

RESEARCH ARTICLE



The Effect of Carbon Emission Disclosure, Green Accounting, Leverage on Company Performance with Firm Age as a Moderating Variable in Energy Sector Companies in Indonesia 2021-2023

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Abstract

This study aims to prove the impact of carbon emission disclosure, green accounting and leverage on firm performance in energy companies in Indonesia; and to verify whether firm age moderates the effect of green accounting, carbon emission disclosure and leverage on firm performance. This research was conducted by analyzing information from companies engaged in the energy sector in 2021 to 2023, in Indonesia and listed on the Indonesia Stock Exchange (IDX). This study uses a descriptive analysis method with a quantitative approach, where this study aims to describe and explain phenomena that occur factually based on data based on numbers and statistics. Analysis of this study shows that carbon emission disclosure, green accounting and leverage are not proven to have a positive effect on company performance in energy companies in Indonesia from 2021 to 2023. Meanwhile, firm age is proven to moderate (strengthen) the positive effect of Carbon Emission Disclosure, Green Accounting and Leverage on Company Performance.

Keyword: Carbon Emission Disclosure, Company Performance, Firm Age, Leverage, Green Accounting

Introduction

Climate change is currently one of the most significant global problems faced by humans. António Guterres, the UN Secretary General, informed that the last ten years, including 2024, recorded deadly temperature extremes, making it the ten hottest years in history. The World Meteorological Organization (WMO) also revealed that 2024 was the hottest year on record. By the end of October 2023, global temperatures increased by 1.4 degrees Celsius compared to the baseline temperature in the pre-industrial period of 1850-1900. Greenhouse gas levels continued to rise to their highest recorded levels, storing heat and resulting in future temperature increases. WMO Secretary-General Prof. Celeste Saulo informed that this year saw many extreme weather events, including record-breaking rains and floods, as well as huge losses due to tropical cyclones, extreme heat, and forest fires in various countries. Prof. Celeste Saulo then added that the time to act is now. To achieve a safer planet, it is a shared and global responsibility.

In 2015, the world made a major commitment to a sustainable future by adopting three major global agendas, namely the Paris Agreement, the Sustainable Development Goals (SDGs) within the framework of the 2030 Agenda for Sustainable Development, and the Sendai Framework for Disaster Risk Reduction 2015-2030. These commitments mark the beginning of global efforts towards the transition to a low-carbon economy.⁽¹⁾ Companies around the world, including those in Indonesia, are now faced with pressure to play an active role in addressing sustainability issues in business, such

as reducing carbon emissions, improving energy efficiency, and reducing waste^[1] (UNFCCC Secretariat, 2017).

Indonesia is one of the countries that contributes the highest levels of carbon emissions in the world. From 2010 to 2020, Indonesia consistently became one of the largest contributors to carbon dioxide emissions. According to the British Petroleum CO₂ Emissions-Statistical Review of World Energy 70th Edition (2021) report, Indonesia is listed as the country with the highest contribution of carbon dioxide emissions in the ASEAN region. With such high carbon emissions, Indonesia must be ready to implement measures to achieve carbon neutrality as an effort to deal with the potential climate crisis.

According to the Ministry of PPN, companies engaged in the energy sector are one of the main contributors to greenhouse gas (GHG) emissions worldwide. Based on information from the IEA, in the last 20 years, greenhouse gas emissions from this sector have more than tripled, from 10 Gigatons of CO₂ to 33 Gigatons of CO₂, from 1999 to 2019. With this contribution, companies in the energy sector are responsible for 36% of total global greenhouse gas emissions. There is also research conducted by the Ministry of National Development Planning/Bappenas, which states that the energy sector is predicted to be the highest contributor to emissions in Indonesia starting in 2022, replacing the forestry sector (Low Carbon Development Indonesia, 2024).

Corporate activities, especially in the energy sector, which involve the exploitation of natural resources for the production process, often have a negative impact on the environment. Global and public awareness of the dangerous impacts of climate change and carbon emissions on the environment has created a demand for companies to pay more attention to the impact of their operations on the environment. Sustainability measures are now one of the main agendas of companies to adapt to social and environmental changes.

According to Rusmana & Purnaman (2020), Global Warming has become one of the main topics in CSR discussions around the world. This phenomenon is caused by changes in

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the earth's surface temperature that lead to environmental damage and various disasters. The increase in industrial activities by companies is one of the factors that trigger global warming, which in turn produces carbon emissions.

