CARBON PRODUCTIVITY'S IMPACT ON COMPANY'S FINANCIAL PERFORMANCE (CASE STUDY OF COMPANIES LISTED ON IDX80 STOCK INDEX)

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ABSTRACT

Objective: Environmental issues are a concern, especially global warming. One of the consequences of global warming is a significant increase in carbon emissions each year. However, investors are trying to understand whether increased carbon also improves companies' financial performance. This study seeks to investigate the influence of carbon productivity on the company's financial performance (case study of companies listed on the IDX80 index). **Research Design & Methods:** This research uses a quantitative method with secondary data taken from the company's annual and sustainability reports from 2020 to 2023. The sampling method used is the purposive sampling method. The sample used in this research was 80 companies listed on the IDX80 Index. Panel Data Regression Analysis is used to analyze the data. **Findings:** The findings of the study indicated carbon productivity has no significant effect on company financial performance, whether measured through ROA or MBR On the other hand, when control variables are added, they have a significant effect on the company's financial performance as measured through ROA. **Implications and Recommendations:** From these findings, stakeholders, investors and financial managers in the Indonesian capital market can help in making investment decisions, especially regarding the influence of carbon productivity on financial performance and for stakeholders. **Contribution & Value Added:** This study adds value to the practice of finance that seeks to see that companies that disclose higher carbon emissions will affect the company's financial performance in the context of developing countries, especially Indonesia.

Keywords: carbon productivity; corporate financial performance; firm size; growth; leverage**.**
JEL codes: G30, Q5
Article type: research paper

INTRODUCTION

Sustainable Development Goals (SDGs) is an expansion of the global sustainable development framework established in 2015 by countries that are members of the United Nation (UN) (Ortiz-de-montellano et al., 2023). The SDGs have 17 main goals which contain 169 targets and 231 indicators that are generally set and agreed upon by governments, companies, organizations, communities and knowledge institutions until 2030 (Tulder et al., 2021). The SDGs can be classified into three main dimensions: environmental, social and economic. One of the dimensions that the UN focuses on is the environment, which emphasizes the efficient and responsible utilization of resources, the improvement of environmental welfare and the absence of environmental issues caused by harmful emissions (Boar et al., 2020).

Environmental issues are a problem that needs to be considered by various countries, one of which is erratic climate change. These changes are due to global warming accompanied by rising temperatures

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due to the effects of greenhouse gases (GHG) which include CO2, methane, chlorofluorocarbons, and nitrous oxide (Florencia & Handoko, 2021). Related to climate change, several actions have been taken, one of which is the implementation of the Kyoto Protocol which was introduced in 1997 to mitigate against world climate change (Kim, 2021). In the 2008-2012 period, the Kyoto Protocol succeeded in reducing GHGs by 5.2% compared to the level of GHG emissions in 1990 (Najarzadeh et al., 2021). On the other hand, in line with the formation of the SDGs in 2015, a treaty called the Paris Agreement was also formed, which has the same international goal of making a transition to low carbon and climate stability by limiting the average temperature rise to well below 2∘C and striving for 1.5∘C (Iacobuță et al., 2022).

The UN emphasizes that carbon emissions are increasing each year in a significant and sustainable manner, impacting the survival of humans and the universe (Derindag et al., 2023). According to Kementerian Energi dan Sumber Daya Mineral Republik Indonesia (2022), Indonesia will increase the carbon emission reduction target in the Enhanced Nationally Determined Contribution (E-NDC) from the original 29% or 835 million tons of CO2, changing to 32% or 912 million tons of CO2 in 2030 to maintain stable carbon emissions. The increasing sense of public concern for the environment stimulates companies to carry out business processes by prioritizing environmentally friendly operations (Das, 2023). Concern for the environment encourages governments and companies to implement policies to reduce these carbon chemicals (Ganda & Milondzo, 2018). Concern for the environment has also been implemented in Indonesia, with the enactment of Financial Services Authority Regulation Number 51 /POJK.03/2017 companies in Indonesia such as financial services institutions, issuers, and public companies are required to publish sustainability reports to support changes towards the implementation of sustainable finance.

Companies that submit sustainability reports are expected to be able to stabilize and continue to improve factors such as economic, social and environmental factors to gain more trust from the public and investors (Kartika et al., 2023). The Indonesia Stock Exchange itself together with sustainalytics also categorizes company shares to see the ESG score incorporated in the IDX ESG Leader. IDX ESG Leader is an index in which it measures the performance of shares of companies that have good categories in environmental, social and governance (ESG) values, are not involved in significant environmental problems and have transaction liquidity and healthy financial performance (Kristianti, 2023). However, most companies still issue sustainability reports separately from the company's financial statements, making it difficult to see the relationship between environmental value and company financial performance (El Khoury et al., 2023).

