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The Effect of Carbon Performance on Corporate Financial Performance in a Growing Economy: Evidence from Indonesia

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Abstract

This study aims to examiAne the effect of carbon performance on corporate financial performance, with firm growth (as a proxy for a growing economy) as a moderating variable. The method employed is a quantitative approach using secondary data. The sample consists of 4,265 firm-year observations from manufacturing companies listed on the Indonesia Stock Exchange over the 2019–2023 period. The results show that Carbon Emission Intensity (CEI) has a significant impact on two out of three financial performance indicators tested, namely Return on Assets (ROA) and Return on Investment (ROI), indicating that better carbon performance can positively contribute to financial outcomes. However, firm growth does not moderate the relationship between CEI and financial performance, suggesting that growth factors do not influence the positive impact of CEI on corporate financial performance in the Indonesian manufacturing context

Keywords: Carbon Performance, Corporate Financial Performance, Growing Economy

Introduction

The global increase in carbon emissions has raised serious concerns about environmental sustainability, especially in emerging economies like Indonesia. Global CO_2 emissions increased by 1.9% in 2019 compared to the previous year (Cahyono et al., 2022), driven by industrial activities, energy consumption, and economic growth. According to Our World in Data (2023), Indonesia's carbon emissions have continued to rise from 1889 to 2022, making the country the largest carbon emitter in Southeast Asia.

In response, Indonesia ratified the Kyoto Protocol through Law No. 17 of 2004, committing to reduce six greenhouse gases (GHG), including carbon dioxide (CO_2). The government has set an ambitious target to cut carbon emissions by 32% (912 million tons) by

2030 under the Enhanced Nationally Determined Contribution (E-NDC). However, the Institute for Essential Services Reform (IESR, 2023) notes that the pace of renewable energy development remains slow, threatening Indonesia's ability to reach peak emissions or achieve carbon neutrality by 2060.

A large portion of GHG emissions in Indonesia originates from the industrial sector, particularly from fossil fuel combustion and inefficient production systems. As a result, companies are now expected to reduce their Carbon Emission Intensity (CEI) the amount of carbon emitted per unit of output as a key environmental performance indicator. Firms with lower CEI are considered to have better carbon performance, often reflected in improved operational efficiency, stronger reputation, and enhanced financial performance (Priliana, 2023; Putri & Murtanto, 2023).

However, it remains unclear in the Indonesian context whether carbon efficiency translates into financial gains and how firm growth influences this dynamic. This study addresses this gap by investigating the effect of carbon performance on financial performance, and whether firm growth moderates this relationship.

This research is important for both policymakers and business leaders in understanding the financial consequences of carbon initiatives. For regulators, the findings may guide climate policy design; for firms, the results provide insights into how environmental strategies can deliver financial returns.

Grounded in legitimacy theory, stakeholder theory, and institutional theory, this study aims to explain why firms voluntarily manage and disclose their carbon performance and how institutional pressures and stakeholder expectations influence firm strategies. Furthermore, it evaluates how firm growth, as a strategic business dimension, can enhance or weaken the carbon finance relationship, following studies like Ganda (2018) and Yan et al. (2022).

By doing so, this study offers a relevant contribution to the environmental accounting literature and supports the integration of carbon considerations into business strategy and performance measurement frameworks particularly for manufacturing firms in Indonesia, which are among the largest contributors to industrial emissions.

Literature Review

Financial Performance

The ability of a business to turn a profit and maintain long-term stability, including solvency and liquidity, is referred to as financial performance. In this study, "corporate profit management" refers to a set of actions taken by management to change or manipulate financial statement profit figures (Yopie & Robin, 2023). The financial performance of a business has a significant impact on its overall performance. If it becomes better, the performance of the business will benefit as well. However, it will negatively affect the company's performance if it gets worse.

Carbon Performance on Financial Performance

The management of carbon emissions, namely the measurement of greenhouse gas emissions that can contribute to climate change and the actions taken by the organization to

lower such emissions, is known as carbon performance (Priliana, 2023). Low carbon emissions are indicative of a company with good carbon performance, whereas high carbon emissions are indicative of a company with bad carbon performance (Priliana, 2023). By increasing energy efficiency, creating innovative technologies, and utilizing cleaner materials, more ecologically conscious businesses might lessen ecological issues and eventually increase their sales (Ghosh et al., 2023). Additionally, businesses can improve their financial standing by lowering the detrimental effects of production waste and greenhouse gas emissions. Based on the explanation in the paragraph above, the research hypothesis can be concluded as follows:
H1: Carbon performance has a positive and significant impact on financial performance.

