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The influence of carbon emission disclosure on financial performance: Do firm characteristics matter?

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ABSTRACT

This study aims to provide empirical evidence on the effect of carbon emission disclosure on financial performance by considering the moderating role of firm characteristics, such as firm size, firm age, and sales growth. This quantitative study is based on the positivism paradigm that applies the purposive sampling method in determining its sample. Hypothesis testing uses multiple regression and moderated regression analysis. This study successfully proves that carbon emission disclosure has a positive effect on accounting-based performance measures. This positive effect can only be strengthened by one of the firm characteristics tested in this study, sales growth. Meanwhile, this study has not succeeded in proving the positive effect of carbon emission disclosure on market-based performance measures. This study contributes to the development of literature, especially carbon emission disclosure research, by proving signaling theory and legitimacy theory. This study has practical implications, especially for Indonesia and China, related to the issue of carbon emission disclosure. This study offers novelty in carbon emission disclosure research by introducing new moderators, firm characteristics and focusing on energy sector companies in Indonesia and China.

Introduction

The issue of climate change caused by global warming has increasingly attracted global attention in recent decades (Bedi & Singh, 2024). One of the main causes of global warming is the release of carbon dioxide, known as carbon emissions. Carbon emissions have become one of the critical threats to the sustainability of life on earth (Siddique et al., 2021; Mclennan, 2022). Companies are major players in increasing global carbon emissions (Cadez et al., 2019). In recent years, stakeholders have demanded that companies be more transparent in explaining climate change-related activities, such as disclosing carbon information (Alsaifi et al., 2020a; Siddique et al., 2021; Bedi & Singh, 2024). The public will view the disclosure of carbon information as a positive signal that shows the company's concern and responsibility following applicable norms (Emmanuel et al., 2023; Siddique et al., 2021). Companies that have a good reputation in environmental management tend to be valued higher by the capital market (Siddique et al., 2021; Hardiyansah et al., 2021). Investors will respond more positively to companies that demonstrate a commitment to sustainable business practices as a form of good management and lower long-term risk (Alsaifi et al., 2020b).

In recent years, research on the consequences of carbon emission disclosure (CED) has become a hot topic of discussion (Bedi & Singh, 2024; Emmanuel et al., 2023; Alsaifi et al., 2020a; Alsaifi et al., 2020b; Siddique et al., 2021; Hardiyansah et al., 2021). Using a sample of financial companies in Nigeria, Emmanuel et al. (2023) found a positive effect of carbon information disclosure on the company's financial performance. The results of this study are in line with Alsaifi et al. (2020a) and Alsaifi et al. (2020b), which used a sample of companies in the UK. Limited to using a sample of 82 companies listed on the Indonesia Stock Exchange and receiving awards in the Indonesian Sustainability Reporting Award (ISRA), Hardiyansah et al. (2021) proved that carbon emission disclosure has a positive impact on company value. In addition to a number of studies that focus on specific countries, Siddique et al. (2021) investigated companies worldwide included in the Financial Times (FT) Global 500 (G500) and succeeded in proving a positive relationship between carbon disclosure and long-term company performance.

According to some empirical evidence that proves the positive effect of CED on firm performance, the investigation of the role of moderating variables in this relationship can be investigated. Firm characteristics, such as firm age, firm size, and sales growth, can be explored as moderating variables. Companies that have been

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established for a long time generally have gained legitimacy from the community because the company has made efforts to run its business following applicable norms, including showing concern for the environment (Abdi et al., 2022). Established companies in line with their age tend to have adequate resources to support their environmental disclosure activities (Chen et al., 2021). Using a sample of non-financial companies listed in Western European countries from 2008–2018, D'Amato & Falivena (2020) proved the moderating role of company age in the relationship between corporate social responsibility and company value.

Furthermore, firm size determines the size of public visibility and attention. In line with stakeholder and legitimacy theories, large companies are more required to play an active role in showing concern for the environment. By carrying out this role, companies can satisfy the demands of stakeholders and gain legitimacy from society (Bedi & Singh, 2024; Aguilar-Fernández & Otegi-Olaso, 2018; Abdi et al., 2022). Empirical studies conducted by Abdi et al. (2022) prove the moderating role of firm size in the relationship between sustainability disclosure and company value and company financial performance. This study focuses on 38 airlines worldwide for the period 2009 to 2019. The results of this study are in line with D'Amato & Falivena (2020). Specifically related to carbon information disclosure, Bedi & Singh (2024), using data from 100 companies listed on the Bombay Stock Exchange, prove that firm size moderates the effect of CED on company financial performance.