The company's financial performance is a tool used in the company to measure the achievement of company goals in realizing its competitive advantage (Kurniawati et al., 2020). Various studies related to financial performance that have been conducted previously use several indicators that can be used in measuring the financial performance of a company, including profitability ratios, liquidity ratios, leverage ratios, company size, and debt policy (Adhikari et al., 2023; Habib, 2023). These factors are determined based on the analysis of financial statements or directly stated in the company's financial statements. To see the achievement of the company's company performance, it is not only from financial ratios that need to be considered. There are other factors that affect company performance such as environmental factors regarding the risk of climate change (Cho et al., 2019; Danso et al., 2019; Nizam et al., 2019; Tien et al., 2020).

Climate change risks that occur in companies include several things, such as natural disasters, enactment of regulatory changes, technology, and consumer interests that encourage companies and governments to limit carbon production to transition to a greener economy (Reboredo & Ugolini, 2022). Therefore, companies and governments are committing to global decarbonization through energy efficiency, consuming less fuel, and reducing emissions through carbon productivity, which focuses more on the carbon emissions produced by a company (Shah et al., 2023). Carbon productivity is a way for governments or companies to explore their carbon reduction activities, by which emissions management is efficiently addressed in business metrics and is a key assessment indicator in analyzing the competitiveness of companies in addressing global climate change (Ghose et al., 2023). Carbon productivity becomes very effective and efficient by integrating 2 important objectives, namely with the

main goal of prioritizing carbon reduction and still maintaining stable economic growth, so carbon productivity becomes one of the effective and efficient ways to mitigate global climate change from environmental problems (Guo et al., 2021).

The importance of environmental issues in doing businesses attract researcher to scrutinize these matters. For example in term of carbon productivity, several previous studies have examined carbon productivity and corporate financial performance but to date, there is still not much clear research on how emission reductions by companies and how such performance affects corporate financial results by carbon productivity (Ghose et al., 2023; Makan & Kabra, 2020; Trinks et al., 2020). On the other hand, many studies in developed countries reveal that there is a positive influence of carbon emissions on corporate financial performance (Gallarza et al., 2012; Nishitani & Kokubu, 2012; Saka & Oshika, 2014). In addition to developed countries, there are economic studies on developing countries about the negative effect of carbon emissions on corporate financial performance. Although research conducted in developing countries is still quite limited, in recent years it has begun to get more attention from stakeholders (de Lima et al., 2022; Ganda & Milondzo, 2018). However, in developing countries, especially in Indonesian context, limited studies still been done in order to scrutinize the relationship between carbon productivity and financial performance.

Based on those gaps, this study will re-examine the effect of carbon productivity on corporate financial performance in developing countries, especially in Indonesian setting because there are still few studies on carbon productivity and corporate financial performance studied in Indonesia. Then there are inconsistencies in the results of research from developed and developing countries, therefore also in this research adding other variables such as firm size, leverage, and growth as control variables on the Indonesia Stock Exchange, especially for stocks that are members of the IDX80 index. The IDX80 index is formed from a collection of 80 company stocks that are measured based on high liquidity levels and have a large market cap and also have good company fundamentals (IDX, 2023).

The results of this study will contribute to provide benefits for academics related to the effect of carbon productivity on corporate financial performance with firm size, leverage, and growth as control variables and can add insight and become a reference for further research. Practically, the results of this study are also expected to be a consideration and knowledge for investors and potential investors in the Indonesian capital market so that it can help investors in making investment decisions in the Indonesian capital market, as well as for stakeholders and companies in considering the company's financial performance through the environmental impact provided by the carbon emissions produced.

LITERATURE REVIEW

Environmental, Social, and Governance (ESG)

Environmental, Social, and, Governance (ESG) is a non-financial evaluation measure that focuses on three main aspects, namely environmental, social, and corporate governance to encourage sustainability benefits for the welfare of economic development in the company's business value (Wang et al., 2023). According to Broadstock et al. (2020), the environmental aspect of the company brings the company to be more concerned about environmental management systems, energy efficiency, reduction of gas emissions, water conservation, and reduction of unexpected waste or spills so that environmental risks can be minimized in the long term so that the company can flexibly and quickly deal with emerging negative environmental business impacts. Followed by the social aspects of the company, consistent performance can control employees, supply chain management, community involvement, handling controversies, and humanity accompanied by a high commitment to maintain the situation during the crisis so that the company can be socially responsible within the company rather than terminating employment by reducing company costs. In addition, companies that implement governance aspects will tend to be better at managing foreign taxes, reporting violations, and handling negative incidents related to governance so that the company's performance will be more stable in managing the company's finances so that it is not shaken when facing situations that harm the company (Broadstock et al., 2021).

The ESG concept is also used by investors for decision making to reduce risk and increase company profits (Giese et al., 2019). Therefore, companies that implement and disclose ESG concepts will

encourage investors to understand the company's ESG activities (Wan et al., 2024). In line with this research, Garel & Petit-Romec (2021) state that companies that are more environmentally friendly and pay attention to the company's environmental value will get a better stock return rate compared to companies that do not disclose and apply the ESG concept. Nowadays, both in developed countries or developing countries, ESG become an important issue. Especially in investment term. Investors in developed countries or developing countries demand that companies should comply with ESG principles and supports sustainability issues. Some studies in developed countries show that ESG compliance will enhance the value of the company, while in developing countries, the results still vary because sometime ESG been seen as a compliance in order to do the business.