Every company has goals to achieve, and success in achieving these goals is evidence of the company's management achievements. In this context, the study aims to measure the company's performance based on the company's value, namely Tobin Q. This ratio also illustrates the effectiveness of the company in managing its carbon emissions. This ratio also illustrates the effectiveness of the company in asset management. Tobin Q measures the relationship between the market price of a company and the cost of its assets. Where the ratio provides information related to the effectiveness of the company to generate profits, with the ability to manage and optimize resources, income, expenses, assets and liabilities. Firm value also reflects the company's ability to maintain sustainability, and carry out its environmental and social responsibilities.

In addition, this study also aims to measure the effect of green accounting, carbon emission disclosure and leverage on company performance. By deepening the understanding of the factors that affect company performance, this study is expected to provide useful insights for other researchers, investors and company stakeholders in an effort to improve company performance, as well as carry out corporate responsibility for social and environmental sustainability.

Furthermore, the results of this study can also be used as a foundation for the development of policies and best practices in implementing sustainable business and achieving global agendas and efforts towards the transition to a low-carbon economy and environmental empowerment. In addition, this research can also encourage investors to make sustainability investments, where investors consider other factors beyond financial returns, namely the company's environmental and social impacts. Sustainability investment is an effective tool for investors who want to make a positive contribution to the world while achieving more optimal returns. By assessing the effect of a company's activities on air quality, investors can identify companies that are committed to protecting the environment and innovating, and avoid companies that lag behind or negatively impact society. (Puntarangi, 2024)

This research can also have a significant influence in the context of an appeal to entrepreneurs and stakeholders to improve corporate reputation through the application of transparency in carbon emission reporting. Where Carbon Emission Disclosure is a form of social responsibility and a form of corporate concern for the main global problem of climate change. By reporting on the implementation of social responsibility, environment, and nature preservation (carbon emission disclosure) in the annual report, the company is expected to gain legitimacy for its contribution to social aspects, environmental concerns, and nature preservation. This also opens up opportunities for companies to gain support from the community, and has a positive impact on the survival of the company. (Hanifah, 2016)

Finally, this study will enrich academic literature by providing broader information related to company performance and the factors that influence it, namely the application of green accounting, carbon emission disclosure and company age to company performance. Based on this research, future researchers can use the information as a basis for discussion in the field of accounting and corporate sustainability.

In this study, company performance based on company value is the main focus, this measurement is used to assess the quality of the company and assess whether the company has the ability to manage the company through the value of the stock price. Therefore, in the context of this research, various variables that can affect firm value will be considered in order to comprehensively understand how the factors studied can affect firm performance.

Thus, this research can contribute to corporate and social by increasing transparency, and public trust in the company's social and environmental sustainability plans. This research is expected to increase the understanding of the public, company stakeholders, and investors regarding the company's environmental and social impacts. In addition, this research also encourages the active role of individuals in supporting sustainability actions, such as choosing products from companies committed to sustainability practices and prioritizing investments in sustainable initiatives, to then achieve the global agenda of net zero emissions..

Method

This study uses a quantitative descriptive approach to identify the effect of carbon emission disclosure, green accounting and leverage for energy companies in Indonesia on company performance with moderation of firm age. The research was conducted by collecting primary data from companies listed on the Indonesia Stock Exchange (IDX) for the period 2021 to 2023 specifically for the energy sector.

The population used in this study are energy companies listed on the Indonesia Stock Exchange (IDX). Sampling in this study using purposive sampling method technique. The secondary data collection method was also carried out to obtain information on the company's annual financial statements and annual sustainability reports. The population selection uses the country of Indonesia, with the consideration that the country is the highest carbon emitter in the world.

Below are the conditions used in the sample selection:

1. Energy Sector Companies in Indonesia that are listed on the IDX website from 2021 to 2023.
2. Energy Sector Companies in Indonesia that publish annual financial reports ending December 31, 2021 to December 31, 2023.
3. Energy Sector Companies in Indonesia that publish sustainability reports from 2021 to 2023. Based on the above criteria, the number of eligible samples was 104 samples out of a total sample size of 104 samples.

This study uses a quantitative descriptive approach with the support of secondary data obtained from trusted sources. The research is supported by literature study by tracing previous research and using academic references to support the research framework. This research also includes collecting data on financial reports and sustainability reports in 2021-2023 on energy sector companies listed on the Indonesia Stock Exchange. All data obtained is obtained from official forums such as, IDX, company websites, and trusted financial data platforms, which are then verified.

