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THE INFLUENCE OF COMPANY SIZE AND PROFITABILITY ON CARBON ACCOUNTING INFORMATION DISCLOSURE: EVIDENCE FROM THE SHANGHAI A-SHARE HEAVILY POLLUTING INDUSTRIES

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ABSTRACT

In this study, the relationship among firm size, profitability, and carbon accounting information disclosure (CAID) of 131 highly polluting Shanghai A-share listed companies was analysed using a multivariate regression approach based on the stakeholder theory. The results revealed that larger and more profitable companies were more transparent in disclosing carbon accounting information, which aligned with stakeholder expectations. This study enhanced the comprehension of the interplay between company characteristics and CAID dynamics and emphasised its pivotal role in fostering sustainability and transparency. The insights are valuable for policymakers, industry experts, and stakeholders and guide environmentally responsible business practices.

INTRODUCTION

Implementing the International Financial Reporting Standards (IFRS) S1 and S2 increased focus on organisational carbon emissions, sustainability policies, and related risks and possibilities. The IFRS S1 emphasises the disclosure of sustainability-related risks and opportunities, whereas IFRS S2 concentrating on disclosing climate-related risks and opportunities (Avi, 2022). Globally, stakeholders DOI:10.47191/jefms/v5-i4-11 pressure companies to increase their accountability, specifically regarding social and environmental issues (Pasko et al., 2021).

The Carbon Disclosure Project (CDP) is the leading international platform for carbon accounting information disclosure (CAID), aiming to establish uniform reporting protocols for companies' climate-related activities. It supplements annual financial reports by providing investors with information on global warming-associated business risks and opportunities. Unlike carbon financial accounting, CDP reports cover various climate-related activities, such as measuring emissions, preparing organizations, investing in technology, trading, and offsetting. Carbon accounting is a specialized process involving the measurement and quantification of emissions within legal frameworks (Kolk et al., 2008). In 2021, the CDP disclosed environmental data from 13,000 enterprises, representing 64% of the global market value—a 35% increase from 2020 and a 141% rise since the Paris Agreement in 2015 (CDP, 2021). Specifically, CDP revealed carbon accounting information for 2,000 companies in China, a 43% increase from 2020, surpassing the global growth rate. Xiong (2015) highlighted CAID level variations across Chinese industries, particularly in heavily polluting sectors facing stricter regulations and higher penalties. These industries, characterized by high energy consumption and emissions, encounter challenges in reducing their environmental impact, with some prioritizing economic growth over environmental protection and experiencing weak regulation enforcement (Ou & Jiang, 2023).

Considering the challenges involved, comprehending the elements that affect the CAID of heavily polluting Chinese enterprises is important. Although there are various factors influence organisational CAID, size and profitability levels maybe crucial. Faisal et al. (2018) discovered that larger, more profitable, and lower-leverage companies are more motivated to disclose carbon accounting information to stakeholders Among the ASEAN countries, Asif (2021) reported that governance, industry characteristics, organisational efficiency, operational size, and transparency levels substantially influence CAID. Liu (2018) and Yang (2022) have found and highlighted the importance of company size and profitability, revealing their critical role in shaping organisational CAID behaviour. These findings provided important clues for a deeper understanding and interpretation of corporate environmental disclosure behaviour. In enhancing the understanding and provide insights into how heavily polluting industries can improve environmental performance, this study aimed to integrate stakeholder theory organically with the IFRS S1 and S2 guiding principles. This comprehensive investigation aimed to provide companies with a more refined and practical blueprint for CAID implementation.

LITERATURE REVIEW AND HYPOTHESIS

The stakeholder theory recently gained significant attention as it highlights the importance of businesses considering the effect of their actions on stakeholders. Organisations are expected to be accountable to their shareholders and other stakeholders, such as employees, customers, suppliers, the environment, and society (Freeman, 2010). An increased company size involves more stakeholders, which increases the importance of meeting their disclosure requirements, such as CAID.