Firm Growth on Financial Performance
An expansion in a company's size or scope is referred to as "firm growth," and it can be quantified using a variety of metrics, including more revenue, a larger workforce, more assets, or a larger market share (Mansikkamäki, 2023). Business expansion is frequently regarded as a sign of success. However, unless backed by sufficient financial performance, business growth is not always a sign of profitability (Wei & Li, 2024). The ability of the business to turn a profit and maintain long-term stability, including solvency and liquidity, is referred to as financial performance. Financial performance is impacted by firm expansion. Growth in a business's revenue, market share, or manufacturing capacity is frequently followed by increased operational effectiveness and a decrease in fixed costs per unit. Based on the explanation in the paragraph above, the research hypothesis can be concluded as follows:
H2: Firm growth has a positive and significant impact on financial performance.

Carbon Performance on Financial Performance through Firm Growth as a Moderating Variable
Firm growth refers to an increase in the size or scale of a company, which is generally considered a primary goal for managers to achieve (Torres et al., 2024). A fast-growing company is expected to have better survival prospects compared to a slow-growing company. One important factor that affects financial performance is how companies handle environmental issues, such as carbon emissions disclosure. This disclosure is considered important by investors as it reflects the company's commitment to environmental sustainability and business ethics. In this case, companies that can reduce their negative impact on the environment, such as carbon emissions, often receive positive responses from investors. Companies investing in carbon reduction technologies are considered high-risk, but with significant growth, they have the potential to achieve higher financial returns. On the other hand, companies that do not invest in new technologies tend to experience low financial gains, especially if their growth is slow or declining. Companies with high growth tend to implement strong and integrated operating systems to comply with environmental regulations, prompting them to adopt more carbon reduction technologies. Based on the explanation in the paragraph above, the research hypothesis can be concluded as follows:
H3: Firm growth moderates the relationship between carbon performance and financial performance.

Research Methodology
The research method used in this thesis is a quantitative approach. This type of research is causal research, which aims to determine the effect of one variable on another. The sample in this study consists of financial reports from non-financial sector companies listed on the

Indonesia Stock Exchange from 2020 to 2023. The data analysis technique used in this study is panel data, and the data is processed using Stata software.

Table 1
Measurement of Variables

Variable	Measurement	Source
Carbon Performance (X)	CEI = (Total Carbon Emissions) / (Total Sales of Firm)	Priliana & Ermaya (2023)
Financial Performance (Y)	ROA = (Net Income) / (Total Assets)	Fortune & Ganda (2017)
	ROI = (Current Investment Value – Investment Cost) / (Investment Cost)	Fortune & Ganda (2017)
Firm Growth (Z)	Firm Growth = ($Income_t$ – $Income_{t-1}$) / ($Income_{t-1}$)	Fortune & Ganda (2017)

Source: Processed by Researcher (2025)

The measurement of Carbon Performance in this study is based on Carbon Emission Intensity (CEI), defined as the ratio of total carbon emissions to total firm sales (CEI = Total Carbon Emissions / Total Sales of Firm). This approach links a company's environmental impact directly to its revenue-generating activities, thereby indicating how efficiently the firm produces sales relative to the carbon it emits. The use of CEI follows the methodology proposed by Priliana and Ermaya (2023) and serves as a critical indicator of corporate environmental performance.

Financial performance is assessed using two widely accepted ratios: Return on Assets (ROA) and Return on Investment (ROI). ROA is calculated as net income divided by total assets (ROA = Net Income / Total Assets) and measures how effectively a firm employs its assets to generate profit. ROI, defined as the difference between the current investment value and its original cost divided by the original cost (ROI = (Current Investment Value – Investment Cost) / Investment Cost), evaluates the returns achieved on the firm's investments. Both ROA and ROI are drawn from the standards established by Fortune and Ganda (2017), reflecting their broad acceptance as benchmarks for financial health across industries.

Finally, Firm Growth is measured by the year-over-year change in revenue, using the formula Firm Growth = ($Income_t$ – $Income_{t-1}$) / $Income_{t-1}$. This metric captures the firm's ability to expand its revenue base over time and is a key indicator of its capacity for market growth and competitive positioning. This growth measure also follows the convention set out by Fortune and Ganda (2017), emphasizing revenue expansion as a primary gauge of corporate development.

