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The Influence of Carbon Emission Disclosure, Green Innovation, and Eco-Efficiency on Firm Value in Manufacturing Sector Companies Listed on The Indonesia Stock Exchange

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ABSTRACT: *This paper aims to test and analyze the effect of carbon emission disclosure, green innovation, and eco-efficiency on firm value in manufacturing companies listed on the Indonesia Stock Exchange (IDX) in 2018-2022. The sample selection technique used in this study was purposive sampling method which resulted in 16 manufacturing sector companies.Carbon emission disclosure is measured using the amount of carbon emission disclosure, green innovation is measured using a ratio scale, eco-efficiency is measured using dummy variables based on ISO 14001 certification attached to the sustainability report, and firm value is measured using Tobin's Q ratio. The type of data used is secondary data which includes annual reports and sustainability reports. Hypothesis testing using panel data regression with Eviews version 12. The results of this study reveal that carbon emission disclosure and green innovation have a positive and significant effect on firm value while eco-efficiency does not have a significant effect on firm value.*

KEY WORD*: Carbon Emission Disclosure, Green Innovation, Eco-Efficiency, Firm Value*

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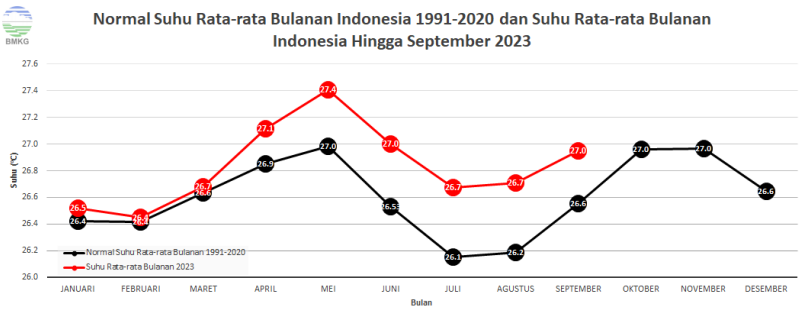
I. INTRODUCTION

1.1 Research Background

The condition of the earth today is very alarming. The earth's temperature has increased by 1.1º Celsius since 1880. The average temperature of the Earth's surface has risen by 0.74 ± 0.18º Celsius over the past century (Utina, 2019). The Earth's temperature is expected to surpass the crisis point of 1.5º Celsius in the next five years. Based on the analysis of 116 BMKG stations, September 2023 will see an average air temperature of 27.0º Celsius. The climatologically normal air temperature for September 2023 during the 1991-2020 period in Indonesia is 26.6º Celsius (within the normal range from 20.1º Celsius to 28.6º Celsius). This number indicates a positive anomaly of 0.4º Celcius for the average air temperature anomaly in September 2023 Indonesia's September 2023, the air temperature anomaly ranks fourth in terms of maximum anomaly value since 1981(Wicaksono, 2023), when the observation period began. Deforestation followed by industrial activities has accelerated the temperature rise. In addition, the increase in temperature is also as a result of the rise in greenhouse gasses. Greenhouse gas emissions are a factor that affects global warming, which will impact human life in the future.

Figure 1: Comparison of Indonesia's Average Monthly 1990-2020 and 2023



Source: BMKG, 2O23

The largest contributor to greenhouse gas emissions today is human activity related to industrial activities. Many industrial activities carried out by humans are only concerned with the income and profits generated without thinking about the condition of nature itself.The manufacturing sector is also a form of industrial activity carried out by humans. Manufacturing is an activity that processes raw materials into finished materials through the production process. However, the more production of an item, the more pollution is created. Therefore, companies must also think about the impact caused and must be able to take a stand for this problem. The number of manufacturing companies in Indonesia is quite large, there are 195 manufacturing businesses listed on the Indonesia Stock Exchange between 2018 and 2020. This not a small amount considering that one manufacturing company can cause a tremendous impact on nature, so this must be given more attention.