Empirical studies consistently demonstrated a statistically significant positive correlation between company size and the CAID level. Zhao and Yan (2014) studied the listed companies in heavily polluting industries and reported that company size significantly affected the CAID. Similarly, Gao (2014) examined publicly listed manufacturing organisations and reported a noteworthy and positive association between company size and CAID. Faisal et al. (2018) examined the factors that influence CAID by analysing the annual reports of 37 publicly traded businesses in Indonesia from 2011 to 2014. The findings indicated that organisations that are large and

extremely lucrative, while also low-leverage, are strongly motivated to provide carbon-related information to their stakeholders. Furthermore, Ika et al. (2022) and Yu et al. (2020) reported that firm size and profitability were positively related to CAID.

A growing company will likely involve more stakeholders, which increases the organisational CAID disclosure requirements. Organisational stakeholders significantly influence the development of organisational sustainability practices. Profit-seeking shareholders may prioritise short-term financial returns over long-term sustainability goals. Nevertheless, as more investors become socially responsible, they are increasingly interested in the organisational environmental and social impact. This interest could encourage companies to disclose more information about their carbon accounting practices (Zumente & Bistrova, 2021).

Highly profitable firms are more dependable when managing public affairs, such as environmental issues or social donations, which align better with social norms and legitimacy requirements (Gamerschlag et al., 2011; Yang, 2022; and Yu et al., 2020) identified a significant positive correlation between profitability and CAID. Nonetheless, the effect of profitability on CAID is debatable. Gao (2014) and Chen (2018) reported a negative correlation between profitability and CAID. Furthermore, Kholmi et al. (2020) determined that profitability negatively affected carbon emission disclosure in Indonesia. Nevertheless, Ma (2015), Larasati et al. (2020), and Larasati et al. (2020) reported that the profitability variable did not significantly affect CAID.

METHODOLOGY

Given the increased government oversight and societal focus on significantly polluting industries, the research sample in this study was corporations in such industries. In this study, 20 industries were screened from the industry codes according to the relevant regulations of the China Securities Regulatory Commission and the State Environmental Protection Administration[1]. Cross-sectional data from all A-share listed businesses in the heavily polluting sector covering 2021 were used. Yearly data were used, and the original sample was screened according to the following criteria to guarantee the dependability and accuracy of the findings:

(1) Companies in the heavily polluting industry were selected from the industry codes of listed companies.
(2) The ST[2], SST[3], ST[4], and PT[5] companies were excluded.
(3) Companies with missing or abnormal values for relevant variables were excluded.

Stratified sampling was used to ensure a representative and unbiased sample by partitioning the population into multiple strata based on similar attributes, with samples randomly selected from each stratum. The study population consisted of 513 companies, and a sample size of 129 valid samples was determined using G-Power software. After applying the stratified sampling method, the final sample size was adjusted to 131, maintaining a ratio of 129/513 (25.15%). The heavily polluting industries were divided into 20 strata to capture industry variations

1 The Guidelines for Environmental Information Disclosure of Listed Companies (Draft for Comments) issued by the Ministry of Environmental Protection on September 14, 2010, state that 16 industries (thermal power, iron and steel, cement, electrolytic aluminium, coal, metallurgy, chemicals, petrochemicals, building materials, papermaking, brewing, pharmaceuticals, fermentation, textiles, tanning, and mining) are heavily polluting industries.
2 ST: Special treatment: Companies that experience consecutive annual losses receive preferential treatment.
3 SST: Companies experiencing consecutive yearly losses are subject to special treatment and have not implemented stock reform.
4 ST: Companies that experience financial losses for three consecutive years are issued a warning regarding delisting.
5 PT: Particular transfer: Stocks awaiting delisting undergo trading suspension and their prices are reset to zero.

effectively, with SPSS facilitating sample selection at a 25% ratio. Despite aiming for a 25% proportion, some discrepancies arose due to practical adjustments during the study, introducing sampling bias. These discrepancies are discussed in detail in the Discussion section, where suggestions for future research design improvements are provided.