Conceptual Framework

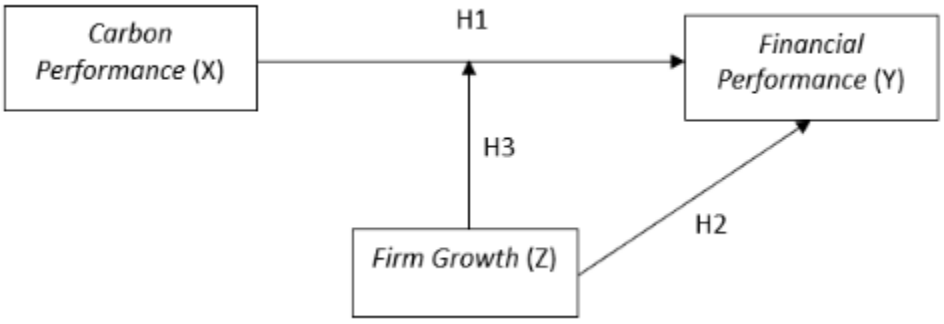

Figure 1. The Proposed Conceptual Framework

Results and Discussions

Data Description

This study uses non-financial sector companies listed on the Indonesia Stock Exchange (IDX) over the period 2019–2023. The non-financial sector was selected to avoid the unique regulatory and financial-structure characteristics of financial firms, thereby ensuring that the research findings remain focused and relevant. The data is secondary, obtained from companies' annual reports and sustainability reports published officially on the IDX website and on each company's own website.

Table 2

Sample Criteria Using Purposive Sampling

No.	Criterion	Count
1	Companies listed on the Indonesia Stock Exchange during 2019–2023	953
2	Non-financial sector companies listed on the Indonesia Stock Exchange during 2019–2023	853
3	Total observations over the five-year period (853 companies × 5 years)	4,265

Source: Processed by Researcher (2025).

Based on these criteria, a total of 4,265 observations were obtained as the sample (853 companies × 5 years). Annual financial reports were sourced from the literature journals, articles, and books as well as directly from the IDX website (www.idx.co.id).

Regression Analysis

Carbon Performance → Firm Performance using the First Measurement (ROA)

Table 3

Regression Analysis X to Y_1

Firm Performance 1 (ROA)	Coefficient	Std. err.	t	P>|t|
Carbon Performance	.095804	.0107681	8.90	0.000
_cons	.8050572	.8050572	33.22	0.000

Source: Processed in STATA (2025)

Based on the regression results, where the p-value = 0.000, it can be concluded that the Carbon Performance variable has a significant effect on Firm Performance using the first

measurement (ROA). A p-value of 0.000 indicates statistical significance at the 95% confidence level (and beyond), as this value is below the critical threshold of 0.05.

Carbon Performance → Firm Performance using the Second Measurement (ROI)
Table 4
Regression Analysis X to Y_2

Firm Performance 2 (ROI)	Coefficient	Std. err.	t	P>|t|
Carbon Performance	.2323136	.0117815	19.72	0.000
_cons	.989869	.0265148	37.33	0.000

Source: Processed in STATA (2025)

Based on the regression results, where the p-value = 0.000, it can be concluded that the Carbon Performance variable has a significant effect on Firm Performance using the second measurement (ROI). A p-value of 0.000 indicates statistical significance at the 95% confidence level (and beyond), as this value is below the critical threshold of 0.05.

Firm Growth → Firm Performance using the First Measurement (ROA)
Table 5
Regression Analysis Z to Y_1

Firm Performance 1 (ROA)	Coefficient	Std. err.	t	P>|t|
Firm Growth	.0056651	.001563	3.62	0.000
_cons	.9545901	.0168309	56.72	0.000

Source: Processed in STATA (2025)

Based on the regression results, where the p-value = 0.000, it can be concluded that the FIRM GROWTH variable has a significant effect on the FIRM PERFORMANCE variable using the first measurement (ROA). A p-value of 0.000 indicates that the result is statistically significant at the 95% confidence level (or higher), as this value is below the critical threshold of 0.05.

Firm Growth → Firm Performance using the Second Measurement (ROI)
Table 6
Regression Analysis Z to Y_2

Firm Performance 2 (ROI)	Coefficient	Std. err.	t	P>|t|
Firm Growth	-.0022187	.0017724	-1.25	0.211
_cons	1.374612	.0190859	72.02	0.000

Source: Processed in STATA (2025)

Based on the regression results, where the p-value = 0.211, it can be concluded that the firm growth variable does not have a significant effect on firm performance using the second measurement (ROI). A p-value of 0.211 indicates that this result is not statistically significant at the 95% confidence level.