Another company characteristic that can be considered as a moderator in the relationship between carbon information disclosure and company financial performance is sales growth. Information on sales growth can be a positive signal for investors to make investments (Putri & Rahyuda, 2020). This condition is in line with signaling theory. With an increase in the amount of investment, the company has additional funds that can support various activities carried out, including environmental information disclosure activities. Disclosure of carbon information that has a positive impact on the company's financial performance will be further supported by the company's sales growth.

A number of empirical studies that prove the moderating role of age (D'Amato & Falivena, 2020) and firm size (Abdi et al., 2022; Bedi & Singh, 2024) in the relationship between environmental/carbon information disclosure and company performance are still opportunistic. This is because existing research does not clearly show the direction of the moderating variables being investigated, whether they strengthen or weaken the existing relationship. Therefore, further research can fill this gap and, at the same time, confirm the role of moderation. Furthermore, to the best of our knowledge, to date, there has been no research that explores sales growth as a moderating variable that can strengthen the influence of carbon information disclosure on company performance.

Empirical research on carbon emission disclosure has not highlighted sectors with a high carbon footprint, such as the energy sector. Existing data shows that greenhouse gas emissions from the energy sector have tripled in the last two decades (IPCC, 2023). In addition, the energy sector contributes around 36% of total greenhouse gas emissions worldwide. Furthermore, carbon emission research that has been conducted focuses on India (Bedi & Singh, 2024), the United Kingdom (Alsaifi et al., 2020a; Alsaifi et al., 2020b), and Nigeria (Emmanuel et al., 2023). There has been no research that highlights China as the largest carbon emitter in the world (Crippa et al., 2023; Alamsyah, 2024). Research using data from Indonesia as the largest carbon emitter in Southeast Asia (Crippa et al., 2023) is also still very limited. Research with Indonesian data focuses on companies that have received the Indonesian Sustainability Reporting Award (Hardiyansah et al., 2021).

This study aims to provide empirical evidence on (1) the positive influence of carbon emission disclosure on accounting-based (short-term) and market-based (long-term) financial performance of companies, (2) the moderating role of company characteristics (company age, company size, and sales growth) that strengthen the positive influence of carbon emission disclosure on accounting-based (short-term) and market-based (long-term) financial performance of companies. This study offers the following novelties. First, this study focuses on energy sector companies in Indonesia and China. Focusing on companies with high carbon footprints is expected to open broader insights. Choosing Indonesia and China as the largest carbon producers in Southeast Asia and the world is expected to enrich knowledge related to the consequences of carbon disclosure in both countries. Second, empirical evidence of the positive consequences of carbon disclosure on company performance through a number of previous studies encourages this study to investigate the moderating role of company characteristics (company age, company size, and sales growth) in strengthening this relationship. Given that the investigation of the moderating role that exists so far has not been able to confirm a clear direction. Third, this study separates financial performance into accounting-based financial performance that reflects short-term performance, and market-based financial performance that reflects long-term performance. This separation is expected to enrich knowledge to understand whether carbon information disclosure has a positive impact in the short term, long term, or both. These results are expected to provide real practical implications.

Literature Review

Legitimacy Theory

Legitimacy theory argues that companies should conduct their operations within the boundaries and norms accepted by society (Suchman, 1995). Companies use carbon emission disclosure as a legitimation tool driven by

the desire to project their environmentally friendly image in the eyes of the public (Jiang et al., 2021). Stakeholders generally tend to respond more positively to companies that demonstrate a commitment to sustainable business practices (Alsaifi et al., 2020b).

Stakeholders Theory

According to the stakeholder theory, companies aim to provide various benefits to stakeholders (Freeman, 1984). This theory explains how stakeholders pay attention to various company actions related to environmental and social issues (Zhou et al., 2024) Disclosure of environmental information, including carbon information, has a direct impact on stakeholder attitudes and perceptions. By adhering to this theory, companies to maximize value creation and support their long-term sustainability (Mahajan et al., 2023).

Signaling Theory

Signaling theory is a concept that describes how to reduce asymmetric information between parties who have information and parties who need it through certain signals or signs (Spence, 1973). This theory refers to how information conveyed by company management can imply positive indications to investors (Brigham and Houston, 2015). This theory is able to explain the reasons behind the disclosure of information by companies to the public. Companies can provide signals through the disclosure of reliable information, such as financial reports, sustainability reports, and disclosure of carbon emission information.

Carbon Emission Disclosure and Accounting-based Financial Performance

Legitimacy is one of the strategic factors for company development. Therefore, in running its business, the company always strives to gain legitimacy from the community. The company will take actions that are considered appropriate and follow social norms (Suchman, 1995). Legitimacy can direct the company to achieve a competitive advantage. Customers tend to choose products from companies that have gained public legitimacy. Therefore, achieving corporate legitimacy can ultimately lead to increased corporate profits. One effort that companies can make to gain legitimacy is to disclose their environmental information more transparently (Zhou et al., 2024). Disclosure of environmental information can improve the company's financial performance (Zhou et al., 2024), including carbon information (Alsaifi et al., 2020a; Emmanuel et al., 2023).
H_1: Carbon emission disclosure has a positive influence on accounting-based financial performance.

