1225	0.11089	1.117785	0.57997696	0.193439648
IDP	1225	30.77%	62.50%	38.70%	6.57%
SCALE	1225	3	15	8.3	2.657
HERF	1225	0.062066	0.680784	0.2841467	0.151958244
CEO	1225	0	1	0.16	0.364
CSP	1225	0	1	0.7	0.46
NCR	1225	-1.85371	200.05212	6.30462	20.736
EPS	1225	-1.989276	5.357525	0.65753088	0.923282105
BSS	1225	3	7	4.33	0.999
DTL	1225	1.0925	58.7142	4.02	6.574

It can be seen from the data in Table 8 that the selected samples are in different fields, which proves that the sample selection is reasonable and extensive; Profitability reflects that the profitability of various industries is not high, and some enterprises are in the stage of loss. The other indicators reflect great differences.

5.3.2. Correlation test

Before the regression analysis of carbon accounting information disclosure factors of high energy consuming listed companies, it is necessary to test and analyze the correlation between explanatory variables and explained variables.

The test results of the correlation of all samples show that the company size (SIZE), the size of the board of supervisors (BSS), cash flow (NCR), market recognition (EPS) and equity characteristics (CSP) have obvious correlation with the carbon accounting information disclosure level (CDL) at different levels, and the correlation of other variables is not significant (Pearson correlation test, the test result table is omitted).

In order to avoid multiple collinearity between variables and test the correlation between samples again, this paper calculates the variance expansion factor and tolerance based on Pearson coefficient (the test result table is omitted). The test results show that the variance expansion factor is less than 2.5 and the tolerance of explanatory variables is greater than 0.4, indicating that there is no multicollinearity between variables, and multiple regression analysis can be further carried out.

5.3.3. Analysis of regression results

Using the model mentioned in Part 4.2.2, multiple regression analysis is carried out by SPSS software. The regression results are shown in Table 9 and table 10.

Table 9: The result analysis of the model as overall

R	R2	Adjusted R2	Error of standard estimation	F(sig)
0.548	0.3	0.203	0.1634657	0.001

Table 9 shows that the whole model has passed the test.

From Table 10, we can see that: H2c and H3 pass the correlation test at 1% level; H4c and H4f all pass the correlation test at 5% level; H1c and H4d pass the correlation test at 10% level. However, the level of carbon accounting information disclosure did not lead to the strengthening of debt repayment

scale (H1b failed). The level of carbon accounting information disclosure did not increase the profitability of the company (H2a failed). The level of carbon accounting information disclosure did not improve the company's development ability (H2b failed). The increase in the proportion of independent directors also did not lead to the improvement of the level of carbon accounting information disclosure (H4a was not passed). The increase in the size of the board of directors did not significantly improve the level of carbon accounting information disclosure (H4B failed). The integration of the two rights also did not bring about the improvement of the level of carbon accounting information disclosure (H4e failed). The test results show that the willingness of the company to independently disclose carbon accounting information is not high without the mandatory disclosure requirements of the CSRC.

Table 10: Variables, hypothesis, expected symbol and Regression analysis results

Variable	Hypothesis	(βi) / Expected symbol	Coefficient	T-value	sig
Constant		($\beta 0$)/?	0.129	0.897	0.372
SIZE	H1a	($\beta 1$)/+	0.023	3.749	0.000***
ROE	H2a	($\beta 2$) /+	0.017	0.09	0.929
GROWTH	H2b	($\beta 3$) /+	-0.005	-0.112	0.911
LEV	H1b	($\beta 4$) /+	-0.183	-1.516	0.133
IDP	H4a	($\beta 5$) /+	0.014	0.094	0.926
HERF	H4d	($\beta 6$) /+	0.255	2.058	0.053*
CEO	H4e	($\beta 7$) /+	0.02	0.416	0.648
CSP	H4f	($\beta 8$) /+	0.017	0.291	0.014**
NCR	H3	($\beta 9$) /+	0.003	0.394	0.000***
EPS	H2c	($\beta 10$) /+	0.021	0.695	0.000***
BSS	H4c	($\beta 11$) /+	0.052	2.967	0.004**
SCALE	H4b	($\beta 12$) /+	0.004	0.593	0.554
DTL	H1c	($\beta 13$) /-	-0.151	-0.187	0.062*

*Pass the test at the 10% level; **Pass the test at the 5% level; ***Pass the test at the 1% level.