Table 1: Definitions of the Variables and Data Sources

Variable	Description	Document Type	Data Source	Data Selection or Processing Method
Independent	Company size; Profitability	Annual report	CSMAR database	Relevant CSMAR data selected and exported based on company codes
Dependent	CAID	Annual report Sustainability report ESG report	WIND, CNINFO website, official company website	CAID-related content identified and coded using content analysis of collected reports

Variables Definition and Modelling

CAID: This study developed the CAID evaluation system and checklist using the approaches of Shen, Zheng, Adams and Jaggi (2020), Fan (2021), Choi, Lee and Psaros (2013), and Utami (2022). Initially, carbon information was categorised into non-monetary CAID (CAIDNM) and monetary CAID (CAIDM) based on whether they involved specific monetary funds. Guided by Fan (2021), the sampled companies were scored using a content analysis method. The analysis established five primary indicators (carbon reduction goals and strategies, carbon reduction management, carbon emission accounting, carbon reduction performance, capital investment and returns) and 10 secondary indicators.

The CDP Information Request sheets were analysed by referencing Choi et al. (2013) and Utami (2022). The analysis identified five major categories related to climate change and carbon emissions: climate change risks and opportunities (CC), greenhouse gas emissions accounting (GHG), energy consumption accounting (EC), greenhouse gas reduction (RC), and cost and carbon emission accountability (ACC). Eighteen key items within these categories were selected with Fan's (2021) scoring table. All items were assigned equal weight to ensure a fair evaluation. Companies achieved a maximum score of 18 when they fully disclosed information on all 18 environmental items.

Company Size: Company size is crucial in disclosure policy research (Foster, 1986). It can be measured by sales revenue, total assets, and market value. Total assets, which reflect a company's internal control responsibilities, are less affected by market changes (Yan, 2014). This study used the logarithm of year-end total assets for empirical research, referencing Li et al. (2018). Accordingly, Hypothesis 1 was proposed.

Hypothesis 1: Company size is positively correlated with the CAID level.

Table 2: CAID Scoring Criteria Checklist

Category	Primary Indicator	Secondary Indicator	Score	Explanation
CAIDNM	Carbon reduction goals and strategies (1/2)	(1) Carbon reduction goals	0, 1	1 point if there are carbon reduction goals; otherwise, 0 points.
		(2) Carbon reduction strategies	0, 1	1 point if there are carbon reduction strategies; otherwise, 0 points.
	Carbon reduction management (3/4/5/6)	(3) ACC1: Indicates which board committee (or other executive accountability body) has overall responsibility for actions related to climate change. Establishment of low-carbon management organisation.	0, 1	1 point if there is a dedicated management department; otherwise, 0 points.
		(4) ACC2: Describes the mechanism by which the board (or other executive body) reviews company progress regarding climate change.	0, 1	1 point if it includes mechanism or department review of climate change; otherwise, 0 points.
		(5) Training or promotion of low-carbon awareness among employees	0, 1	1 point if there is training or promotion; otherwise, 0 points.
		(6) Incorporation of low-carbon energy efficiency in performance assessment	0, 1	1 point if included in the performance assessment; otherwise, 0 points.
	Climate change risks and opportunity (7/8)	(7) CC1: Assessment or description of the risks (regulatory, physical, or general opportunities) related to climate change and actions taken or impending.	0, 1	1 point if included in description of the risks relating to climate change and actions taken or to be taken; otherwise, 0 points.
		(8) CC2: Assessment or description of current (and future) financial implications, business implications, and opportunities of climate change.	0, 1	1 point if included in the climate change opportunities; otherwise, 0 points.
	Carbon emission accounting (9/10/11)	(9) GHG1: Description of the methodology used to calculate GHG emissions (GHG protocol or ISO)	0, 1	1 point if it describes the GHG calculation methodology; otherwise, 0 points.
		(10) GHG2: External verification of quantity of GHG emission; if so, by whom and on what basis.	0, 1	1 point if it includes verification of GHG quantity; otherwise, 0 points.
		(11) GHG6: Disclosure of GHG emissions by the facility- or segment-level.	0, 1	1 point if it includes carbon emission data or resource usage; otherwise, 0 points.