Carbon Emission Disclosure and Market-based Financial Performance

Companies are required to foster good relationships with stakeholders because they support the availability of resources for the company's operational activities (Hörisch et al., 2014). In other words, stakeholders play an important role in the sustainability of the company. Therefore, companies must implement various efforts that can build and maintain stakeholder trust, including transparency of environmental information. This is in line with the stakeholder theory (Freeman, 1984). The more environmental, social, and governance (ESG) information disclosed by a company, the higher the company's market performance (Qureshi et al., 2020). Companies with better ESG practices tend to have a higher value per share due to more optimal operational efficiency and improved corporate reputation. Investors view the disclosure of a company's carbon emission information as good news that will lead to an increase in stock prices (Hardiyansah et al., 2021). Investors may consider investing in companies that pay attention to carbon emissions and have plans to minimize the environmental impact of their operations (Siddique et al., 2021). Alsaifi et al., (2020b) and Bedi & Singh (2024) found different results. The more carbon information is disclosed, the lower the company's financial performance.
H_2: Carbon emission disclosure has a positive influence on market-based financial performance.

Carbon Emission Disclosure, Firm Age, and Financial Performance

Companies that have been in business for a long time tend to have a competitive advantage in terms of experience to improve performance compared to young companies (Younis & Sundarakani, 2020). The age of the company can be a factor that indicates survival skills (Grosse et al., 2023). Success in overcoming challenges generally belongs to companies with a longer history and have gained legitimacy from the community so that these companies tend to be more successful than younger companies. In general, younger companies are less concerned about their public image and therefore undertake fewer sustainability initiatives (Abdi et al., 2022). Meanwhile, established companies tend to have more resources to support their various environmental activities, which ultimately have an impact on improving performance (Chen et al., 2021). D'Amato & Falivena (2020) prove that firm age is a relevant moderator in the relationship between the implementation of corporate social responsibility and firm value.

H_3: Firm age strengthens the positive influence of carbon emission disclosure on accounting-based financial performance

H_4: Firm age strengthens the positive influence of carbon emission disclosure on market-based financial performance

Carbon Emission Disclosure, Firm Size, and Financial Performance

Firm size is an important factor in determining the relationship between company activities and the company's desired performance (Farooq et al., 2021). Firm size is a key contextual variable in various studies related to corporate innovation, including innovation in disclosing its information, because the complexity of additional information is highly dependent on different company sizes. Referring to stakeholder and legitimacy theories, large companies generally receive higher public scrutiny. This means that they will be under pressure to disclose all information, including environmental information, more transparently (Bedi & Singh, 2024). Large companies tend to be more active in presenting environmental policies related to corporate sustainability (Aguilar-Fernández & Otegi-Olaso, 2018; Abdi et al., 2022). With greater resources and a wider market, large companies are better able to utilize environmental information disclosure to improve their image and attract customers who care about environmental issues. These resources can be invested in various forms of environmental disclosure activities (Gipper et al., 2022). Firm size can encourage environmental, social, and governance disclosure efforts (Abdi et al., 2022; D'Amato & Falivena, 2020) and carbon emission disclosure (Bedi & Singh, 2024) which ultimately affect the improvement of company performance (Abdi et al., 2022; D'Amato & Falivena, 2020; Bedi & Singh, 2024).

H_5: Firm size strengthens the positive influence of carbon emission disclosure on accounting-based financial performance

H_6: Firm Size strengthens the positive influence of carbon emission disclosure on market-based financial performance

Carbon Emission Disclosure, Sales Growth, and Financial Performance

Sales growth implies that the company has sold its products effectively and efficiently and can generate returns on the investment made (Putri & Rahyuda, 2020). This condition shows that consumers believe in the company's products. In addition, sales growth is also a positive signal for investors to make investments so it can encourage an increase in stock prices. In other words, sales growth has an impact on firm performance and value. A company is considered successful in implementing its strategy when it achieves sales growth (Afinindy et al., 2021). In today's era, stakeholders view companies as needing to have an environmental awareness strategy, such as disclosing carbon information. The sales growth achieved can support the company in implementing this strategy.

H_7: Sales growth strengthens the positive influence of carbon emission disclosure on accounting-based financial performance

H_8: Sales growth strengthens the positive influence of carbon emission disclosure on market-based financial performance

The conceptual model of this research is presented in Figure 1 below.