The analytical tool used to answer this research problem is a panel regression model with the following steps:

Estimating 3 types of panel regression consisting of Common Effect Model (CEM) which assumes no difference in behavior between cross section and time series, Fixed Effect Model (FEM) which assumes differences in behavior between cross section and time series and Random Effect Model (REM) which assumes differences in behavior between cross section and time series through residual differences.

Conducting model recovery testing which consists of:

Chow test, which aims to choose whether the right model is REM or FEM with decision making if the p-value of the cross section $\chi^2_{p-value} \leq 0.05$ then the selected model is FEM while if the p-value of the cross section $\chi^2_{p-value} > 0.05$ then the selected model is CEM.

Hausman testing where this test is carried out if the Chow test results are selected FEM. Hausman testing aims to select the right model REM or FEM with decision making if the p-value of the cross section $\chi^2_{p-value} \leq 0.05$ then the selected model is FEM and vice versa if the p-value of the cross section $\chi^2_{p-value} > 0.05$ then the selected model is REM.

LM testing where this test is carried out if the Chow test results are selected CEM. LM testing aims to select the right model CEM or REM with decision making if the p-value of Breusch $\chi^2_{p-value} \leq 0.05$ then the selected model is REM and vice

versa if the p-value of Breusch Pagan > 0.05 then the selected model is CEM.

Testing classical assumptions

Classical assumption testing is carried out if the selected model is CEM where there are four classical assumption tests that must be tested, namely normality, multicollinearity, autocorrelation and heteroscedasticity.

Conducting theoretical hypothesis testing consisting of Coefficient of Determination (R²)

Used to determine how much variation or behavior of the independent variable can explain the variation or behavior of the dependent variable. The R² value is in the range of 0 to 1 where the closer to 1, the more fit the model is and the closer to 0, the less fit the model is.

Simultaneous Testing (F-test)

Simultaneous testing is used to test whether there is at least one independent variable that has a significant effect on the dependent variable with decision making if the p-value of the F statistic ≤ 0.05 then H₀ is rejected (H_a is accepted) which means it is proven that there is at least one independent variable that has a significant effect on the dependent variable and vice versa if the p-value of the F statistic > 0.05 then H₀ is accepted or in other words all independent variables have no effect on the dependent variable.

Partial Testing (t test)

Partial testing is used to test the effect of each independent variable on the independent variable with decision making if the p-value of t statistics ≤ 0.05 then H₀ is rejected (H_a is accepted) which means that the independent variable has an effect on the dependent variable and vice versa if the p-value of t statistics > 0.05 then H₀ is accepted which means that certain independent variables have no effect on the dependent variable.

The variables used in this study consist of three independent variables, namely carbon emission disclosure, green accounting and leverage, one dependent variable is company performance based on company performance ratios, namely Tobin's Q and one moderating variable, namely firm age. The measurement for each research variable is explained as follows.

Company Performance

The dependent variable in this study is company performance as measured using Tobin's Q firm value, which uses the formula according to Dzahabiyya et al (2020):

$$\text{Tobins} - Q = \frac{\text{MVE} + \text{Debt}}{\text{Total Asset}}$$

MVE : Market Value Equity

Debt : Liabilities / Total Debt

Total Assets : Total Assets (book value of the company's total assets)

$$\text{Debt to Asset Ratio} = \frac{\text{Total Debt}}{\text{Total Assets}}$$

To assess the company based on market value, it can be done by comparing the Q ratio, with the valuation value, namely:

If the Q ratio is more than 1, it can be concluded that the market values the company higher than the cost of replacing its assets. So, there is market optimism about the company's prospects in the future. Where the market is willing to pay more for company shares in anticipation of greater profits or added value from existing assets.

If the Q ratio is lower than 1, it can be concluded that the market values the company lower than the cost of replacing its assets. Therefore, the market assesses the company as having less prospects and below the value of its assets.

If the Q ratio is 1, it can be concluded that the market value of the company is comparable to the replacement cost of its assets. Thus, the market values the company reasonably according to its intrinsic value.

Tobin's Q ratio provides an overview of the market value of companies listed on the financial markets with the asset replacement value of the company. A high Q ratio can be interpreted that the company's share price is above its asset value, which means the company may be overvalued. Conversely, a low ratio may mean that the company is undervalued. When the ratio is calculated for the entire market, it can give an idea of whether the market as a whole is overvalued or undervalued.