Moderation Regression Analysis

Table 7

Moderation Regression Analysis of X on Y_1 through Z

Firm Performance 1 (ROA)	Coefficient	Std. err.	t	P>|t|
Carbon Performance	.1019561	.0108562	9.39	0.000
Firm Growth	.0122986	.0022676	5.42	0.000
FG.CEI	-.0042677	.0010385	-4.11	0.000
_cons	.7885457	.0243476	32.39	0.000

Source: Processed in STATA (2025).

Based on Table 7, all coefficients including the interaction term (FG.CEI) are statistically significant (p = 0.000). This indicates that Firm Growth significantly moderates the relationship between Carbon Performance (CEI) and Return on Assets (ROA). In other words, changes in firm growth alter the strength and/or direction of CEI's effect on financial performance as measured by ROA.

Table 8

Moderation Regression Analysis of X on Y_2 through Z

Firm Performance 2 (ROI)	Coefficient	Std. err.	t	P>|t|
Carbon Performance	.2357388	.0119109	19.79	0.000
Firm Growth	.0005894	.0024879	0.24	0.813
FG.CEI	-.0020374	.0011393	-1.79	0.074
_cons	.9885144	.026713	37.01	0.000

Source: Processed in STATA (2025)

Based on Table 8, the interaction term (FG.CEI) has a p-value of 0.074, which exceeds the 0.05 threshold. This indicates that Firm Growth does not significantly moderate the relationship between Corporate Environmental Initiatives (CEI) and Return on Investment (ROI). In other words, variations in firm growth do not strengthen or alter the positive impact of CEI on ROI.

Carbon Performance on Firm Performance (ROA)

Based on the regression results, a p-value of 0.000 was obtained, indicating that the carbon performance variable has a significant effect on Firm Performance (ROA). A p-value smaller than the critical threshold of 0.05 indicates that the relationship between carbon performance and Firm Performance (ROA) does not occur by chance but shows a real correlation. This means that at a 95% confidence level, it can be ensured that the implementation of carbon performance affects financial performance as measured by Firm Performance (ROA). This impact may be due to increased operational efficiency, cost reduction through better resource management, or improved company reputation that can attract more customers or investors. Thus, these results affirm the importance of the role of carbon performance in enhancing a company's financial performance, and companies that adopt environmentally friendly practices may achieve better financial gains in the long term. The study conducted by Itan et al (2024) reveals that Corporate Social Responsibility (CSR), as disclosed in accordance with the Global Reporting Initiative (GRI) standards, has a significant negative impact on corporate performance, as measured by both Return on Assets (ROA) and Tobin's Q. This indicates that CSR expenditure and activities, in the short term, may be

perceived as costs that do not directly generate financial returns, thereby negatively affecting the company's financial performance and market valuation.

Carbon Performance on Firm Performance (ROI)

Based on the regression results with a p-value of 0.000, it can be concluded that the carbon performance variable has a significant effect on Firm Performance (ROI). A p-value smaller than the critical threshold of 0.05 indicates that the relationship between carbon performance and Firm Performance (ROI) is statistically significant at the 95% confidence level. This indicates that the improvement of a company's carbon performance, such as emission reductions or the adoption of environmentally friendly technologies, can enhance resource use efficiency and generate greater profits for the company. Thus, improvements in carbon performance not only provide environmental benefits but can also positively impact company profitability and investment returns, as reflected in higher Firm Performance (ROI). Research by Wang et al. (2022) indicates that the adoption of environmentally friendly technologies directly contributes to improving a company's Firm Performance (ROI) because it promotes operational efficiency and enhances customer loyalty. This research supports the findings in this study that investments in carbon performance yield significant and sustainable financial outcomes.

Firm Growth on Firm Performance (ROA)

Based on the regression results showing a p-value of 0.000, it can be concluded that the Firm Growth variable significantly influences Firm Performance, particularly when the company's performance is measured using Return on Assets (ROA). The significance value well below 0.05 indicates that the effect is statistically very significant at a confidence level of 95% or higher. This means that the higher the company's growth rate, the greater the likelihood that the company can increase the efficiency of its asset utilization in generating profits. This result indicates that high-growth companies tend to have better abilities in utilizing resources to generate earnings, either through operational expansion, increased revenue, or strengthening financial structure. Company growth can be a positive signal for investors and other stakeholders that the company has promising prospects, which then impacts the overall improvement of financial performance. These findings are in line with a study by Chen et al. (2020), which stated that company growth is an important indicator in explaining financial performance as it demonstrates the company's ability to respond to market dynamics and manage resources effectively.