Carbon Emissions

Carbon emissions are one of the main causes of global warming caused by human activities such as burning coal, oil from fossils, as well as human activities such as the use of heating or cooling water, air conditioning, and lighting, making it difficult to mitigate climate change with green technologies due to dependence on the world's social and economic conditions (Du et al., 2019; Röck et al., 2020). The impacts caused by global warming by carbon emissions lead to other impacts such as rapid climate change and environmental threats such as natural disasters driven by excessive energy consumption (Doğan et al., 2021). In achieving environmentally friendly economic growth, the government seeks energy production efficiency by saving energy, controlling environmental damage, and using environmentally friendly technologies to achieve the government's goal of low CO2 emissions (Hao et al., 2021). According to Balsalobre-Lorente et al. (2018), stated that a country that implements new renewable energy will find it easier to reduce dependence on non-renewable energy that causes emissions in a country. The importance of reducing carbon emissions helps the government implement sustainable development to improve economic growth and human living standards (Xu et al., 2021).

Carbon Productivity

Carbon productivity is a way for companies and governments in a region to meet human needs by reducing carbon emissions associated with economic improvement in order to create a relevant environment, a low-carbon economy, and low-carbon cooperation in various regions (Sun et al., 2022). Carbon productivity can be defined as net sales divided by carbon dioxide emissions as an effective way to reduce the greenhouse gas (GHG) effect divided into two scopes, the first scope includes the combustion of fossil fuels or the processing of chemicals processed by the company, while the second scope includes indirect emissions obtained from the generation of electricity purchased and used in the company (Makan & Kabra, 2020; Nishitani & Kokubu, 2012). Carbon productivity is an effective indicator to reduce carbon emissions by adding economic value in the company to have an impact on the environment (Busch & Lewandowski, 2018).

Previous Research in Developed and Developing Countries

Studies in developed economies include several studies that reveal the positive influence of carbon emissions on several aspects. Several studies examined that carbon reduction tends to increase the value of Japanese manufacturing companies from 2006 to 2008 (Nishitani & Kokubu, 2012; Saka & Oshika, 2014). In line with this research Gallego-Álvarez et al. (2015) revealed that there is a positive relationship between carbon emissions and company performance in 89 companies in Australia. Jaggi et al. (2018) also argue that GHG disclosure has a positive effect on stock prices because strong corporate relationships have established voluntary environmental committees such as companies in Italy. Likewise Velte (2021) revealed that research on European capital markets that directs carbon performance has a positive effect on real earnings management.

On the other hand, research conducted on 81 companies in the United States related to GHG reduction reduces profitability and firm value due to more responsibility for the environment from stakeholders so that less attention to other factors results in a decrease in profit from the company (García-Sánchez & Prado-Lorenzo, 2012; Palareti et al., 2016). According to Lee et al. (2015), companies in South Korea received a negative response from the market for participating in carbon reduction projects, resulting in reduced shareholder value. Alsai et al. (2020) also conducted research related to the disclosure of carbon

emissions on the FTSE 30 index in the UK which made the market assume the disclosure had no significant results and only reduced the company's competitive advantage. So that this has a negative impact on the company's financial performance, because the company is too focused on environmental management, especially reducing carbon emissions and paying less attention to other factors that make the company's profits decrease.

In addition to developed countries, there are economic studies on developing countries although research conducted on developing countries is still quite limited but in recent years has begun to get more attention from stakeholders. According to Ganda & Milondzo (2018) in their research on 63 South African companies, the amount of carbon emissions produced by a company will have a negative impact on company performance. In addition, research conducted by de Lima et al. (2022) also did not get significant results related to companies in disclosing carbon emissions on the company's financial performance on the Brazilian Stock Price Index (BOVESPA). Another study related to carbon emissions was also conducted on 49 Turkish companies in the 2014-2019 period, stating that companies disclosing carbon emissions will have a significant impact on capital structure and financial performance (Kalash, 2021). In line with the above research, the positive impact on financial performance is also influenced by the company's efforts to reduce the level of carbon emissions in 38 companies that have gone public in India in the period 2016-2019 (Makan & Kabra, 2020).

Control Variables

The control variable in this study aims as a controlling variable of the influence of variable X or independent, namely carbon productivity on variable Y or dependent, namely the company's financial performance. Control variables are expected to be able to control other influences that can affect the company's financial performance apart from the carbon productivity variable. The control variables added in this study are firm size, leverage, and growth.

According to Trinks et al. (2020), firm size is a control variable that is seen through the total assets owned by the company in the value of hundreds or even trillions of rupiah which is proxied by the natural logarithm with the aim of simplification without changing the original value of the company's total assets used to see the size of a company. Firm size is used as one of the control variables because the greater the value of the company's total assets, the better the company's financial performance (Andi et al., 2019).