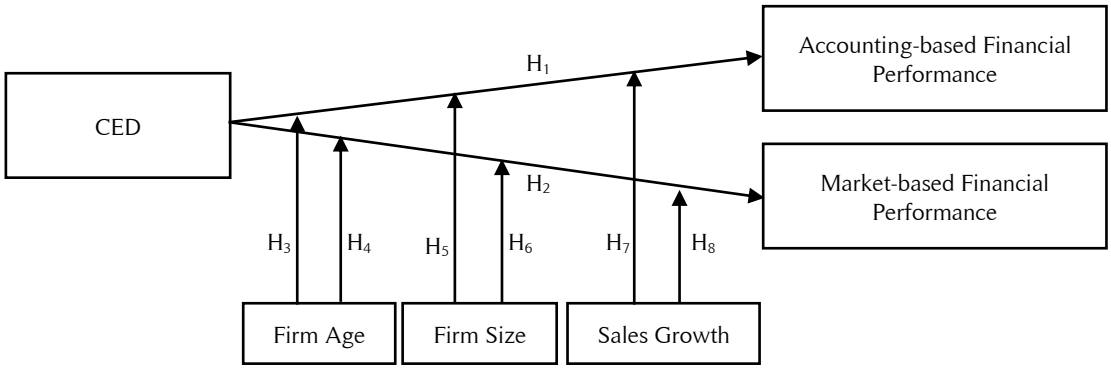

Figure 1. Research Conceptual Model

Research Methods

Population and Sample

The research population in this study is all public companies included in the energy sector in Indonesia and China that can be accessed through the S&P Capital IQ database. In the last two decades, greenhouse gas emissions from

the energy sector have increased threefold (IPCC, 2023). The energy sector contributes around 36% of total greenhouse gas emissions worldwide. Therefore, this study focuses on energy sector companies.

China is the world's highest carbon emitter (Crippa et al., 2023; Alamsyah, 2024), and Indonesia is the highest carbon emitter in Southeast Asia (Crippa et al., 2023). Studying the consequences of carbon emissions disclosure in both countries is very relevant and is expected to provide new knowledge. In determining the sample, this study used a purposive sampling method. The criteria set to determine the number of samples in this study are as follows:

1. Energy sector companies in Indonesia and China whose financial statements and annual/sustainability reports can be accessed through the S&P Capital IQ database for the period 2021-2023.
2. Energy sector companies in China that present financial statements and annual/sustainability reports in English. This criterion is an exclusion criterion determined due to limited resources to translate reports from Mandarin to English.

Data Collection Technique

This study adopts a quantitative approach. The research data are secondary, in the form of financial reports, annual reports, and company sustainability reports for the period 2021-2023, obtained through the S&P Capital IQ database.

Empirical Research Model

Hypothesis testing uses multiple linear and moderated regression analysis with SPSS Statistics 30 software. The empirical model of this study comprises four models, presented below. The first and second empirical models are used to test H_1 and H_2. The third empirical model is used to test H_3, H_5, and H_7. The fourth empirical model is used to test H_4, H_6, and H_8.

Model 1:

$$ROA_{i,t} = \alpha + \beta_1 CED + \beta_2 LEV + \beta_3 PBV + \beta_4 DBE + \beta_5 CF + \varepsilon$$

Model 2:

$$TBQ_{i,t} = \alpha + \beta_1 CED + \beta_2 LEV + \beta_3 PBV + \beta_4 DBE + \beta_5 CF + \varepsilon$$

Model 3:

$$ROA_{i,t} = \alpha + \beta_1 CED + \beta_2 SZE + \beta_3 AGE + \beta_4 SGR + \beta_5 CED*SZE + \beta_6 CED*AGE + \beta_7 CED*SGR + \beta_8 LEV + \beta_9 PBV + \beta_{10} DBE + \beta_{11} CF + \varepsilon$$

Model 4:

$$TBQ_{i,t} = \alpha + \beta_1 CED + \beta_2 SZE + \beta_3 AGE + \beta_4 SGR + \beta_5 CED*SZE + \beta_6 CED*AGE + \beta_7 CED*SGR + \beta_8 LEV + \beta_9 PBV + \beta_{10} DBE + \beta_{11} CF + \varepsilon$$

Description:
CED = *Carbon Emission Disclosure*
TBQ = Tobin's Q
ROA = *Return on Assets*
SZE = Firm Size
AGE = Age
SGR = *Sales Growth*
LEV = *Leverage*
PBV = *Price to Book Value*
CF = *Cash Flow*
DBE = *Debt to Equity*
α = Constanta
β = Coefficient
ε = Error

Operational Definition of Variables

Firm Financial Performance

This study focuses on the dependent variable, namely firm financial performance. Firm financial performance is divided into 2: accounting-based financial performance and market-based financial performance. The proxy for

measuring accounting-based financial performance is the Return on Assets/ROA (Khan et al., 2024). The high and low ROA reflects the objective financial status of the company without being affected by the company's extraordinary events (Lu et al., 2021). In addition, ROA is also one of the financial performance indicators that has good comparability and is most considered by stakeholders. Companies with higher levels of profitability are expected to take advantage of more opportunities to invest in sustainability initiatives (Kim & Li, 2021).

