

Relationship between the Size of Accounting Firm and the Quality of Carbon Accounting Information Disclosure——The Case of Shanghai and Shenzhen A-share listed companies in heavy pollution industry in Beijing-Tianjin-Hebei region

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Abstract. The quality of carbon accounting disclosure has attracted much attention as carbon neutrality and carbon peaking targets were mentioned in the general debate of the United Nations General Assembly in 2020. As the world's largest country of Carbon Emission, China lacks research related to the size of accounting firms and the quality of carbon accounting disclosure. This paper establishes an evaluation system of carbon accounting information disclosure quality from the perspective of accounting information quality characteristics, selects Shanghai and Shenzhen A-share listed companies in Beijing, Tianjin and Hebei regions in 2021 as the research sample, and compares carbon accounting information disclosure quality of listed companies audited by accounting firms of varying sizes from each characteristic dimension of accounting information quality characteristics, and lastly a comprehensive comparison and one-way ANOVA were conducted to explore the relationship between the size of accounting firms and the quality of carbon accounting information disclosure of listed companies in the heavy pollution industry as a whole. The research results indicate that the reliability, timeliness, understandability, and integrity of carbon accounting information of listed companies audited by larger accounting firms are better, but comparability and relevance are not significantly related to accounting firm size; overall, the larger accounting firms correspond to higher quality of carbon accounting information disclosure of listed companies in heavy pollution industries. Based on the research results, this paper puts forward relevant suggestions at three levels: accounting firms, the state, and enterprises, to improve the quality of carbon accounting information disclosure of listed companies, and then to promote the carbon emission reduction work of enterprises, thereby facilitating the achievement of "dual carbon" objectives.

Keywords: Accounting firm size; Carbon accounting information disclosure quality; Evaluation system; Heavy pollution industry.

1. Introduction

1.1 Carbon Accounting and Carbon Accounting Information Disclose (CAID)

Global warming and frequent natural disasters have led to a profound reflection on environmental issues. For the sustainable development of human society, "the United Nations Framework Convention on Climate Change", has set requirements for greenhouse gas emissions of the parties, and number of countries are taking proactive steps to cope with climate change. The term "Carbon Accounting" was first proposed in 2008, which marked "Carbon Accounting" as an important accounting matter began to receive attention and concern from the international accounting community^[1]. Some foreign organizations have explored how to disclose their carbon information. Among them, the Carbon Disclosure Project (CDP) is currently recognized internationally as the most authoritative organization on carbon emissions information. However, its disclosure quality has been controversial. The content disclosed is discontinuous in time, incomplete in content, and difficult to distinguish from some financial information^[2-4].

Since the reform and opening up, China has achieved rapid economic development, but the ecological environment has been seriously damaged, and now China has become the number one

carbon-emitting country. In order to reduce greenhouse gas emissions, China has promulgated a series of relevant regulations. Nonetheless, these regulations mainly focus on environmental information disclosure, and only in recent years have relevant regulations been made to disclose "carbon accounting" information (CAI). Due to the late start, China lacks unified quality specifications for carbon accounting information disclosure (CAID) ^[5-6]. In response to the most influential international CPD evaluation method for CAID, many scholars argued that CPD has some problems, for instance, the questionnaire design is not reasonable, the questionnaire results are filled in arbitrarily, the credibility of the results is not high ^[7-8]. Hence, China still does not have a perfect CAID system, and the disclosure quality is poor. Many scholars in China are actively building a CAID quality evaluation system adapted to China's national conditions. Cui and others evaluated the quality of carbon information disclosure of listed companies from five levels: awareness level, planning level, implementation level, performance level and evaluation level ^[9]; Wang and others constructed carbon information disclosure quality evaluation system from the perspective of the quality characteristics of accounting information ^[10-11].

The domestic research on "Carbon Accounting" started late, and the standardization and credibility of the most influential international CPD quality evaluation method are controversial at home and abroad, so there is no unified evaluation system for the quality of CAID in China. At present, many scholars are trying to construct system from different perspectives.