Then the second control variable, namely leverage, is a ratio used by the company to assess the company's ability to fulfill its obligations or pay off its debts against the assets owned by the company (Liao et al., 2015). Leverage is used as a control variable because if the company is unable to fulfill its obligations, it will affect the company's financial performance. The higher the value of the company's leverage ratio, it will negatively affect the company's financial performance (Chen, 2020).

The last control variable, namely growth, is a measure used by the company to determine the percentage comparison of the company's sales value in the current year against the previous year by dividing the sales value in the current year minus the previous year divided by the company's sales value in the previous year (Kartika et al., 2023). Growth is used as a control variable because the greater the percentage of total growth changes owned by the company, the greater the increase in company sales which will affect the company's financial performance (Chen, 2020).

The Effect of Carbon Productivity on Financial Performance

Theoretically, there are two different views regarding the effect of carbon productivity on corporate financial performance. The first view reveals that by doing carbon productivity through environmental maintenance, companies will waste a lot of company costs, which is in line with neoclassical theory that states all factors must be able to improve the company's economy (Horváthová, 2010; Palmer et al., 2018). A factor of concern in neoclassical theory is that a low economy can result from a firm focusing more on improving the environment than on the resources and problem management of the firm (Gallego-Álvarez et al., 2015). Carbon productivity in the short term will reduce ROA financial performance because companies have to incur costs in disclosing carbon emissions in corporate sustainability reports. In addition, according to Hassel et al. (2005) companies that pay attention and

make improvements to environmental and social responsibilities will have a negative impact on the company's financial performance and only create a situation that is not always favorable for the company. Some of the views above, it can be concluded that companies that want to increase environmental and social responsibility require large funding and investment, so that it causes reduced company profits which will also have an impact on the company's poor financial performance and reduce the company's competitiveness in the short term. However, it will improve ROA's financial performance in the long run, because if the company is consistent in improving and reducing the impact of carbon disclosure in the long run, it will change the perception of stakeholders so that they will support the activities or corporate activities carried out by the company.

In contrast to the research above, the modern view is that improving the environment can be a tool to increase competitive advantage and the reputation and image of the company so that stakeholders support the business activities carried out by the company (Cai et al., 2023). Within a company, carbon productivity can reflect improvements in environmental activities by responding positively to decisions from stakeholders within the company (Manrique & Martí-Ballester, 2017). Secondly, by implementing carbon productivity, the company will improve the efficiency of the production process through waste reduction, thereby reducing the company's operating costs and increasing the market value of the company (Orsato, 2006). In the context of developing countries, such as Indonesia, where there is an increasing focus on environmental issues, a positive relationship between carbon productivity and financial performance through MBR is expected. Carbon productivity in the short term will reduce the financial performance of MBR in the short term because the market assumes that companies that have a large value of emissions disclosure are seen as having a poor corporate reputation. However, when the company consistently reports carbon disclosure in the long term, the company is viewed favorably, which makes investors interested in the company and will increase the financial value of the company.

Based on this, the following hypothesis can be formulated:

H1a: There is a positive effect of carbon productivity on financial performance ROA

H1b: There is a positive effect of carbon productivity on MBR financial performance

METHODS

This study uses a quantitative method with secondary data taken from the company's annual and sustainability reports from the company's website. Secondary data taken from the report in the form of financial data and data on carbon emissions of a company in the selected period, namely from 2020 to 2023. The sampling method used was purposive sampling method. The sample used in the study included 80 companies listed in the IDX80 Index. The selection process is based on the Table 1. Based on the criteria listed in Table 1, the results for the final sample were 21 companies from the selected population of 80 companies from 2020-2023.

Table 1. Sample Selection Process

No	Criteria	Number of Companies
1	The total number of companies consistently listed in the IDX80 Index in 2020-2023	53
2	Companies that do not include coverage 1 & 2 in their sustainability report in 2020-2023	(22)
3	Companies that do not present annual financial reports in rupiah units	(10)
	Final sample size	21
	Year of observation	4
	Number of observations	84

Source: Data from the company's annual report and sustainability report, processed

In this study, there are several variables which are explained in the operational definition of variables on Table 2. The scope of the Carbon Productivity (CRP) can be explained as follows:

Scope 1: Greenhouse gas emissions from sources owned and managed by the company, i.e. from fuel consumption.

Scope 2: Greenhouse gas emissions arising from electrical energy, heating, cooling, and steam power purchased or obtained and consumed by the company.

Scope 3: Greenhouse gas emissions that are not generated by the company, but result from the company's value chain from upstream to downstream such as transportation for distribution, waste disposal and waste generated in the operation process.

For first-time companies reporting coverage results on greenhouse gas emissions, companies only need to focus on reporting any scope 1 and 2 GHG emissions from energy use for machinery and operations within the organization first. Therefore, this study only uses scopes 1 and 2 because many companies still do not report greenhouse gas emissions based on their scopes.