Firm Growth on Firm Performance (ROI)

Based on the regression results with a p-value of 0.211, it can be concluded that the Firm Growth variable does not have a significant effect on Firm Performance when measured using the Return on Investment (ROI) indicator. Since the significance value is far above the 0.05 threshold, the relationship between company growth and ROI is not statistically proven at a 95% confidence level. This means that an increase in the size or scale of a company's operations does not necessarily impact on the effectiveness of the company in generating returns from the total investment made. These findings indicate that even though a company is growing, this does not always correlate with investment management efficiency. Other factors such as investment decision-making, asset use efficiency, and financing policies may play a larger role in influencing ROI. In some cases, growing companies actually face risks of resource waste or investments that have not yielded results in the short term, thereby making

the impact on ROI insignificant. These results are consistent with research by Kurniawan and Sari (2020), who found that company growth does not directly improve ROI, especially when such growth is not accompanied by cost control and investment efficiency. Chen et al. (2021) also stated that companies with aggressive expansion sometimes experience a decline in ROI due to high capital expenditure that has not yet produced optimal outcomes.

Carbon Performance on Firm Performance (ROA) with Firm Growth as a Moderator
Based on the regression results with a significance value of 0.000, it can be concluded that firm growth is able to moderate the relationship between carbon performance and Firm Performance (ROA). A significance value smaller than 0.05 indicates that there is a significant interaction between company growth and carbon performance in affecting Firm Performance (ROA). In other words, the effect of carbon performance on Firm Performance (ROA) becomes stronger or weaker depending on the company's growth rate. This indicates that under high growth conditions, companies can utilize environmental initiatives more efficiently to drive greater profitability, or conversely, under low growth conditions, the impact of carbon performance on Firm Performance (ROA) becomes less effective. These findings are consistent with research by Nguyen et al. (2022), which found that the effect of sustainability practices on financial performance can be strengthened by internal factors such as company growth. Similarly, Lee and Choi (2021) showed that in the context of growing companies, environmental strategies can provide a greater competitive advantage, thus contributing to asset-based profitability. Therefore, firm growth not only acts as a control variable but also as a factor that strengthens the relationship between environmental performance and financial performance.

Carbon Performance on Firm Performance (ROI) with Firm Growth as a Moderator
Based on the regression results with a significance value of 0.074, it can be concluded that firm growth is not able to moderate the relationship between carbon performance and Firm Performance (ROI). The significance value greater than 0.05 indicates that changes in the company's growth rate do not have a significant effect on the relationship between carbon performance and Firm Performance (ROI). This means that even if the company is growing, the increase does not strengthen or weaken the impact of carbon performance on the returns generated by investment. Therefore, carbon performance still contributes directly to the company's Firm Performance (ROI) without being significantly influenced by company growth as a moderating variable. This is in line with the findings of Ramírez et al. (2023), who found that although companies undergo expansion or growth, the investment return from environmental policies tends to be direct and does not depend on the growth rate. These findings reinforce the argument that environmental practices such as carbon emission management have a real impact on ROI without significant influence from firm growth as a moderating variable.

Conclusions
This study aims to analyze the effect of Carbon Emission Intensity (CEI) on the financial performance of companies, as measured by Return on Assets (ROA) and Return on Investment (ROI), with firm growth as a moderating variable. The results indicate that CEI has a significant effect on both ROA and ROI (p-value < 0.05), suggesting that improved carbon performance positively contributes to corporate profitability and investment returns. However, firm growth does not moderate the relationship between carbon performance and

the financial performance indicators tested, as the significance values for the interaction effects exceed 0.05. This suggests that growth alone may not strengthen or weaken the financial benefits derived from carbon efficiency.

The practical implication of this finding is that companies that improve their carbon performance can achieve better financial outcomes. Adopting environmentally sustainable practices not only supports ecological goals but also serves as a strategic move to enhance profitability and shareholder value. From a policy perspective, this research underscores the importance of promoting carbon disclosure and environmental transparency. Encouraging such disclosures can strengthen firms' financial resilience, enhance investor confidence, and align corporate practices with global sustainability commitments. Future research is recommended to explore alternative moderating variables such as company size, industry type, or environmental regulatory pressure to better understand the complex dynamics between carbon performance and financial success across diverse corporate contexts.

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