CAIDM	Carbon emission accounting (12/13)	(12) Carbon emission data or resource usage related to carbon emissions.	0, 1	1 point if disclosed by the facility- or segment-level; otherwise, 0 points.
		(13) GHG7: Comparison of GHG emissions with previous years.	0, 1	1 point if there is trend comparison; otherwise, 0 points.
	Carbon reduction performance (14/15/16)	(14) Recognition or awards for carbon emission reduction by relevant organisations.	0, 1	1 point if recognised by the government; otherwise, 0 points.
		(15) Resource conservation, utilisation, and development.	0, 1	1 point if included in the reduction performance; otherwise, 0 points.
		(16) RC3: Emissions reductions and associated costs or savings achieved to date due to the reduction plan.	0, 1	1 point if included in the cost saving for the reduction; otherwise, 0 points.
	Capital investment and returns (17/18)	(17) Low-carbon research and development investment and achievements.	0, 1	1 point if included in the investment and achievements; otherwise, 0 points.
		(18) Benefits from low-carbon economic development.	0, 1	1 point if included in low-carbon economic development; otherwise, 0 points.

Sources: Bae Choi et al. (2013) and Fan (2021)

Company Profitability: Companies with stronger profitability generate higher annual operating profits and are more capable of undertaking corporate social responsibility (CSR) and high-quality environmental accounting disclosures (Xiong, 2015). The return on equity (ROE) is the most comprehensive indicator for measuring profitability levels. The ROE represents the ratio of the organisational net profit to shareholders' equity over a specific period and reflects the return on investment from the shareholders' perspective. Shareholders can compare companies using the ROE and choose the company offering the highest investment return as their investment target (So, 2023; Utami, 2022). Thus, Hypothesis 2 was suggested: Hypothesis 2: Company profitability is positively correlated with the CAID level.

The operational definitions of the variables used in this study are detailed in Table 3.

Table 3 Operational Definitions of the Variables

Variable	Variable Name	Symbol	Description
Explanatory	CAID index	CAIDI	CAID index
Response	Company size	CS	Log total assets; total assets at the end of the period logarithm
	Profitability (ROE)	ROE	Net operating profit (NOP)/average net assets

The research model was constructed as follows:

CAIDI	=	CAID index
α_0- α_2	=	Regression coefficient
CS	=	Log total assets
ROE	=	NOP/average net assets
	=	Disturbance term

FINDINGS

In this study, the total assets of the annual report data for 2021 of the sampled 131 companies were represented using the log total assets. The maximum value of 38.58 was distributed within the Electric Power, Heat Production and Supply sector (D44), while the minimum value of 28.87 was distributed within the Petroleum Processing, Coking, and Nuclear Fuel Processing (C25) sector. The mean value was 32.69 (standard deviation: 2.12). The findings suggested substantial disparities in the asset sizes among the heavily polluting industries.

The magnitude of organisational assets is a significant metric for assessing its financial security and overall size. In this study, the average asset size among the sampled industries was 28–38. This result implied that certain industries own greater asset quantities, whereas other industries have comparatively lower asset quantities. The average asset scale parity of the Electricity, Heat Production, and Supply sector (D44) was 34.87 (maximum: 38.58; minimum: 30.1). Contrastingly, the mean asset size of Petroleum Processing, Coking, and Nuclear Fuel Processing (C25) companies was 29.55 (maximum: 30.23; minimum: 28.87. This phenomenon underscored variations in the magnitude of assets across the industries.