The role of the government, companies, all community institutions, and individuals is needed to overcome these problems. The Indonesian government has tightened environmental rules, including Government Regulation "(PP) Number 22 of 2021 concerning the Implementation of Environmental Protection and Management". People who understand and realize the importance of the environment will preserve this nature. This also applies to companies. Companies that care about the environment will also raise the company's value(Feronika et al., 2020).

Firm value is the value that arises from investors' confidence in a company in achieving the targeted rate of return so that investors want to buy the company's shares (Safitri& Nani, 2021). According to Suwarno& Susanto (2021), firmvalue is the result of the company's operational performance since the company was founded and has the aim of prospering shareholders. The share price of a corporation increases in direct proportion to its worth. Therefore, the company will continue to raise the value of the company in order to achieve the company's goals.

Disclosure of carbon emissions, green innovation, and ecological efficiency are concepts that are intimately connected to increasing firm value. Through the sustainability report disclosed by the company on an ongoing basis, it can be a reference to how much the company cares about the environment. It can be a consideration for investors in investing their wealth for the purchase of shares of a company(Agustia et al., 2019).Sustainability reports, which are official reports published by companies on their environmental and social performance, have become one of the important tools to measure and communicate a company's efforts in achieving sustainability (Febriyanti, 2021). This report may include information on carbon footprint reduction, green innovations, and eco-efficiency measures taken by the company.

The content of stakeholder theory is the role of the company in considering the interests and impacts on the various parties involved in the company's activities(Febriyanti, 2021). Stakeholder theory emphasizes the importance of communicating and meeting the needs of stakeholders, not only focusing on seeking financial gain but including various actions such as running sustainable business practices, contributing to the local community, and paying attention to ethical issues.

1.2 Research Objectives

The objective of the research is to analyzingand knowing the effect of carbon emission disclosure on firm value, the effect of green innovation on firm value, and the effect of eco-efficiency on firm value.

II. LITERATURE REVIEW

2.1 Stakeholder Theory

Stakeholder theory is a concept that identifies and understands the various groups of individuals and groups that have an interest in a company. Within the realm of business, internal stakeholders encompass several entities such as shareholders, firm proprietors, and employees (Freeman & McVea, 2005).Externalstakeholders in a given context encompass many entities such as consumers, suppliers, government bodies, and the local community. This theory emphasizes that companies must be responsible to all parties involved in the company's operations. The relationship between this theory and corporate value is that by treating stakeholders fairly, accommodating their interests, and taking into account social and environmental impacts, companies can build trust, strong reputations, and positive long-term relationships and ultimately can increase corporate value by reducing risk, improving financial performance, and ensuring sustainable business continuity. By basing their actions on the principles of stakeholder theory, companies can achieve more sustainable long-term value, not only for shareholders, but also for society and the surrounding environment. This theory provides clarity that companies must provide benefits to stakeholders by providing information related to company activities. The company's activities in question are activities that affect them. The purpose of this theory is to help business managers derive more value from the operational tasks they perform and minimizing possible losses for company stakeholders (Suharyani et al., 2019).

2.2 Carbon Emission Disclosure

According toBae Choi et al (2013), carbon emission disclosure is a variable that describes how enterprises reveal information about the quantity of greenhouse gas emissions they produce as a result of their operations and the environmental effects these activities have on the environment. Carbon emission disclosure is a way for companies to provide transparency regarding their contribution to climate change and other environmental impacts. Carbon emission disclosure covers company practices and policies related to measuring, reporting and disclosing carbon emissions to stakeholders (Hardiyansah et al., 2021).The carbon emission disclosure index consists of a total of 18 components, distributed over 5 distinct categories. The process of measurement involves assigning a numerical value of 1 to each thing that has been revealed, while assigning a numerical value of 0 to items that have not been revealed. The summation of the score value is divided by the total number of transparency components, and subsequently multiplied by 100%. The carbon emission disclosure variable is measured using the following formula:

$$CED = \frac{Number\ of\ item\ disclosed}{Number\ of\ disclosure\ items} \times 100\%$$