1.2 Accounting Firms' Size with Information Disclose Quality

The audit of accounting firms is essential external supervision, the last line of defense to identify the level of accounting information, and plays a crucial role in the level of it. Foreign scholars have paid attention to the influence of accounting firm size on the quality of information disclosure as early as 1981. Su and Chen cited the study of De Angelo, who illustrated that the quality of corporate information disclosure would be affected by the size of the accounting firm, the larger the accounting firm's size, the better the quality of information disclosure ^[12-13]. Wang and Yang, citing Moore and Scott, similarly argued that the size of accounting firms had a positive relationship with the quality of corporate disclosure ^[14-15].

In China, scholars have conducted many studies on the relationship between the size of accounting firms and the quality of accounting information disclosure, but the conclusions are not lopsided. Tang and others concluded that large accounting firms could improve the quality of accounting information disclosed to the public ^[15-18]. However, Wang found that firm size is not necessarily positively related to audit quality ^[19]. Wang concluded that there is no significant correlation between the size of accounting information firms and audit quality ^[20].

Through combing the whole literature, it is obvious that with the development of the economy and environmental protection, people pay more attention to the quality of CAID. Currently, CDP, which is widely used internationally, nevertheless has flaws. Chinese academics are actively investigating a CAID quality evaluation method. However, the definition of CAID content is still vague, which makes the measurement indexes for evaluating the quality of CAID vary greatly. In addition, the audit of accounting firms is an important external supervision tool, many domestic and foreign scholars have studied the relationship between firm size and disclosure quality, but many domestic scholars have reached conclusions that differ significantly. The reasons are that due to the immature development of the audit market, the academic community does not have authoritative criteria for the division of accounting firm size, and so on. Because of this phenomenon, ongoing attention must be paid to the relationship between firm size and information disclosure quality. Additionally, due to the late start of the research on "carbon accounting", there is a lack of research on the relationship between the size of accounting firms and the quality of CAID.

1.3 Heavy pollution industry and Beijing-Tianjin-Hebei region

In China, the heavy pollution industry pollutes the environment seriously, and this industry, as the primary responsible subject of carbon emission, is the key to accomplishing the goal of energy saving

and emission reduction. Therefore, this paper conducts an in-depth study in heavy polluting industries, and then promotes the findings to other industry enterprises.

Thanks to the Beijing-Tianjin-Hebei cooperative development strategy, the development of the Beijing-Tianjin-Hebei region is large and dynamic. However, development is accompanied by substantial energy demand, and the regional energy consumption is dominated by fossil fuels, particularly coal, due to the trend of rising carbon emissions. Reducing carbon emissions is a basic requirement to adhere to the green and low-carbon development path. Hence, the study can also represent most regions and provide valuable references for other regions.

1.4 Research Needs and Importance

Based on the research, this paper constructs a CAID quality evaluation system from the perspective of accounting information quality characteristics, and studies the relationship between firm size and CAID quality of listed companies in the heavy pollution industry, which has important theoretical and practical significance. At the theoretical level, it fills the vacuum in research about the relationship between accounting firms' size and CAID quality. The paper also constructs a comprehensive CAID quality evaluation system to regulate the CAID of listed companies and provide a reference for improving the CAID quality of listed companies. At the practical level, the conclusions of this paper provide evidence for listed companies to hire large-scale accounting firms as auditors and provide a theoretical basis for the expansion and merger of accounting firms. In addition, it can urge Chinese enterprises to improve the quality of CAID, so that they can do an excellent job in carbon emission reduction and help China achieve the goal of carbon peaking by 2030 and carbon neutrality by 2060.