$$ROA = \frac{Net\ Income}{Total\ Asset} \times 100\%$$

Market-based financial performance in this study is measured using Tobin's Q. This metric has been widely accepted among researchers and is considered better in explaining corporate activities in cross-sectoral conditions related to investment and diversification decisions, ownership-performance relationships, performance-acquisition relationships, financing policies, dividend policies, and compensation policies (Kurnia et al., 2021; Butt et al., 2023; Muslichah, 2020).

$$Tobin's\ Q = \frac{MVE + BV\ of\ DEBT}{BV\ of\ ASSET} \times 100\%$$

MVE = The company's stock price at the end of the fiscal year multiplied by the number of shares outstanding

Carbon Emission Disclosure

CED is measured by assessing voluntary information provided by companies in annual reports and/or sustainability reports related to carbon emissions and climate change (Choi et al., 2013). This measure is recognized as reliable in reflecting carbon emission disclosure (Kılıç & Kuzey, 2019; Bui et al., 2020; Budiharta & Kacaribu, 2020; Budiharta & Kacaribu, 2020; Lina & Devyanti, 2024; Lina & Rohmah, 2024). The measurement method used is a carbon emission disclosure checklist based on the list used by the Carbon Disclosure Project/CDP. This checklist covers five main categories relevant to climate change and carbon emissions, namely: climate change risks and opportunities (CC), greenhouse gas emissions (GHG), energy consumption (EC), greenhouse gas reductions and costs (RC), and carbon emission costs and accountability (ACC). Within these five categories, there are 18 specific items identified, each item is given the same weight, namely one.

$$CED = \frac{Number\ of\ Items\ Disclosed}{Total\ Maximum\ Value}$$

Firm age

Older companies have had a lot of time to build relationships with various stakeholders from various organizations, including various parties who pay attention to issues such as environmental management (Ambarwati & Hapsoro, 2020). The measurement of company age in this study uses the following formula:

$$Firm\ Age = Year\ of\ Research - Year\ of\ Company\ Founding$$

Firm size

Larger companies generally have sufficient physical and financial resources to present non-financial information in detail and comprehensively. In addition, large companies also often face intensive public scrutiny (Shah Mohd & Ahmed Siddiqui, 2020). Company size reflects the amount of assets owned, both financial and non-financial. Company size is measured using the natural logarithm (ln) of total assets. This size was chosen because the total value of the company's assets can be very large in number, so simplification is needed by converting it into a logarithm to avoid the possibility of outlier data (Nasih et al., 2019).

$$Firm\ Size = LnTotal\ Asset$$

Sales growth

The progress of a company is often measured by how well the company is developing, which can then be a benchmark for potential investment from investors in the future. An increase in company sales is one way to show this growth; the higher the level of sales a company has, the better the operational performance that can be achieved (Nur & Mahiri, 2022). Sales growth can be calculated using the following formula.

$$Sales\ Growth = \frac{Current\ Year\ Total\ Sales\ -\ Previous\ Year\ Total\ Sales}{Previous\ Year\ Total\ Sales} \times 100\%$$

Leverage

Hardiyansah et al. (2021) stated that the higher the company's leverage level, the greater the company's responsibility to creditors. Zou & Wang (2024) stated that the use of high leverage in a company's capital structure can cause a decline in financial performance. Leverage is measured using the following formula.

$$LEV = \frac{Total\ Debt}{Total\ Asset}$$

Price to Book Value

The price-to-book value ratio/PBV is a ratio that compares the market value of shares with the book value of shares (Xu et al., 2024). PBV shows how much the market values the company's equity. PBV is one of the indicators for investors in making investment decisions (Harinurdin, 2023). PBV is formulated as follows:

$$PBV = \frac{Price\ per\ share}{Book\ Value\ per\ share}$$

Debt to Equity Ratio

The Debt-to-Equity Ratio shows the company's capital ability to pay debts. If a company with a high ratio is also concerned with comprehensive carbon emission disclosures, this disclosure can be seen as the company's effort to increase transparency and reputation in the eyes of investors and the public (Harinurdin, 2023). This variable is measured by the following formula.

$$DBE = \frac{Total\ Debt}{Total\ Equity}$$

Cash Flow

Abdi et al. (2022) stated that environmental information disclosure initiatives can increase company value. This increase can be in the form of an increase in shareholder value, which has an impact on the company's operational cash flow. Cash flow can be calculated using the following formula (Kumar & Prakash, 2019)(Prakash & Hawaldar, 2024).

$$Cash\ Flow = \frac{Cash\ Flow\ from\ Operating\ Activities}{Total\ Asset} \times 100\%$$

Results and Discussion

Research Data

This study uses data from financial, annual, and/or sustainability reports of business entities as secondary data. The focus of the study is public companies in the energy sector in Indonesia and China listed on S&P Capital for the period 2021-2022. This study aims to investigate the influence of CED on ROA and TBQ with AGE, SZE, and SGR variables as moderators. Using the purposive sampling technique, the sample is selected based on certain criteria adjusted to the research needs, as in Table 1.