Table 2. Operational Definition and Measurement of Research Variables

Type of variable	Variable	Definition	References
Dependent Variables	Return on asset (ROA)	Ratio of profit after tax (PAT) to total assets	Gallego-Álvarez et al. (2015); García-Sánchez & Prado-Lorenzo (2012)
	Market-to-book ratio (MBR)	Ratio of market value of equity to book value of equity	García-Sánchez & Prado-Lorenzo (2012); Makan & Kabra (2020)
Independent Variable	Carbon Productivity (CRP)	Ratio of net sales to total carbon emissions of scope 1 and scope 2	Makan & Kabra (2020); Nishitani & Kokubu (2012)
Control Variables	Firm size (SIZE)	Natural logarithm of total assets	Trinks et al. (2020)
	Leverage (LEV)	Ratio of total debt to total assets	Liao et al. (2015)
	Growth (GROW)	Percentage change in annual net sales	Russo & Fouts (1997)

The data in this study will be analyzed using panel data regression which is taken from combining time series data and cross section data and processed using Eviews 12 software. Time series data is data on a research object covering several time span periods while cross section data itself is data consisting of few or many objects in a period of time. The combination of time series data with cross section data is called panel data (Gujarati, 2003).

Descriptive statistics is a test used to provide information related to the description of data collected, summarized, and described which includes the value of the average (mean), minimum value, maximum value, and also the standard deviation of a data (Morcillo, 2023).

Before the panel data regression test is carried out, the most appropriate model selection will be carried out, several tests must be carried out to determine the best estimation model. Model selection based on Nuryanto & Pambuko (2018) among others:

The Chow test aims to determine whether the regression test to be used is most appropriate using the Common Effect Model (CEM) or the Fixed Effect Model (FEM) based on the value of the cross-section Chi-Square on the following basis:

H0: Common Effect Model (CEM)

H1: Fixed Effect Model (FEM)

The basis for the Chow test decision-making criteria is that when the probability value of the cross-section chi-square is greater than 0.05, H0 is accepted so that the Common Effect Model (CEM) will be used as the most appropriate model. Conversely, when the probability value of the cross-section chi-square is smaller than 0.05, H0 is rejected or H1 is accepted so that the right model to use is the Fixed Effect Model (FEM).

The Hausman test is one of the statistical tests used to select the most appropriate model between the Random Effect Model (REM) and the Fixed Effect Model (FEM) to be used in research on the following basis:

H0: Random Effect Model (REM)

H1: Fixed Effect Model (FEM)

Model selection in the Hausman test is determined based on the probability value of the cross-section chi-square greater than 0.05 then H0 is accepted so that the Random Effect Model (REM) will be used as the most appropriate model. However, when the probability value of the cross-section Chi-square is smaller than 0.05, H0 is rejected or H1 is accepted so that the right model to use is the Fixed Effect Model (FEM).

The Lagrange Multiplier test is a test to see whether the Random Effect Model (REM) is better than the Common Effect Model (CEM). Unlike the previous two tests, the LM test looks at the Both Breusch-Pagan probability value on the basis of the following decision making:

H0: Common Effect Model (CEM)

H1: Random Effect Model (REM)

Determination of the model to be used in research for the Lagrange Multiplier test when the probability value of Both Breusch-Pagan is greater than 0.05 then H0 is accepted so that the model to be selected is the Common Effect Model (CEM). But on the other hand, when the probability value of Both Breusch-Pagan is smaller than 0.05, H0 is rejected or H1 is accepted so that the right model to use is the Random Effect Model (REM).

The proposed research model is as follows:

$$Y_{it} = a + \beta (X_{it}) + \lambda(CV_{it}) + \varepsilon_{it}$$

Where "i" refers to the cross-section i.e. companies, and "t" refers to the period. Y is the Dependent Variable which is the company's financial performance measured through ROA and MBR. X represents the independent variable of the study i.e. CRP or Carbon Productivity. CV indicates the control variables included in the model. α is the intercept, β captures the coefficients of the independent variables, λ captures the coefficients of the control variables considered in the study and ε_{it} symbolizes the model error time or error value. The study also uses two specific models which are given as follows:

$$ROA_{it} = a + \beta_1(CRP_{it}) + \lambda_1(SIZE_{it}) + \lambda_2(LEV_{it}) + \lambda_3(GROW_{it}) + \varepsilon_{it} \tag{1}$$

$$MBR_{it} = a + \beta_1(CRP_{it}) + \lambda_1(SIZE_{it}) + \lambda_2(LEV_{it}) + \lambda_3(GROW_{it}) + \varepsilon_{it} \tag{2}$$

Model (1) uses ROA as the dependent variable, while model (2) uses MBR as the dependent variable.

FINDINGS

Descriptive Statistics

Descriptive statistics is a test used to provide information related to the description of data collected, summarized, and described which includes the value of the average (mean), minimum value, maximum value, and also the standard deviation of a data.