Carbon Emission Disclosure

The first independent variable is carbon emission disclosure by reviewing the total number of disclosure items by companies related to carbon emissions. The measurement for carbon emission disclosure is done using content analysis:

Table 1 Criteria of scoring Carbon Emission Disclosure

Carbon Emission Index Parameters and Climate Change			
No.	Category	Item	Description
1	Climate Change: Risks and Opportunities	CC-1	Assessment/description of the risks (regulatory, physical or general) relating to climate change and actions taken or to be taken to manage the risks
		CC-2	Assessment/description of current (and future) financial implications, business implications and opportunities of climate change
2	GHG Emissions Accounting	GHG-1	Description of the methodology used to calculate GHG emissions (e.g. GHG protocol or ISO)
		GHG-2	Existence external verification of quantity of GHG emission- if so by whom and on what basis
		GHG-3	Total GHG emissions- metric tonnes CO ₂ -e emitted
		GHG-4	Disclosure of Scopes 1 and 2, or Scope 3 direct GHG emissions
		GHG-5	Disclosure of GHG emissions by sources (e.g. coal, electricity, etc.)
		GHG-6	Disclosure of GHG emissions by facility or segment level
		GHG-7	Comparison of GHG emissions with previous years
3	Energy Consumption Accounting	EC-1	Total energy consumed (e.g. tera-joules or peta-joules)
		EC-2	Quantification of energy used from renewable sources
		EC-3	Disclosure by type, facility or segment
4	GHG Reduction and Cost	RC-1	Detail of plans or strategies to reduce GHG emissions
		RC-2	Specification of GHG emissions reduction target level and target year
		RC-3	Emissions reductions and associated costs or savings achieved to date as a result of the reduction plan
		RC-4	Cost of future emissions factored into capital expenditure planning
5	Carbon Emission Accountability	ACC-1	Indication of which board committee (or other executive body) has overall responsibility for actions related to climate change
		ACC-2	Description of the mechanism by which the board (or other executive body) reviews the company's progress regarding climate change

Green Accounting

Measurement of Green Accounting by finding out the value of dollars spent by the company for environmental protection activities and reducing carbon emission waste.

Leverage

For the last independent variable, leverage, which is measured using the Debt to Asset Ratio or the ratio of debt to assets, by comparing the company's total debt to total assets. If the resulting ratio is a high value, it can be concluded that a lot of the company's funding comes from third parties (debt) and vice versa if the resulting value is low, it can be concluded that the company's funding comes from little debt so that the potential for repayment of these debts is high. The calculation formula used is:

Firm Age

The moderating variable of this study is firm age which is measured based on the total age of the company in years from the time the company issued its first shares on the Indonesia Stock Exchange (IDX) until the research year.

Discussion

The results of descriptive statistical processing of research variables can be seen in table 2. The average value for the Tobins'Q variable is 1,609, which indicates that overall the companies used as research samples have good company value as indicated by the Tobins'Q value of more than 0. The standard deviation value of 1,926 indicates that the variation in Tobins'Q value data between one company and another is quite heterogeneous with a maximum value of 13,140 owned by BIYAN in 2023 and the lowest value of 0.446 owned by RIGS in 2023.

Table 2 Descriptive Statistics of Research Variables

Variable	Mean	St. Dev	Median	Maximum	Minimum
TOBINSQ	1.609	1.926	1.045	13.140	0.446
CARBON	65.545	25.657	72.222	94.444	5.556
GACC	0.480	0.922	0.086	4.906	0.001
LEV	0.444	0.227	0.433	1.283	0.028
AGE	15.096	8.753	13.000	33.000	2.000

Source: Data processed with Eviews12

The results of descriptive statistical calculations for the Carbon Emission disclosure variable have an average value of 65.545%. The standard deviation value of 25.657 shows that the variation in the value of Carbon Disclosure between one company and another is quite large. The highest value of 94.444% is owned by PTBA (2022). ADRP (2022). PGAS (2022), KKG (2023) and TOBA (2023), while the minimum value of 5.556 is owned by MBAP in 2021.

Descriptive statistics of Green Accounting variables produce an average value of 0.480 which indicates that the average company expenditure on environmental costs is 0.480%. The standard deviation value of 0.922 indicates that the variation in Green Accounting data between one company and the company is quite heterogeneous. The maximum value of Green Accounting of 4.906% is owned by RIGS in 2023 and the minimum value of 0.001 is owned by BIPI in 2023.