5.3.4. Robustness test

The evaluation criteria of advantages and disadvantages are difficult to be stated, in order to further improve the reliability of the test results since the reference indicators that can reflect the profitability, development ability and solvency of the enterprise are not unique. The robustness test is added. The profit rate of total assets is replaced by the return on net assets, the growth rate of total assets is replaced by the growth rate of operating revenue and the asset liability ratio was replaced with the current ratio. The re-obtained correlation analysis and regression results are based on the normal distribution of histogram and regression standard residual, and the sample data shows a long tail distribution, which proves that it comes from obeying the same distribution. It represents that the correlation between the influencing factors after replacing the indicators and the level of carbon accounting information disclosure has not changed significantly, which is basically consistent with the previous conclusions.

We also use standardized explanatory variables with the formula $[(x_i - \bar{x}) / \sigma]$ instead of which in Table 6 to test our model, the result is similar.

6. Countermeasures and suggestions

6.1. Establish and improve laws and regulations

Therefore, it is difficult to establish a complete legal system of accounting information disclosure in China. In addition, enterprises have not formed a clear understanding of this, so the overall carbon accounting information disclosure level of the industry is not high. In view of this, it is urgent to establish a complete supervision system of carbon accounting information disclosure. Relevant departments should clarify the status of carbon accounting in the form of law, speed up the establishment of disclosure system and specific rules, such as the formulation of carbon information disclosure guidelines, so that the company can be familiar with relevant standards in a short time, so as to escort the reasonable supervision of carbon accounting information disclosure in the future.

6.2. Improve the internal governance structure of the company

According to the empirical results, under the current market, independent directors do not have a direct impact on the level of carbon accounting information disclosure. Therefore, the potential role of the company's internal governance mechanism and regulatory efficiency in strengthening the level of

carbon accounting information disclosure cannot be underestimated. Enterprises should avoid inaction caused by low supervision. Therefore, enterprises should pay more attention to the environment, establish a low-carbon and environmental protection corporate culture, and continuously optimize and upgrade the independent director system, so as to improve their supervision efficiency.

6.3. Consciously improve the professional quality of the company's employees

When sorting out the carbon accounting information disclosure of various enterprises, it is revealed that at present, there are obvious problems in the carbon accounting information disclosure of domestic high energy consuming listed companies, such as chaotic disclosure form, scattered content and so on; At the same time, during the study of the company's annual social responsibility report and annual financial report, it is also found that most enterprises lack a clear supervision and management mechanism, which reflects the large vacancy in carbon accounting talents and the low professional quality of existing on-the-job personnel in China. In view of this, the state and enterprises should strengthen the construction and training of professional talents at the same time, which will be the mainstay force on the road to improve the level of carbon accounting information disclosure, so as to promote the stable development of China's carbon accounting field and the industrial transformation of enterprises and take the road of sustainable development.

6.4. Strengthen government supervision and social supervision

At present, most companies in high energy consuming industries have strong subjectivity and randomness in the disclosure of carbon accounting information. In view of this, the government should strengthen supervision and management through mandatory means, improve the requirements of green development and low-carbon energy conservation, flexibly carry out various inspections, and promote enterprises to consciously fulfill their social responsibility and environmental protection obligations, so as to control the scope of negative impact on the environment in production and operation activities. Secondly, the third-party supervision institutions should also fulfill their social responsibilities. For example, accounting firms need to strictly carry out audit activities and publish the audit results in time to ensure the authenticity of their input and output in the green energy-saving link. At the same time, the public should also improve their sensitivity to low-carbon environmental protection, and actively fulfill citizens' supervision rights by supervising high energy consuming enterprises in a reasonable and compliant manner. If violations of laws and regulations are found, they should be reported to relevant government departments in time and will not be tolerated. Only when the government, society and citizens cooperate together and give full play to their respective regulatory functions, the quality of carbon accounting information disclosure in China can be guaranteed.

6.5. Raise public awareness of low-carbon environmental protection

The stronger the public's awareness of environmental protection, the better the effect of environmental protection implementation. When a country's citizens have a strong awareness of environmental protection, the country's enterprises will face greater pressure on environmental disclosure. There are many ways to improve our citizens' awareness of environmental protection. Firstly, the government can strengthen the publicity of energy conservation and emission reduction and green and low-carbon through different media, such as news and newspapers, so as to enable the public to establish a basic awareness of energy conservation and low-carbon.

Secondly, communities and schools can regularly carry out publicity or experience on environmental governance and carbon accounting information disclosure, so that people can fully contact with relevant ideas, so as to better accept the idea of green development. Giving full play to citizens' sense of ownership and being fully conscious of low-carbon environmental protection, can help to establish a good new trend of low-carbon, energy conservation and emission reduction. Then investors pay attention to the carbon information of enterprises when investing in securities.

Acknowledgement

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