Table 3. Descriptive Statistics Test

Statistic	ROA	MBR	CRP	SIZE	LEV	GROW
Mean	0.0520	1.7203	449,499,220	32.1577	0,5569	0.1395
Std. Dev	0.0571	1.2494	954,104,198	1.6098	0,2308	0.5432
Maximum	0.2817	6.8277	6,431,124,496	35.3154	0,8897	4.5244
Minimum	-0.1186	0.1748	1,223,853	29.5431	0,1455	-0.4478

Source: Data from the company's annual report and sustainability report, processed

Based on the descriptive statistical test results in Table 3, the average value for the company's financial performance expressed in ROA is 0.0520 with a standard deviation value of 0.0571. The maximum value of ROA is 0.2817 generated by the company PT Bukit Asam Tbk (PTBA) in 2022, while the minimum value of ROA generated is -0.1186 by the company PT Wijaya Karya Tbk (WIKA) in 2023. On the other hand, financial performance in MBR has a mean value of 1.7203 with a resulting standard

deviation of 1.2494. In 2021, PT Tower Bersama Infrastructure Tbk (TBIG) has the highest MBR value of 6.8277 while PT Pembangunan Perumahan (Persero) Tbk (PTPP) has the lowest MBR value of 0.1748 in 2023.

Then for carbon productivity expressed in CRP has an average value of 44,499,220 with a standard deviation of 954,104,198. The maximum value for CRP is 6,431,124,496 by the company PT Wijaya Karya Tbk (WIKA) in 2022. On the other hand, the minimum value is by the company PT Indocement Tunggal Prakarsa Tbk (INTP) of 1,223,853 in 2021. Furthermore, for firm size, the average value is 32.1577 with a standard deviation value of 1.6098. The maximum value is 35.3154 by the company PT Bank Mandiri (Persero) Tbk (BMRI) in 2023 and the minimum value is 29.5431 by the company PT Surya Citra Media Tbk (SCMA) in 2020.

Furthermore, the average leverage is 0.5569 with a standard deviation value of 0.2308. The maximum value of 0.8897 was obtained by the company PT Bank Tabungan Negara (Persero) Tbk (BBTN) in 2020. As for the minimum value of 0.1455 by the company PT Kalbe Farma Tbk (KLBF) in 2023. The growth variable has a mean value of 0.1395 with a standard deviation of 0.5432, and the maximum value of 4.5244 was again obtained by PT Bank Tabungan Negara (Persero) Tbk (BBTN) in 2020 and the minimum value for growth is the company PT Pakuwon Jati Tbk (PWON) in 2020.

Determination of the Best Panel Data Regression Model

Testing using panel data analysis techniques must go through several stages to test the selection of the regression model first. The panel data regression estimation test applies tests including the Chow test which compares the common effect model and the fixed effect model first, then the Hausman test which looks at the difference between the random effect model and the fixed effect model, and finally the Lagrange Multiplier test with the aim of getting one of the common effect models and random effect models.

Table 4. Chow Test

ROA			
Effect Test	Statistics	d.f	Prob.
Cross-section F	4.019274	(20.59)	0.000
Cross-section Chi-square	72.215293	20	0.000
MBR			
Effect Test	Statistics	d.f	Prob.
Cross-section F	12.5877	(20.59)	0.000
Cross-section Chi-square	139.5633	20	0.000

Source: Data from the company's annual report and sustainability report, processed

The Chow test is an initial test of model selection in panel data regression, which compares the common effect model and the fixed effect model as seen through the Cross-Section Chi-Square probability value. A probability value of less than 0.05 means that the fixed effect model is selected, and vice versa when the probability value is more than 0.05, the model selected is the common effect model. When viewed from Table 4, the value of the Cross-Section Chi-Square probability of ROA and MBR is 0.000 <0.05, then the fixed effect model is the model chosen in the Chow test.

Table 5. Hausman Test

ROA			
Test Summary	Chi-Sq Statistic	Chi-Sq d.f	Prob.
Cross-section random	8.2503	4	0.0828
MBR			
Test Summary	Chi-Sq Statistic	Chi-Sq d.f	Prob.
Cross-section random	2.5352	4	0.6383

Source: Data from the company's annual report and sustainability report, processed

After conducting the Chow test, the next test is to conduct the Hausman test (Table 5). The Hausman test aims to determine the model between the fixed effect model and the random effect model. If the resulting cross-section random probability value is <0.05 then the selected model is the fixed effect model, we do not need to conduct further model selection tests. But if the probability value > 0.05, then

the random effect model is the selected model. The cross-section random ROA probability value is 0.0828 > 0.05, so the selected model is the random effect model. Likewise, for the MBR random cross-section probability value of 0.6383 > 0.05, the selected model is the random effect model.