Table 1. Research Data

Description	Total Firms		Total
	Indonesia	China	Firm-Years
1. Total energy sector companies in Indonesia and China that have complete data and can be accessed through the S&P Capital IQ database for the period 2021-2023.	54	102	
2. Total energy sector companies in China for the period 2021-2023 that present financial statements and annual reports/sustainability reports do not use English.	---	(71)	
Total	54	31	255

Descriptive Statistics

The results of descriptive statistical testing are presented in the following table. This study does not exclude companies that suffer losses, so ROA has a minimum value of -0.617. The maximum ROA value in the observed sample is 0.616. This means that there are samples of companies that achieve a ratio of net profit to total assets of 61.6%. The standard deviation shows the distribution of ROA data that is close to the average value. The average value of Tobins Q is 1.34148. This value is far below its maximum value. This shows that, on average, the observed samples have not succeeded in achieving company performance based on market value. The standard deviation value of Tobins Q, which is close to the average value, indicates that the data distribution is close to the average value. The minimum CED value of 0.0566 indicates that there are still samples of companies that disclose their carbon information minimally. On the other hand, the maximum value reaching 1 shows that there are samples of companies that have made efforts to fully disclose their carbon information. CED shows an average value of 0.60654. This value shows that the samples observed in this study have made efforts to disclose their carbon information on average. The standard deviation value is close to the mean value. This result shows that the data distribution is close to its mean value.

The age of the company is in the age range of 9 years to 59 years. On average, the selected samples are companies that have been operating for an average of 30 years. A standard deviation value that is smaller than the mean value indicates that the data distribution is less varied. Firm size is measured using the natural logarithm of total assets. The standard deviation value is below the mean value. This means that the distribution of firm size data is less varied. Sales growth in the observed sample shows negative growth. This means that sales this year have decreased compared to the previous year. The maximum value indicates that there is a sample that has a sales growth of almost 7 times compared to sales in the previous year. The standard deviation value that is not too far from the mean value indicates that the data distribution is close to its mean value. Based on the standard deviation value, it is known that the distribution of leverage and cash flow data is close to its mean value. Meanwhile, the Price-to-Book value/PBV and debt-to-equity value/DBE have diverse data variations because they have a standard deviation value that is greater than the mean value. A minimum PBV value of less than 1 indicates that in the observed sample, there are undervalued stocks. This means that the market value of the stock is lower than its book value. This indicates an opportunity to buy stocks, especially for companies that have good growth potential. The DBE value is a consideration for creditors and investors to provide loans or investment funds to the company. The minus DBE value indicates that in the observed sample, there are companies that have experienced accumulated losses that exceed their equity.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ROA	255	-.617	.616	.06726	.1487442
TBQ	255	.242	12.92	1.34148	1.27602
CED	255	.0566	1	.60654	.256851
AGE	255	9	59	30.14	12.314
SZE	255	1.512	12.884	6.46237	2.232323
SGR	255	-.826	6.918	.25744	.66751
LEV	255	.031	2.418	.52987	.307398
PBV	255	-117.452	65.807	1.03013	10.555436
DBE	255	-29.143	12.144	1.48708	2.826293
CF	255	-.132	.782	.12344	.141171

Multicollinearity Diagnostics Test

The results of multicollinearity testing for model 1 and model 2 in Table 3 show that the independent variables in this study are not correlated with each other. Therefore, it can be concluded that both models are free from multicollinearity problems.

Tabel 3. Multicollinearity Test Results for Model 1 and Model 2

	Model 1		Model 2	
	Tolerance	VIF	Tolerance	VIF
CED	.969	1.032	.969	1.032
LEV	.893	1.120	.893	1.120
PBV	.796	1.256	.796	1.256
DBE	.769	1.301	.769	1.301
CF	.911	1.098	.911	1.098

Models 3 and 4 in Table 4 show the existence of multicollinearity problems. However, this problem can be ignored considering that the independent variables that correlate, namely the carbon emission disclosure variable, company age, company size, and sales growth, are interaction variables. The use of interaction variables in this study is related to the research model that uses moderation variables.