2. Research Design

2.1 Theoretical basis and research hypothesis

According to Reputation Theory, the larger the firm is, the more willing the auditor is to devote effort to improve the quality of the audit, thus preserving its reputation. According to the Principal-Agent Theory, the client and the accounting firm have a game of interest. The larger accounting firms, which have more clients and stronger expertise, have more say in the process of the game, and they will ask listed companies to adopt more stringent carbon accounting disclosure methods, and make disclosures with the highest possible quality in order to maintain the reputation of the accounting firms and thus promote their long-term development. Based on the above discussion, this paper proposes the following hypotheses.

H1: The larger the accounting firm, the higher the quality of carbon accounting information disclosure of listed companies in heavy polluting industries.

2.2 Design Rationale

This paper takes the perspective of accounting information quality characteristics, combines the carbon information disclosure framework of CDP, constructs a comprehensive CAID quality evaluation system according to the situation of Chinese enterprises, studying the relationship between accounting firm size and CAID quality. In 2006, the China Ministry of Finance issued "Accounting Standards for Enterprises - Basic Standards", which put forward eight quality characteristics, including Reliability, Relevance, Understandability, Comparability, Substance Over Form, Materiality, Prudence, and Timeliness. Since the CAID is still at the voluntary stage and there is no unified disclosure standard, the three quality characteristics of "substance over form, materiality and prudence", which are not applicable to the assessment, have been removed. In addition, the quality of CAID depends largely on the integrity of information disclosed by enterprises, so this paper takes integrity as an important indicator. In summary, this paper selects reliability, comparability, timeliness, understandability, relevance and integrity as the first indicators. Based on these six

information quality characteristics, 14 secondary indicators are set as the overall CAID quality evaluation system.

2.3 Establishment of indicators

Table. 1. Carbon accounting disclosure quality evaluation system

First Indicator	Secondary Indicator	Instruction
Reliability	CAI collection process and other instructions (R ₁₁)	Whether the enterprise describes the source of CAI data and the process of collecting related data
	Internal review (R ₁₂)	Whether to indicate that carbon emissions review is included in the internal audit of the company
Comparability	Carbon Accounting Standard (C1)	Whether the disclosure is made with reference to the accounting standards and content format determined by the industry
Timeliness	Time of CAID (T1)	Timeliness of corporate annual report and social responsibility report disclosure
Understandability	Combination of graphs, data, and text (U1)	The combination of overall charts, text, and data for carbon accounting disclosure
	Explanation of technical terms (U2)	Availability of notes to explain terminology
Relevance	Greenhouse gas range description (R ₂₁)	Types of greenhouse gas emissions confirmed according to the scope of production and operation of the enterprise
	Carbon Emissions Inventory Preparation (R ₂₂)	Whether to prepare GHG emission inventories based on GHG ranges for internal and external information users
	Carbon Assets (I1)	Disclosure of fixed assets and assets under construction held by enterprises to reduce carbon pollutant emissions
	Carbon Liabilities (I2)	Disclosure of annual carbon pollutant emission fees payable by enterprises; disclosure of administrative fines for exceeding carbon pollutant emission standards, etc.
Integrity	Carbon Revenues (I3)	Disclosure of government subsidies received by enterprises for the implementation of policies to reduce carbon pollutant emissions; disclosure of income received by enterprises from the transfer of carbon emission rights and other intangible assets
	Carbon Expenses (I4)	Disclosures of expenses for reducing carbon pollutant emissions, including

Carbon Targets (I5)

environmental protection and greening expenses, education expenses for employees, etc.

Disclosure of emission reduction targets for the current or even future years

Emission reduction department: a dedicated body responsible for carbon emission reduction management;

Emission reduction measures: measures taken to reduce carbon emissions;

Emission reduction incentives: monetary incentives and non-monetary incentives such as promotions;

Carbon Governance (I6)

Emission Reduction Supervision: Establishment of corresponding supervisory departments and supervision measures

Reliability: Reliability requires truthfully reflecting various economic behaviours of accounting subjects in terms of low carbon. In this paper, two secondary indicators are set for reliability. The reason is that enterprises provide the basis for the data and information of the disclosed information by reporting the carbon information collection process to increase the reliability of the information. Meanwhile, the carbon emission review into the enterprise's internal audit will increase the information's reliability.