Table 6. Lagrange Multiplier

ROA

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	15.5935	0.2316	15.8252
	(0.0001)	(0.6303)	(0.0001)
Honda	3.9488	-0.4813	2.4519
	(0.0000)	(0.6849)	(0.0071)
King-Wu	3.9488	-0.4813	0.9773
	(0.0000)	(0.6849)	(0.1642)
Standardized Honda	4.6247	-0.1854	-0.7574
	(0.0000)	(0.5735)	(0.7756)
Standardized King-Wu	4.6247	-0.1854	-1.4489
	(0.0000)	(0.5735)	(0.9263)
Gouieroux et al	--	--	15.5935
			(0.0001)

MBR

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	67.2158	1.2107	68.4266
	(0.0000)	(0.2712)	(0.0000)
Honda	8.1985	-1.1003	5.0191
	(0.0000)	(0.8644)	(0.0000)
King-Wu	8.1985	-1.1003	1.9348
	(0.0000)	(0.8644)	(0.0265)
Standardized Honda	9.0740	-0.8754	2.1682
	(0.0000)	(0.8093)	(0.0151)
Standardized King-Wu	9.0740	-0.8754	-0.3499
	(0.0000)	(0.8093)	(0.6368)
Gouieroux et al	--	--	67.2158
			(0.0000)

Source: Data from the company's annual report and sustainability report, processed

The last test in determining the regression model is the Lagrange Multiplier test, which is a test that determines the model selection between the random effect model and the common effect model (Table 6). If the resulting value of the probability of cross-section breuch pagan < 0.05 then the model that should be used is random effect model and if the probability value of cross-section breuch pagan > 0.05 then the selected model is common effect model. The cross-section breuch pagan probability values of ROA and MBR are 0.0001 and 0.0000 <0.05, respectively, so the selected model is the random effect model.

Results of Panel Data Regression Analysis with ROA as the Dependent Variable

Panel data regression analysis was conducted with two model tests, according to the regression model formed. The first regression model is to see the influence between carbon productivity as the dependent variable on the company's financial performance assessed through ROA with firm size, leverage, growth as control variables.

The estimation results from Table 7 show that the constant value is -0.0959 which means that if all independent variables are considered constant, the value of the company's financial performance as measured by return on assets (ROA) is -0.0959. The probability value (Significance) generated from the carbon productivity variable has a Prob value of 0.2698 greater than alpha 0.05 so that H1a is rejected so it is proven that carbon productivity does not significantly affect the company's financial performance ROA. On the other hand, the leverage control variable has a significance value of 0.0000 <0.05, so it can be concluded that leverage has a significant effect on the company's financial performance as

assessed by ROA. As for the other control variables, namely firm size has a significance value of 0.2022, and the growth variable 0.1396 is greater than 0.05 so it can be concluded that the control variables firm size, and growth do not have a significant effect on the company's financial performance described by ROA. Then when viewed from the Prob value (F-statistics) which is 0.0001 smaller than 0.05. These results mean that the variables of carbon productivity, firm size, leverage, and growth simultaneously or jointly affect the company's financial performance as measured by ROA. Based on the coefficient of determination or the ability of the independent variable to explain the dependent variable seen from the Adjusted R-Squared value of 0.2090, it means that the independent variable can explain the dependent variable by 0.2090 or the remaining 20.9% is explained by other factors outside the model.

Table 7. ROA Regression Analysis Result

Variable	Coefficient	Std. Error	t-Statistics	Prob
C	-0.0959	0.1817	-0.5278	0.5991
Carbon Productivity	6.0278	5.4244	1.1112	0.2698
Firm Size	0.0078	0.0060	1.2859	0.2022
Leverage	-0.1930	0.0417	-4.6193	0.0000
Growth	0.0112	0.0075	1.4921	0.1396
Adj. R-squared	0.2090			
Prob (F-statistics)	0.0001			

Source: Data from the company's annual report and sustainability report, processed

Results of Panel Data Regression Analysis with MBR as the dependent variable

The second panel data regression model test is by replacing ROA which was previously the dependent variable to assess the company's financial performance into MBR as the dependent variable.

Table 8. MBR Regression Analysis Result

Variable	Coefficient	Std. Error	t-Statistics	Prob
C	5.0456	6.0822	0.8295	0.4093
Carbon Productivity	8.9359	1.1549	0.7737	0.4414
Firm Size	-0.1165	0.2003	-0.5820	0.5622
Leverage	0.6706	1.2620	0.5314	0.5966
Growth	0.0744	0.1503	0.4951	0.6219
Prob (F-statistics)	0.8595			

Source: Data from the company's annual report and sustainability report, processed

Based on Table 8, the resulting constant value is 5.0456 which means that if all independent variables are considered constant, the value of the company's financial performance as measured by the market to book value ratio (MBR) is 5.0456. The resulting probability value of carbon productivity or independent variables on the financial performance of MBR companies is 0.4414 greater than 0.05 so that H1b is rejected so it is proven that carbon productivity does not have a significant effect on the financial performance of MBR companies. Then for the control variable firm size has a significance value of 0.5622, leverage 0.5966, and growth 0.6219 which is greater than 0.05, so all control variables do not significantly affect the financial performance of companies measured through MBR. Furthermore, for the simultaneous test seen from the Prob (F-statistic) of 0.8595 which means that carbon productivity, firm size, leverage, and growth together or simultaneously have no significant effect on the company's financial performance measured by MBR.