Table 4. Multicollinearity Test Results for Model 3 and Model 4

	Model 3		Model 4	
	Tolerance	VIF	Tolerance	VIF
CED	.069	14.459	.069	14.459
AGE	.142	7.062	.142	7.062
SZE	.076	13.108	.076	13.108
SGR	.226	4.419	.226	4.419
LEV	.867	1.153	.867	1.153
PBV	.778	1.285	.778	1.285
DBE	.650	1.537	.650	1.537
CF	.804	1.243	.804	1.243
CEDxSZE	.031	32.554	.031	32.554
CEDxAGE	.077	12.965	.077	12.965
CEDxSGR	.224	4.456	.224	4.456

Hypotheses Test

The results of testing model 1 and model 2 are presented in Table 5. Model 1 is used to test H_1. This study successfully supports H_1. The p-value and coefficient are 0.013 and 0.053, respectively. The results show that carbon emission disclosure has a positive influence on accounting-based performance measures, which reflect short-term performance measures. This result is in line with Alsaifi et al. (2020a) and also supports the legitimacy theory. The company's efforts to manage environmental impacts responsibly are responded to positively by society. This condition can improve the company's reputation. This increased reputation often influences the market to value the company more, resulting in lower capital costs. With lower capital costs, companies can increase net profits, thereby driving return on assets value. Companies that actively report carbon emissions can also reduce environmental risks and increase resource efficiency, which directly supports higher profits from the use of existing assets.

The results of testing H_2 using model 2 show that carbon emission disclosure negatively influences market-based performance measures. The p-value and coefficient are 0.005 and -0.806, respectively. These results indicate that H_2 has not been supported. These results are in line with research by Alsaifi et al. (2020b) and Bedi & Singh (2024). Additionally, referring to the R-squared value, it can be concluded that the variation of the carbon emission disclosure variable can explain the variation of the market-based performance measures variable by only 18.10%, while the rest is explained by other variables not examined in this study. This value reflects that carbon emission disclosure does not provide a significant contribution for investors.

Table 5. Results of Hypotheses Test – Model 1 and Model 2

	Model 1		Model 2	
Variables	Coefficient	P-Value	Coefficient	P-Value
CED	.053	.013***	-.806	.005***
LEV	-.115	<.001***	1.040	<.001***
PBV	.000	.847	.024	.002***
DBE	-.001	.797	-.091	.002***
CF	.758	<.001***	2.740	<.001***
	Dependent: ROA		Dependent: TBQ	
	R squared: 0.675		R squared: 0.181	
	F sig. < 0.001***		F sig. < 0.001***	

***sig. 0.01

The results of testing model 3 are presented in Table 6. Model 3 tests H_3, H_5, and H_7. The results of testing H_3 indicate that firm age has not been proven as a moderating variable in the relationship between carbon emission disclosure and accounting-based financial performance with a p-value of 0.767 and a coefficient of 0.000. Although more mature companies have more resources and experience in managing long-term policies, they often face challenges in adapting to new regulations, such as environmental disclosure policies (Maryana & Carolina, 2021). Therefore, the company age has not been able to strengthen the effect of CED on accounting-based performance measures.

The results of the H_5 test show a p-value and coefficient of 0.003 and a coefficient of -0.032, respectively. Firm size weakens the positive effect of carbon emission disclosure on accounting-based financial performance. This study found no evidence to support H_5. Firm size can bring greater cost consequences in terms of environmental compliance and mitigation, which can affect short-term profitability. This result is not in line with the research of Bedi & Singh (2024).

The results of the H_7 test show that sales growth strengthens the effect of carbon emission disclosure on accounting-based financial performance with a p-value of 0.013 and a coefficient of 0.091. These results show support for H_7. Companies with higher sales growth rates are much better able to allocate resources to sustainability initiatives, including carbon emission disclosure, which in turn improves their financial performance. Sales growth serves as a key driver that allows companies to benefit from environmental disclosure.

Table 6. Results of Hypotheses Test – Model 3 and Model 4

	Model 3		Model 4	
Variables	Coefficient	P-Value	Coefficient	P-Value
CED	.155	.043**	-1.382	.198
AGE	3.435	.975	.012	.460
SIZE	.030	<.001***	-.143	.224
SGR	-.027	.103	.103	.653
LEV	-.118	<.001***	1.035	<.001***
PBV	.000	.543	.021	.006
DBE	-.002	.319	-.075	.019
CF	.707	<.001***	3.013	<.001***
CEDxAGE	.000	.767	.001	.331
CEDxSZE	-.032	.003***	.147	.969
CEDxSGR	.091	.013**	-.411	.420
	Dependent: ROA		Dependent: TBQ	
	R squared: 0.695		R squared: 0.184	
	F sig. < 0.001***		F sig. < 0.001***	

***sig. 0.01; ** sig. 0.05

The results of testing model 4 are presented in Table 6. Model 4 is used to test H_4, H_6, and H_8. The results of testing H_4 show that firm age has not been proven as a moderating variable in the relationship between carbon emission disclosure and market-based financial performance with a p-value of 0.331 and a coefficient of 0.001. Older companies may be more conservative in terms of resource management and disclosure policies that do not always match market expectations that expect transparency and sustainability policies. Company age is often associated with inflexibility in implementing innovation. Older companies may be more tied to old methods and strategies and less focused on innovations that can improve market performance.