Profitability is a fundamental metric for assessing organisational success. The ROE was evaluated as a representation of profitability, where the Chemical Raw Materials and Chemical Product Manufacturing (C26) sector had the highest recorded ROE value (0.53). Conversely, the Electric Power, Heat Production, and Supply (D44) sector had the lowest recorded ROE value (1.26). The average ROE across the various industries was 1.26–0.53. Certain industries exhibited higher profitability, whilst others had comparatively lower profitability. For example, the mean ROE of the Chemical Fibre Manufacturing (C28) sector was 0.23, but the average ROE of the Electric Power, Heat Production, and Supply (D44) sector was 0.04. This observation suggested notable variations in profitability across various industries.

The CAID of 131 firms was evaluated based on the grading criteria outlined in Table 3. The score proportions for CAIDM and CAIDNM were 8/18 and 10/18, respectively. The actual summary score for CAID was 580 points, where CAIDNM scored 369 points, which constituted 63.62% of the total score. The CAIDM scored 211 points, which represented 36.38% of the total score.

The average CAID score was 4.42, indicating low carbon reporting in heavily polluting industries. The Non-ferrous Metal Smelting and Rolling Processing (C32) sector had the highest score of 17, followed by Electric Power, Heat Production, and Supply (D44) and Coal Mining and Washing (B06) with 16 each. Several sectors, including Electric Power, Heat Production, and Supply (D44), had minimum scores of 0. The Non-metallic Mineral Mining and Quarrying (B10) and Non-ferrous Metal Ore Mining (B09) sectors had the highest mean score of 9, followed by Petroleum and Natural Gas Extraction (B07) with 8, and Coal Mining and Washing (B06) with 7.4. Table 4 presents the multiple linear regression analysis results.

Table 4: Multiple Linear Regression Results

Model B		Unstandardised Coefficients		Standardised Coefficients	t	Sig. Tolerance	Collinearity Statistics	
		Std. Error	Beta				VIF	
	(Constant)	-33.018	5.029		6.565	0.000		
	LOG TOTALASSETS	0.977	0.147	0.526	6.634	0.000	0.812	1.232
	PROFITABILITY (ROE)	3.980	1.849	0.162	2.153	0.033	0.896	1.116

In Table 4, LOG TOTALASSETS recorded B = 0.977 and p < 0.001. The regression coefficient for LOG TOTALASSETS was 0.977 and the associated p-value was < 0.001. The results indicated a highly significant influence on CAID. Thus, the company size was positively correlated with the CAID level and passed the significance test, and the correlation was consistent with the hypothesis. This result indicated that larger companies are more likely to disclose carbon information. The results aligned with Hypothesis 1 and were consistent with the results of Yan (2014), Li et al. (2018), Faisal et al. (2018), and Asif (2021).

In PROFITABILITY (ROE), B = 3.980 and p = 0.033, which indicated that profitability positively affected CAID, albeit less robustly than total assets. This result indicated that company profitability strength or weakness is significantly related to the CAID level. Strongly profitable companies in the heavily polluting industry actively communicate positive signals to the market by proactively disclosing carbon information. This result was consistent with the notable positive correlations by Faisal et al. (2018) and Hapsoro and Falih (2020).

DISCUSSION AND RECOMMENDATION

In this study, CAID among A-share listed companies in heavily polluting industries was predominantly non-monetised, with CAIDNM and CAIDM constituting 63.62% and 36.38% of the total score, respectively. The absence of clear legislative restrictions and standardised methodologies likely contributed to the prevalent use of non-monetised metrics. The total CAID level of the sampled companies was not high, and there remains substantial opportunity for growth. The average score among the 131 firms was 4.43, with a wide range (minimum: 0; maximum: 17). This result suggested that the firms had significantly varied disclosure levels. Companies frequently adhere to voluntary disclosure principles due to the absence of clear CAID legislative restrictions, which results in overall low disclosure.