Table 2. 1 Carbon Emissions Disclosure Items

Category	Item
Climate change: risks and opportunities	CC1: Assessment/description of climate change and actions taken to address such risks. related risks (specific and general regulations).
	CC2: Assessment/description of current (and future) financial, business and opportunity implications of climate change.
Greenhouse Gas Emissions (GHG/Greenhouse Gas)	GHG1: Description of the methodology used to calculate greenhouse gases (e.g. GHG protocol or ISO).
	GHG2: Existence of external verification of GHG emissions quantity by whom and on what basis.
	GHG3: Total greenhouse gas emissions (metric tons) generated.
	GHG4: Scope disclosure 1 and 2, or 3 direct emissions.
	GHG5: Disclosure of GHG emissions by origin or source (e.g. coal, electricity, etc.).
	GHG6: GHG emissions disclosure by facility or segment level.
	GHG7: Comparison of GHG emissions with previous years
Energy Consumption (EC)	EC1: Amount of energy consumed (e.g. tera-joules or PETA-joules)
	EC2: Quantification of energy used from renewable resources.
	EC3: Disclosure by type, facility or segment.
Greenhouse Gas Reductions and Costs (RC/*Reduction and cost*)	RC1: Details of the plan or strategy to reduce GHG emissions
	RC2: Specification of the target level and year of GHG emission reductions.
	RC3: Emission reductions and the costs or savings achieved to date as a result of the carbon emission reduction plan.
	RC4: Future emission costs required in capital expenditure planning.
Carbon Emissions Accountability (AEC/*Accountability of Emission Carbon*)	AEC1: An indication of where the board (or other executive body) has responsibility for actions related to climate change.
	AEC2: Description of the mechanism by which the board (or other executive body) reviews the company's progress on climate change.

Source: Bae Choi et al (2013)

2.3 Green Innovation

Green innovation is technology, practices, systems, and production processes used to reduce the impact of environmental damage(Novitasari&Tarigan, 2022). Green innovation refers to the strategic approach employed by companies to attain their objectives through the utilization of novel technology, systems, practices, and industrial processes with the aim of mitigating environmental harm (Dewi &Rahmianingsih, 2020). Green innovation encourages companies to turn waste production into usable products that can generate additional revenue for the company, which in turn will help the company to achieve and maintain corporate value (Fabiola &Khusnah, 2022).The measurement of green innovation in this study uses a ratio scale with several indicators including the following:

a. The production process utilizes new technologies to reduce energy, water, and waste.
b. Products are made from environmentally friendly materials and do not contain substances harmful to the environment.
c. The company reprocesses the waste generated as a result of the production process.
d. Production materials or components can be recycled.

Each indicator is given a point of 1 if the business or company has carried out business activities in accordance with the indicator and give a value of 0 if the company does not do it. The points for the indicators obtained by each sample are summed up, then divided by the total points for all indicators (Agustia et al., 2019).

$$GI = \frac{Total\ disclosure\ value\ related\ to\ green\ innovation}{Total\ points\ of\ all\ indicators}$$

2.4 Eco-Efficiency

Eco-efficiency is a parameter used to measure the extent to which an organization or business process is able to achieve economic goals with minimal environmental impact (Safitri&Gamayuni, 2019). The concept of eco-efficiency encompasses the assessment of efficiency in the utilization of natural resources and energy within the operational framework of a corporation (Valencia & Sri, 2020).In addition, eco-efficiency integrates two important dimensions, namely economic and environmental aspects, and reflects the extent to which a company can achieve high productivity and profitability while minimizing its ecological footprint(Aviyanti&Isbanah, 2019). The measurement of eco-efficiency uses dummies, namely:

1 : The company has ISO 14001 certification

0 : The company does not have ISO 14001 certification

2.5 Firm Value

Firm value is a measure that reflects how much or how well a company is valued in the market. Firm value is commonly assessed by a range of indicators, including market capitalization, stock price, and book value. These measurements provide insights into the perceived worth of a company by investors and other relevant stakeholders(Bagh et al., 2024). The valuation of a firm is determined by the utilization of the Tobin's Q ratio, which involves the multiplication of the closing price of shares by the total number of shares outstanding. This quotient is then added to the aggregate book value of liabilities and subsequently divided by the entire book value of assets. The formula for Tobin's Q is as follows:

$$\text{Tobin's Q} = \frac{\text{Total Market Value} + \text{Total Book Value of Liabilities}}{\text{Total Book Value of Assets}}$$

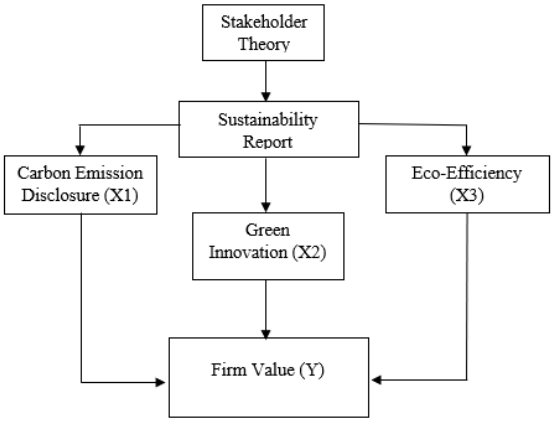
2.6 Conceptual Framework

Given the escalating complexity of global concerns and the pressing issue of climate change, the role of companies in implementing sustainable and environmentally friendly practices has become increasingly crucial. Sustainability is not only a buzzword, but also a strategic goal for organizations committed to creating a positive impact in society and the environment. Companies that adopt sustainable practices will enhance the company's worth.

Firm value is the value created from the company's performance since a company was founded. A quality company is a company that has good operational management and implements a sustainability strategy. The correlation between the superior quality of a company and its stock price is a significant factor that influences the well-being of both the company owner and its shareholders.

Stakeholder theory is the theoretical basis for this research. According to the stakeholder hypothesis, business must also serve the interest of their stakeholders in addition to their own. Carbon emission disclosure, green innovation, and eco-efficiency are one of the ways companies support sustainability. This beneficial phenomenon not only exerts an influence on the environment but also exerts an impact on the value of the firm. Thus, this conceptual framework will be the main basis for this research in exploring the dynamics between business sustainability and firm value.

Figure 2: Conceptual Framework



2.7 Hypothesis Development

2.7.1 The Effect of Carbon Emission Disclosure on Firm Value

Disclosure of carbon emissions is important to stakeholders. This encompasses prospective investors seeking to invest in companies that prioritize environmental considerations. In addition, the public is also more concerned about carbon emissions generated by companies so that companies are expected to disclose in detail related to carbon emissions with the aim of increasing the level of public trust.

According to Rahmanita (2020), stakeholders assert that profitability is no longer the sole determinant in business operations. Climate change has emerged as a worldwide concern, prompting investors to contemplate investing in businesses that demonstrate environmental responsibility. Transparency on the company's carbon emissions will enhance the company's value.

H1: Carbon Emission Disclosure has a positive and significant effect on firm value.

2.7.2 The Effect of Green Innovation on Firm Value

Green innovation refers to any endeavor aimed at mitigating negative effects on the environment. The form of business in question can include production processes, practices, systems and techniques that better utilize natural resources or energy that are environmentally friendly (N. P. Sari &Handayani, 2020). Theoretically, the adoption of green innovations is expected to improve the financial performance of firms through various mechanisms, such as reduced production costs, product differentiation, access to broader markets, and increased customer satisfaction.