Comparability: Comparability includes horizontal and vertical comparability, and only comparable information can provide user decision criteria. At present, because CAI is scattered and lacks consistency, it is difficult for users to compare CAI of enterprises in different periods, so vertical comparability is poor ^[21]. Based on this, this paper sets a secondary indicator for comparability: the carbon accounting standard, which judges whether listed companies disclose according to the uniform accounting standard and disclosure format every year.

Timeliness: Timeliness emphasizes that carbon transactions or matters that occur should be recognized, measured and reported promptly, without advance or delay. Timely disclosure not only protects the value of CAI, but also improves the decision-making efficiency. Therefore, the time of CAID is set as a secondary indicator.

Understandability: Understandability requires CAI to be clear, easy to understand and use by report users. In this paper, two secondary indicators are set for understandability. The explanation of professional terms can increase users' understanding of the information; the combination of charts and data is clearer.

Relevance: Relevance requires CAI to be relevant and useful. Currently, most enterprises publish their carbon emission-related information to the public through annual and social responsibility reports, and rarely release it in independent reports such as environmental reports. Secondly, due to industrial production and operation differences, the types of greenhouse gases involved in carbon emissions differ. Therefore, enterprises should compile a list that can properly reflect the sources of greenhouse gases, to help different information users provide CAI with substantial predictive value. Therefore, this paper sets two secondary indicators for relevance, namely greenhouse gas range description and emission inventory.

Integrity: Integrity characteristics are mainly used to evaluate whether the content of CAID is sufficient and comprehensive. This paper sets a total of six secondary indicators for integrity. CAI

elements of accounting types are carbon assets, liabilities, revenues, and expenses ^[22]. Based on this, this paper sets up four secondary indicators related to carbon accounting that can be measured in monetary terms to measure the integrity of corporate CAID. Moreover, based on the carbon information content covered by the CPD and the current situation of CAID of Chinese companies, two secondary indicators of non-monetary measurement, carbon targets and carbon governance, are also designed.

2.4 Assignment Criteria of Evaluation Indicators

Table. 2. Scoring criteria and value range of each indicator

Secondary Indicator	Assignment of points (26 in total)	Evaluation Criteria
R ₁ 1	0, 1	Undisclosed = 0, Disclosed = 1
R ₁ 2	0, 1	Undisclosed = 0, Disclosed = 1
C ₁	0, 1	Inconsistent = 0, Consistent = 1
T ₁	0, 1, 2, 3, 4	Annual and social responsibility report are disclosed in January, February, March and April of the following year in order of 4, 3, 2, 1 points, 0 points for disclosure in May and later
U ₁	0, 1, 2, 3	Only textual disclosure = 1, Combination of text and data = 2, Combination of text, Data and graphs = 3, None of them = 0
U ₂	0, 1	Undisclosed = 0, Disclosed = 1
R ₂ 1	0, 1	Undisclosed = 0, Disclosed = 1
R ₂ 2	0, 1	Not prepared = 0 Prepared = 1
I ₁	0, 2	Undisclosed = 0, Disclosed = 1, Disclosed with separate account = 2
I ₂	0, 2	Undisclosed = 0, Disclosed = 1, Disclosed with separate account = 2
I ₃	0, 2	Undisclosed = 0, Disclosed = 1, Disclosed with separate account = 2
I ₄	0, 2	Undisclosed = 0, Disclosed = 1, Disclosed with separate account = 2
I ₅	0, 1	Undisclosed = 0, Disclosed = 1
I ₆	0, 1, 2, 3, 4	None = 0, one disclosure = 1, two disclosures = 2, three disclosures = 3, all disclosures = 4

2.5 Sample Selection and Data Sources

According to the "Environmental Information Disclosure Guidelines for Listed Companies" in China, the following 16 industries are defined as heavy polluting industries: thermal power, steel, cement, aluminum electrolysis, coal, metallurgy, chemical, petrochemical, building materials, paper, brewing, pharmaceutical, fermentation, textile, tannery and mining. According to the "Industry Classification Guidelines for Listed Companies" in 2012, the heavy pollution industries selected in this paper are B06, B07, B08, B09, C17, CI9, C22, C25, C26, C28, C29, C30, C31, C32, D44.