The results of descriptive statistical calculations for the leverage variable are indicated by an average value of 0.444 (44.4%) which means that on average every 1 asset becomes 0.444 debt. The standard deviation value of 0.227 indicates that there is a significant variation in Leverage data between one company and another. The maximum value of leverage of 1.283 is owned by ARTI in 2023 and the minimum value of leverage is owned by RIGS in 2023 with a value of 0.028.

The company's general descriptive statistics produce an average value of 15.096 years. The standard deviation value of 8.753 indicates that there is a fairly heterogeneous variation in data between one company and another in the research sample. The company with the highest age of 33 years is owned by PTRO, BUMI and RIGS in 2023 while the company with the lowest age is owned by TEBE in 2021.

Findings and Discussion

The first stage in the formation of the panel regression model is to first test outlier data to avoid biased estimation models. Of the total 103 research samples used, there were 6 outlier data because they produced standardized residuals of less than -3 or more than 3 so that the total sample used in this study was 97 samples.

Chow Testing

The results of testing model selection using Chow produce a p value of cross section random of 0.000 < 0.05 which means Ho is rejected and Ha is accepted so that the right model is FEM. More details can be seen in table 3.

Tabel 3. Chow Testing

Effects Test	Statistic	Chi-square	df	Prob
Cross-section	192.492	192.492	3	0.000
random	808	808	3	0.000

Source: data processed

Hausman Testing

The chow test results selected FEM so continued with Hausman testing as shown in table 4. Information from the table obtained the p-value of the cross section random of 0.6927 > 0.05 so that Ho is accepted or in other words the selected model is REM. Thus, the model in testing the hypothesis of this study is the REM model.

Table 4 Hausman Testing

Effects Test	Statistic	Chi-square	df	Prob
Cross-section	4.7317	4.7317	3	0.6927
random	30	30	3	0.6927

Source: data process

Hypothesis Test

The processing results for testing the theory hypothesis can be seen in Table 5.

Table 5. Theory Hypothesis Testing

Variable	Koefisien	T-Statistic	Prob.
CARBON	-0.0027	-18.299	0.0000
GACC	-0.1034	-1.3258	0.0931
LEV	-0.6771	-2.2181	0.0145
CARBON_AGE	0.0166	2.0911	0.0197**
GACC_AGE	0.0232	1.5338	0.0643*
LEV_AGE	0.1048	3.9268	0.0001**
Adjusted R ²	0.1143		
F statistik	2.7701		
Prob	0.0118		

*=alpha 10% **=alpha 5%

Data Source: Source: Data processed with Eviews12

The processing results for the coefficient of determination test resulted in an adjusted R² value of 0.1143 which means that the variation or behavior of the independent variables (Carbon Emission Disclosure, Green Accounting, Leverage and the interaction of Age with Carbon Emission Disclosure, Green Accounting, Leverage) is able to explain the variation of the dependent variable, Tobins'Q by 11.4319% while the remaining 88.5681% is the variation of other independent variables that affect Tobins'Q but are not included in the model.

The simultaneous test results obtained a statistical F value of 2.770163 with a p-value of 0.011865 < 0.05, which means that Ho is rejected and Ha is accepted, so it can be concluded that it is proven that at least one independent variable has a significant effect on the dependent variable.

Limitation

There are limitations to this study that can be taken into consideration for further research. The limitations of this study include:

1. research that is limited to one dependent variable and three independent variables and one moderating variable.
2. this research is limited to energy sector companies listed on the Indonesia Stock Exchange.

- the research is limited to one specific period, namely 2021-2023.

Conclusions and Recommendations

Based on the results of the above research, it can be concluded that:

- the carbon emission disclosure variable has no effect on company performance in energy sector companies listed on the Indonesia Stock Exchange in 2021-2023.
- the green accounting variable has no effect on company performance in energy sector companies listed on the Indonesia Stock Exchange in 2021-2023.
- The leverage variable has no effect on company performance in energy sector companies listed on the Indonesia Stock Exchange in 2021-2023.
- firm age is able to moderate the positive effect of carbon emission disclosure on company performance in energy sector companies listed on the Indonesia Stock Exchange in 2021-2023.
- firm age is able to moderate the positive effect of green accounting on company performance in energy sector companies listed on the Indonesia Stock Exchange in 2021-2023.
- firm age is able to moderate the positive effect of leverage on company performance in energy sector companies listed on the Indonesia Stock Exchange in 2021-2023.
- There are several suggestions for future researchers, namely: a) the addition of independent variables that can be factors that can affect company performance, b) increasing the time span of the research period, so that it can describe the overall results, c) adding other sectors besides companies with the energy industry.

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