There exists a correlation between green innovation and stakeholder theory, where companies who use green innovation will generate public trust in the company. This demonstrates the company's commitment to environmental sustainability and is expected to enhance the company's overall worth. High company value can be a factor in increasing the valuation of the company's stock. A high share price indicates the level of prosperity of the company owner and its shareholders(Abbas et al., 2020).

H2: Green Innovation has a positive and significant effect on firm value

2.7.3 The Effect of Eco-Efficiency on Firm Value

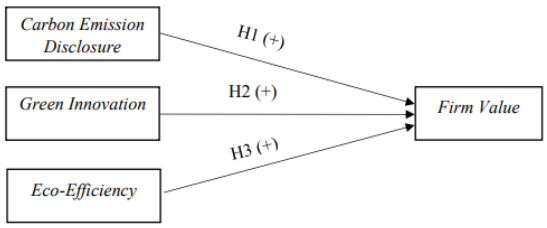
Stakeholder theory posits that stakeholders possess the entitlement to be informed about the company's operations that may have an impact on them. The objective of this theory is to aid corporate managers in enhancing the worth of business operations and reducing adverse effects for stakeholders. By implementing eco-efficiency in the company's operations, the company is in line with the theory above. Eco-efficiency refers to the capacity of a corporation to produce goods or services with the maximum and efficient use of resources by minimizing the impact of the production process (Fernández et al., 2024).

Manufacturing companies have a strong relationship with eco-efficiency. Manufacturing companies use technology to facilitate work in producing a product. In line with that, the technology used should follow environmentally friendly principles such as using a solar heat source as engine power. In this way, companies can save on electricity usage costs and keep the environment safe.

H3: Eco-Efficiency has a positive significant and significant effect on Firm Value

Based on the explanation of the hypothesis above, this research model is constructed as follows:

Figure 3: Research Model



III. RESEARCH METODOLOGY

3.1 Descriptive Statistical Analysis

Descriptive statistics is a form of analysis used to describe data that can be seen through the minimum, maximum, average, and standard deviation values. This analysis is used to create a systematic description of the relationship between the phenomena under study.

3.2 Regression Model Test

In panel data regression analysis, the right model is needed in the analysis. This regression model includes the common effect model (CEM), fixed effect model (FEM), and random effect model (REM)(Basuki &Prawoto, 2016).In order to ascertain the optimal model, it is necessary to do the Chow test, Hausman test, and Lagrange multiplier test.

3.3 Classical Assumption Test

The classic assumption test is a series of statistical tests used in panel data regression analysis. The purpose of testing in classical assumptions is to ensure that the results of regression analysis are unbiased and valid (Ghozali, 2018). This classic assumption test includes normality test, multicollinearity test, heteroscedasticity test, and autocorrelation test. If the selected model is cem and fem then the heteroscedasticity test is needed. Meanwhile, if the selected model is brake, the normality test is needed and the multicollinearity test is needed if there is more than one independent variable. The autocorrelation test is not needed because the panel data regression can already bias the correlation in the research (Basuki &Prawoto, 2016).

3.4 Panel Data Regression Analysis

Panel data linear regression analysis is a method used to determine the relationship between cross section and time series data. Regression analysis uses two or more independent variables to show the direction of the relationship between the independent variable and the dependent variable (Ghozali, 2018). In this study, the dependent variable is firm value while the independent variables are carbon emission disclosure, green innovation, and eco-efficiency. For this reason, the equation in testing the overall hypothesis in this study is:

$$Yit= \alpha+ \beta\_1 X\_(1 it)+ \beta\_2 X\_(2 it)+ \beta\_3 X\_(3it)+ \varepsilon it$$

3.5 Goodness of Fit Test

In the goodness of fit test, three tests are carried out, namely, the f test, the coefficient of determination test, and the t test.