In this paper, according to the industry information of the RESSET database and the official websites of the Shenzhen Stock Exchange and Shanghai Stock Exchange, the following criteria were used for screening: (1) ST and *ST companies were excluded; (2) the sample of companies with missing data were excluded. Finally, 81 Shanghai and Shenzhen A-share listed companies in heavy pollution industry in Beijing-Tianjin-Hebei region were screened. Moreover, the 2021 annual reports and social responsibility reports of these 81 listed companies were collected from the Shanghai and Shenzhen Stock Exchange, and the CAI disclosed by them was organized and statistically analyzed according to the content required by the evaluation system. Subsequently, the listed companies were classified according to the size of accounting firms, and the size of the accounting firms was divided into three major categories according to the most common classification conventions in China, from the largest to the smallest: "Big Four" accounting firms(PricewaterhouseCoopers, Klynveld Peat

Marwick Goerdeler, Ernst & Young, and Deloitte Touche Tohmatsu); Domestic "Big Eight" accounting firms: (Rui Hua, Tian Jian, Li Xin, ShineWing, Da Hua, Da Xin, Zhi Tong and Baker Tilly International); Other accounting firms.

3. Results

3.1 Descriptive statistical analysis

According to the CAID quality evaluation system designed above, the six dimensions of reliability, comparability, timeliness, understandability, relevance and integrity are first compared separately, followed by a comprehensive comparison.

Table 3. The results of CAID reliability comparison

Firm Size	Average	Median	Mode	Standard Deviation	Min	Max	Total Score
The Four	0.583	0.000	0.000	0.759	0.000	2.000	2.000
The Eight	0.386	0.000	0.000	0.573	0.000	2.000	2.000
Others	0.320	0.000	0.000	0.546	0.000	2.000	2.000
Overall Average	0.430	—	—	—	—	—	—

From the comparison of the average in table 3, the reliability of CAID of listed companies audited by larger accounting firms is higher. Meanwhile, the above table also shows that the overall average value of the reliability of CAI is only 0.430, which is a large difference from the total score of 2.000, indicating that the overall reliability of CAI is not high at present. In addition, the mode is 0 under all three scales, indicating that most listed companies do not disclose their CAI collection process and do not indicate whether CAI is included in internal audit.

Table 4. The results of CAID comparability comparison

Firm Size	Average	Median	Mode	Standard Deviation	Min	Max	Total Score
The Four	0.667	1.000	1.000	0.471	0.000	1.000	1.000
The Eight	0.705	1.000	1.000	0.456	0.000	1.000	1.000
Others	0.600	1.000	1.000	0.490	0.000	1.000	1.000
Overall Average	0.657	—	—	—	—	—	—

As seen from table 4, the comparability of the information disclosed by the three sizes of accounting firms is similar, with a small fluctuation above and below the overall mean. It can be concluded that there is not much difference in the comparability dimension of CAI disclosed by the listed companies corresponding to the three accounting firms of different sizes, and the influence of size on the comparability of CAI is not obvious. In addition, the average overall comparability score is 0.657, indicating that some companies in the studied listed companies still do not have a uniform standard of CAID.