The findings indicated that Hypothesis 1 was supported, where the increase in total assets and CAID level were significantly positively correlated (B = 0.977, p = 0.000). This result suggested that larger companies tended to engage in more detailed and comprehensive CAID. This tendency might be due to larger enterprises prioritising transparency and social responsibility in response to societal and stakeholder pressures. Such companies actively disclose carbon accounting information to meet societal expectations. Furthermore, larger companies have a robust capability to shape positive perceptions among the public and key stakeholders. The proactive disclosure of greenhouse gas emission information by such companies demonstrates environmental corporate responsibility. This result underscored the positive role of large corporations in highlighting environmental sustainability through information disclosure (Faisal et al., 2018). Furthermore, larger companies are more likely to use annual reports or other corporate documentation to disclose CSR information (Brammer & Pavelin, 2006).

Profitability was represented by ROE and was positively correlated with the CAID level, albeit with a weaker intensity compared to total assets. Specifically, the enhanced profitability demonstrated a positive correlation trend with the increase in CAID levels. This result suggested that companies in the heavily polluting industry with stronger profitability are more likely to convey positive market signals by actively disclosing carbon accounting information, which highlights their commitment to environmental sustainability. Profitable companies tend to exhibit higher carbon information disclosure indices due to their capacity to allocate ample resources for environmental disclosure expenses. Contrastingly, less profitable companies might prioritise financial goals, which limits their capacity to engage in environmental disclosure practices (Prado-Lorenzo et al., 2009).

Based on the findings, four recommendations are proposed to improve the development of organisational carbon accounting disclosure: First, official legislation mandating that businesses disclose carbon accounting information should be established. Establishing a clearly defined legislative framework would enable regulatory authorities to enforce mandatory disclosure of carbon accounting data. Such disclosure would ensure compliance with environmental obligations and effectively reduce carbon emissions. This approach would foster a fair and competitive business environment, which would motivate companies to adopt sustainable models and contribute to low-carbon development.

Second, transparent rules that encourage businesses to integrate financial carbon accounting data into their reports should be implemented. Detailed disclosure requirements can guide enterprises in systematically collecting, analysing, and reporting carbon accounting information. Emphasising monetary carbon accounting data in reports and integrating textual explanations would enhance clarity and comprehensibility. This transparency would improve disclosure and generate more comprehensive carbon accounting information for sustainable management.

Third, the corporate asset scale should be expanded by increasing the debt ratio. Companies can invest in cutting-edge carbon emission reduction technologies and environmental facilities through debt financing, which would demonstrate financial flexibility and commitment to protecting the environment (Luo et al., 2023). Increasing the debt ratio would fund new energy projects, which would contribute to asset scale expansion and support comprehensive CAID aligned with sustainable development goals.

Lastly, corporate profitability should be enhanced through strategic measures (revenue growth, cost reduction, expense minimisation, tax optimisation). Identifying climate-related opportunities, adhering to environmental regulations, investing in green technologies, and leveraging government incentives can enhance revenue. Optimising costs would involve environmental responsibility initiatives and energy-saving programmes, while efficient tax management, collaboration with policymakers, and proactive utilisation of incentives would contribute to profitability. As profitability frequently correlates with superior carbon disclosure, investors should prioritise companies with higher carbon disclosure indices. This approach would encourage companies to disclose more information and attract additional investment capital for corporate expansion.

CONCLUSION

This research analysed 2021 data from A-share listed companies in Chinese heavily polluting industries to assess their CAID practices. Findings showed suboptimal CAID, marked by insufficient comprehensiveness and poor comparability, with a preference for qualitative over quantitative disclosures. Larger, more profitable companies exhibited higher CAID

levels, highlighting the influence of financial performance and size. The study emphasized the need for ongoing improvements in carbon disclosure and suggested future research should develop more comprehensive, quantitative, and standardized disclosure standards to promote sustainability and transparency.

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