The results of the H_6 test show a p-value and coefficient of 0.969 and a coefficient of 0.147, respectively. Firm size has not been proven as a moderating variable for the positive effect of carbon emission disclosure on market-based financial performance. This study found no evidence to support H_6. Large companies that disclose carbon emissions can be considered riskier by investors, especially if they operate in industries with a large carbon footprint, such as the energy sector. When large companies disclose carbon emission information, the market can react negatively if the disclosure is not in line with expectations or if high emission mitigation costs reduce the company's profitability.

The results of the H_8 test show that sales growth has not been proven as a moderating variable for the positive effect of carbon emission disclosure on market-based financial performance. The p-value and significance are 0.420 and -0.411, respectively. This study failed to prove H_8. The carbon information disclosure strategy that has an impact on improving company performance is not determined by the company's sales growth. The presence or absence of sales growth does not encourage companies to disclose more of their carbon information.

Additional Analysis

Additional testing was conducted for H_1, H_3, H_5, and H_7 using Return on Equity (ROE) as another proxy to measure accounting-based financial performance. The test results are shown in the Table 7. The test results show that carbon emission disclosure has a negative influence on accounting-based financial performance as proxied by ROE. The more carbon disclosures made, the lower the company's financial performance. These results do not support H1. Sales growth has a direct positive effect on financial performance, as indicated by the p-value and coefficient of <.001 and 0.134, respectively. The interaction with the carbon emission disclosure variable shows that sales growth

weakens the effect of carbon emission disclosure on accounting-based financial performance. Based on these results, it can be concluded that sales growth is a quasi-moderator variable.

Table 7. Additional Analysis

	Model 1		Model 3	
Variables	Coefficient	P-Value	Coefficient	P-Value
CED	-.101	.075*	.020	.899
AGE	---	---	.003	.179
SIZE	---	---	-.020	.258
SGR	---	---	.167	<.001
LEV	.191	<.001***	.134	<.001
PBV	.002	.303	1.413E-6	.999
DBE	.017	.004***	.011	.017**
CF	.004	.972	.082	.335
CEDxAGE	---	---	.013	.575
CEDxSZE	---	---	-.002	.615
CEDxSGR	---	---	-.269	<.001***
	Dependent: ROE		Dependent: ROE	
	R squared: 0.328		R squared: 0.452	
	F sig. < 0.001***		F sig. < 0.001***	

***sig. 0.01; ** sig. 0.05; * sig. 0.10

Conclusion

This study successfully proves that carbon emission disclosure has a positive effect on accounting-based performance measures. This result supports the legitimacy theory. Disclosure of carbon emissions is an action that is in accordance with societal norms and has an impact on short-term company performance. Firm characteristics, namely sales growth, are proven to strengthen the positive influence of carbon emission disclosure on short-term company performance. The achievement of sales growth, which is a positive signal for investors, has been proven to support carbon information disclosure activities. This is in line with signaling theory.

On the other hand, this study has not succeeded in proving the positive effect of CED on market-based performance measures. Firm characteristics consisting of firm age, firm size, and sales growth have also not been proven to be able to strengthen this positive effect. Carbon emission disclosure is not always positively correlated with long-term market performance. In making investment decisions, it is important to consider the company's commitment to social and environmental responsibility. By assessing environmental risk management, investors can identify long-term opportunities and pay attention to the impact of sustainability on the firm's value.

Companies need to develop a transparent and comprehensive carbon emission disclosure strategy to improve their reputation and stakeholder trust. Carbon accounting practices are needed to enable companies to understand, report, and reduce emissions more efficiently. Allocating greater resources to sustainability initiatives and environmental risk management is also needed, especially for sectors operating with a high carbon footprint. The results of this study are expected to provide input for the Financial Services Authority/OJK and the China Securities Regulatory Commission (CSRC), especially regarding carbon emission trading regulations through carbon exchanges. This regulation is expected to encourage efforts to reduce carbon emissions through carbon trading mechanisms.

This study acknowledges the following limitations. First, this study did not investigate country-level contrasts by comparing Indonesia and China. Further research can consider making this contrast. Second, the measurement of CED using content analysis has not taken into account the depth of qualitative disclosure. Future research can explore other measures that may be more in-depth. Third, the focus of the study is limited to Indonesia and China. There is potential for further investigation in other countries with high carbon emission levels, such as the United States and India.

Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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