Table 5. The results of CAID timeliness comparison

Firm Size	Average	Median	Mode	Standard Deviation	Min	Max	Total Score
The Four	1.500	1.500	1.000, 2.000	0.500	1.000	2.000	4.000
The Eight	1.227	1.000	1.000	0.470	1.000	2.000	4.000
Others	1.080	1.000	1.000	0.271	1.000	2.000	4.000
Overall Average	1.269	—	—	—	—	—	—

Comparing the average value of table 5, the timeliness of CAID of listed companies audited by larger accounting firms is stronger than that of smaller accounting firms. The larger accounting firms have a stronger sense of responsibility for CAID and pay more attention to whether listed companies disclose important CAI in their annual reports and social responsibility reports on time. Therefore, compared to other size firms, the information of companies audited by the Big Four can be disclosed more often in March. While the mode corresponding to the Big Eight and other accounting firms is 1.000, reflecting that the disclosure of the information is mostly in April, and the urgency for corporate information disclosure is not strong.

Table. 6. The results of CAID understandability comparison

Firm Size	Average	Median	Mode	Standard Deviation	Min	Max	Total Score
The Four	3.417	3.000	3.000	0.493	3.000	4.000	4.000
The Eight	2.818	3.000	3.000	0.649	2.000	4.000	4.000
Others	2.280	2.000	2.000	0.449	2.000	3.000	4.000
Overall Average	2.838	—	—	—	—	—	—

From table 6, the larger the size of the firm, the stronger the understandability of CAID of the listed companies audited by it. The average value of the Big Four is 3.417, corresponding to the highest understandability of CAID of listed companies. Furthermore, there is a huge difference between the average value of the Big Four and other categories, the average value of other is 2.280, which is much lower than the overall average value of 2.838. However, the median and mode of the Big Four are 3.000, which indicates that there is still much opportunity for improvement in the understandability of companies' CAID.

Table. 7. The results of CAID relevance comparison

Firm Size	Average	Median	Mode	Standard Deviation	Min	Max	Total Score
The Four	0.833	1.000	1.000	0.687	0.000	2.000	2.000
The Eight	0.864	1.000	1.000	0.625	0.000	2.000	2.000
Others	0.800	1.000	1.000	0.693	0.000	2.000	2.000
Overall Average	0.832	—	—	—	—	—	—

The average value of table 7 shows that there is not much difference in the relevance of the quality of CAID between different sizes of accounting firms. On the one hand, there is no clear national regulation on whether auditing firms audit carbon emission inventories compiled separately by enterprises. On the other hand, there is also no clear regulation on whether the enterprises compile carbon emission inventories in China, most enterprises only state the types of greenhouse gas emissions in their annual reports, and very few enterprises list a separate inventory. In addition, the overall average score is 0.832, which greatly differs from the total score of 2.000. Therefore, the overall quality of CAI disclosed by listed companies is low in the relevance dimension.

Table. 8. The results of CAID integrity comparison

Firm Size	Average	Median	Mode	Standard Deviation	Min	Max	Total Score
The Four	5.083	5.000	5.000, 6.000	1.891	2.000	9.000	13.000
The Eight	3.932	4.000	4.000	1.587	1.000	9.000	13.000
Others	3.480	3.000	3.000	1.792	1.000	7.000	13.000
Overall Average	4.165	—	—	—	—	—	—

As shown in table 8, the larger the accounting firm is, the higher the integrity of CAI disclosed by the listed companies. According to the principal-agent theory, the larger audit firms have more clients, and the professional level of the firms is stronger, and they hold the right to speak in the process of the game, and they strictly require the listed companies to disclose the information as fully as possible, to promote their long-term development. However, the overall average score is 4.165, which is also far lower than the total score of 13.000, reflecting that the overall listed companies in the heavy pollution industry are not high. Hence, the integrity of disclosure content needs to be improved.