DISCUSSION

The results of the study show that there is no effect of carbon productivity on the company's financial performance either assessed through ROA or MBR. This proves that companies that have good corporate financial performance do not depend on how much greenhouse gas emissions calculated through scope 1 and 2 are produced. Research by Siddique et al. (2021), revealed that the higher the carbon intensity produced by a company does not affect the company's financial performance. In contrast to the findings of Ghose et al. (2023), carbon productivity affects corporate financial performance in 66 Indian companies from 2015-2016 and 2019-2020. Research by El Khoury et al. (2023), supports that most companies still issue sustainability reports separately from the company's

financial statements, making it difficult to see the influence between environmental value and corporate financial performance.

In addition, simultaneously in the research results of the effect of carbon productivity on the company's financial performance assessed from ROA with the added control variables significantly influenced, therefore it can be interpreted that the presence of control variables in the study will significantly affect ROA. When viewed from the influence of each control variable on the company's financial performance, firm size has no effect on the company's financial performance. This is in line with the research of Kurniawati et al. (2020) and Meiryani et al. (2020) that the size of the company cannot be used to describe the good or bad financial performance of a company. This is due to other factors that affect financial performance, such as good corporate governance management (Isbanah, 2015).

Then the second control variable, leverage, has different results between company performance measured by ROA and MBR. In line with research conducted by Chen (2020), the company's financial performance as measured by ROA has a significant effect. Leverage shows the proportion of debt to total assets where the debt can reduce the company's net profit which can affect ROA. Conversely, financial performance as measured by MBR has no significant effect. This is in line with the research of Husna & Satria (2019) who examined the effect of MBR on the financial performance of companies in the manufacturing sector on the Indonesia Stock Exchange (IDX) for the period 2013-2016. MBR can be influenced by various other factors including macroeconomic conditions, perceptions from investors, and good company management. When the company can use the leverage value well, it will increase profitability and increase the market value of a company without having to reduce the book value of the company.

Furthermore, the test result of the last control variable is that growth has no effect on the company's financial performance. Research conducted by Ghose et al. (2023), However, this study is not in line with research conducted by Makan & Kabra (2020) which states that growth affects the company's financial performance.

CONCLUSION

The results of research and discussion that have been carried out in this study are to analyze whether there is an effect of carbon productivity on the company's financial performance. Especially for companies listed on the IDX80 index in 2020-2023. The results prove that there is no significant effect of carbon productivity on the company's financial performance both assessed from ROA and MBR. It can be concluded that the higher the level of carbon produced by a company through scope 1 and 2 has no effect on the company's financial performance assessed through ROA and MBR.

On the other hand, simultaneously or together when including control variables in the test, namely carbon productivity, firm size, leverage, and growth simultaneously affect the company's financial performance assessed through ROA. It can also be concluded that there are many other predictors that affect whether a company is doing well or not.

In addition, leverage as a control variable used in the study has a significant negative effect on the company's financial performance assessed through ROA. This can be seen from the test results that the resulting probability value is smaller than 0.05. So, it can be concluded that a company that is able to manage its debt well will improve the company's performance as assessed through ROA. In this case, companies that have high leverage will increase the financial risk of a company.

The implication of the results of this study theoretically is that there is no effect of carbon productivity on the company's financial performance. Based on the findings of the analysis in the study, it shows that in the research model formed there are control variables that should be considered in improving the company's financial performance assessed through ROA and MBR. Theoretically, the results of this study can add to the literature and can be used as a reference in further research because this study provides different results from previous studies so that there is novelty or novelty produced in this study. The results of this study are also expected to be useful theoretically provide benefits for academics related to the effect of carbon productivity on the company's financial performance with firm size,

leverage, and growth as control variables and can add insight and become a reference for further research because there are still few studies that examine related to the topic.

Practically, the results of this study are also expected to be a consideration and knowledge for stakeholders, investors, and financial managers in the Indonesian capital market so that it can help in making investment decisions in the Indonesian capital market, especially related to the effect of carbon productivity on financial performance and for stakeholders and companies in considering the company's financial performance through the environmental impact provided by the carbon emissions produced.

In this study there are research limitations, namely the small number of companies that publish sustainability reports so that researchers eliminate many companies that do not report sustainability reports so that they affect the number of observations. Then the research only focuses on one variable for carbon productivity.

Suggestions that can be taken for future research based on the test results of the leverage control variable on ROA financial performance that has a significant effect, for future research can add the leverage variable as an independent variable in the study. Then include other calculations other than carbon productivity from scope 1 and 2 such as including all aspects of scope into the study. Can include other variables besides carbon emission assessed from carbon productivity such as ESG score, or see in terms of carbon efficiency because when viewed from the results of the study, the independent variable only explains 20.9% of the dependent variable, the remaining 79.1% is explained by other factors or variables outside the study. In addition, future researchers are expected to expand the scope of observation of the research by conducting research in other indices and sectors listed on the Indonesia Stock Exchange (IDX) which are directly related to the use of carbon emissions in the company's business line in order to produce research that is in accordance with complete information and become a comparison for future research.

CONFLICT OF INTEREST STATEMENT

The author declares that there is no conflict of interest regarding the publication of this manuscript.

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