Table. 9. The results of CAID comprehensive scores

Firm Size	Average	Median	Mode	Standard Deviation	Min	Max	Total Score
The Four	12.083	12.000	12.000	1.935	7.000	15.000	26.000
The Eight	9.932	10.000	9.000	2.104	6.000	15.000	26.000
Others	8.560	8.000	7.000, 8.000	2.022	5.000	12.000	26.000
Overall Average	10.192	—	—	—	—	—	—

From table 8, the average comprehensive score of CAID quality of listed companies in heavy pollution industry audited by the Big Four accounting firms is 12.083, the average comprehensive score of listed companies audited by the Big Eight is 9.932, and the comprehensive level of listed companies audited by other accounting firms is 8.560. Therefore, the larger the size of accounting firms, the higher the comprehensive score of CAID quality of listed companies. However, the overall average value of 10.192 is far lower than the established total score of 26.000, which reveals that the overall quality of CAID of listed companies in heavy pollution industry in China is still at a low level.

3.2 One-way analysis of variance

Table. 10. One-way ANOVA results of the size of accounting firms and the quality of CAID

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Inter-group	101.708	2	50.854	11.603	0.000
Intra-group	341.872	78	4.383		
Total	443.580	80			

Table 10 shows that at the significance level of $\alpha=0.05$, the significance result is 0.000, so the original hypothesis of variance is rejected, indicating that the influence of the size of accounting firm on the quality of CAID of listed companies in heavy pollution industry is significant. Combined with the descriptive statistical analysis, it can be concluded that the quality of CAID of listed companies in the heavy pollution industry audited by large accounting firms is higher than that of small ones, so hypothesis 1 holds.

4. Conclusions

In this paper, from the perspective of accounting information quality characteristics, six accounting information quality characteristics are selected as primary indicators, and then 14 secondary indicators are selected to establish the quality evaluation system of carbon accounting information disclosure (CAID). Subsequently, 81 Shenzhen and Shanghai A-shares listed companies in the heavy pollution industry in Beijing, Tianjin and Hebei region in 2021 are screened. The size of the accounting firms with which these listed companies cooperate is divided into three major categories, and using the established evaluation system, the differences in the quality of CAID of listed companies in the heavy pollution industry audited by the three sizes of accounting firms are compared.

The comparison reveals that the larger the size of the accounting firms audited the higher the quality of CAID of listed companies in the four dimensions of reliability, timeliness, understandability, and integrity. But there is no significant relationship between the size of accounting firms and the CAID in terms of comparability and relevance. Finally, through comprehensive comparison as well as one-way ANOVA, it is concluded that, overall, there is a significant relationship between accounting firms' size and the quality of CAID by listed companies in the heavy pollution industry, and the larger the size of accounting firms corresponds to the overall higher quality of CAID by listed companies. In addition, through the comparison of data, it is found that the overall CAID quality of listed companies in the heavy pollution industry in China is currently low and still has significant defects.

5. Recommendations

After research and analysis, this paper puts forward relevant recommendations from three perspectives: the accounting firm, the state, and the enterprise.

Accounting firm level: The accounting firms themselves should respond to the national policy of "getting bigger and stronger" and actively seek opportunities to strengthen mergers and expand their scale. Meanwhile, they should strive to develop their business scope while not forgetting to pay attention to their reputation building, and constantly provide regular training and assessment for CPAs, cultivating carbon audit talents. In addition, the capital market regulators should support the planning strategy of the accounting industry and provide policy incentives and dividends.

Nation level: It is imperative to strengthen the binding force of policies and laws; accounting practice cannot be separated from legal guidance and regulation. Therefore, the government should strengthen the legislation on carbon accounting work, and make clear instructions on the content, so that enterprises have a relevant legal basis to promote the smooth progress of CAID work in China.

Enterprise level: Listed companies should take the initiative to investigate the gaps, take the initiative to improve the disclosure system of CAI, and set up a special department to carry out internal monitoring and management of CAI. At the same time, according to relevant laws and regulations, improve and clarify the reward and punishment mechanism for individual companies. Through these means, to improve the integrity, understandability, timeliness, and reliability of CAID, thus improving the overall CAID quality of listed companies in China.

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