IV. RESULTS AND DISCUSSION

4.1 Descriptive Statistical Analysis

Descriptive statistics is a method that aims to provide information about the minimum, maximum, average, and median values used to describe the independent and dependent variables. Observation data in this study used 80 observation data obtained from purposive sampling method. The following are the results of descriptive statistical testing for all variables used.

Table 4. 1 Descriptive Statistical Analysis

	Y_FirmValue	X1_CED	X2_GI	X3_ECO
Mean	1.173625	0.580125	0.715625	1.825000
Median	1.070000	0.560000	0.750000	2.000000
Maximum	2.690000	0.830000	1000000	2.000000
Minimum	0.590000	0.330000	0.250000	1.000000

Table 4.1 above shows Firm Value as the dependent variable (Y) has a mean value of 1.1736 and a median value of 1.0700 with the lowest value of 0.59 and the highest value of 2.69. CED as an independent variable (X1) has a mean value of 0.5801 and a median value of 0.5600 with a lowest value of 0.33 and a highest value of 0.83. GI as an independent variable (X2) has a mean value of 0.7156 and a median value of 0.7500 with a lowest value of 0.25 and a highest value of 1.00. ECO as an independent variable (X3) has a mean value of 1.8250 and a median value of 2.0000 with a lowest value of 1.00 and a highest value of 2.00.

4.2 Regression Model Test

4.2.1 Chow Test

The chow test is a test to determine whether CEM or FEM is better. The results of the chow test in this study are as follows:

Table 4. 2 Chow Test

Effects Test	Statistic	d.f	Prob.
Cross-section F	7.670916	(15,61)	0.0000
Cross-section Chi-square	84.797776	15	0.0000

Based on the results of the chow test, the probability value is 0.00 <0.05 so that the selected model in the study is FEM.

4.2.2 Hausman Test

The Hausman test is used to determine whether FEM or REM is better. The results of the Hausman test in this study are as follows:

Table 4. 3 Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	6.048196	3	0.1093

Based on the Eviews output in table 4.3 above, it shows that the probability value is 0.1093> 0.05. Thus, the model selected in this study is the REM model.

4.2.3 Lagrange Multiplier Test

The LM test is used to determine whether REM or CEM is better. The results of the lagrange multiplier test in this study are as follows:

Table 4. 4 Lagrange Multiplier Test

	Test Hypothesis		
	Cross-section	**Time**	**Both**
Breusch-Pagan	38.59882	2.183175	40.78200
	(0.0000)	(0.1395)	(0.0000)

Table 4.4 explains that the Breusch-Pagan value is 0.00 <0.05. So that the model chosen in this study is the REM model. Based on the results of the Chow Test, Hausman Test, and Lagrange Multiplier Test, the best model in this study is the Random Effect Model.

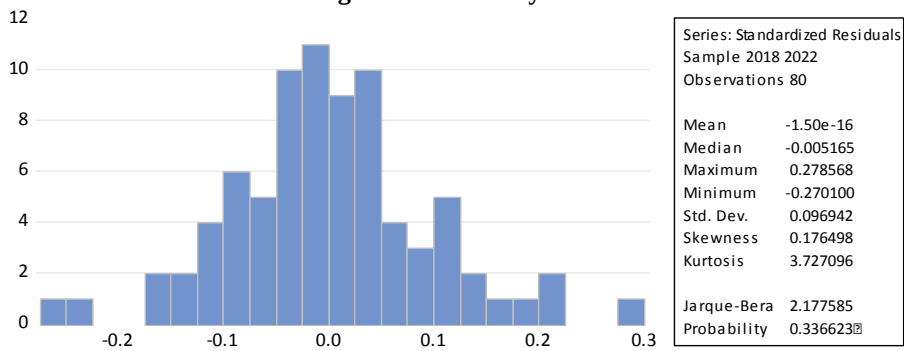
4.3 Classical Assumption Test

The regression model chosen in this study is the Random Effect Model, therefore the classical assumption test must be carried out. The classical assumption tests used for REM are normality test and multicollinearity test (Basuki &Prawoto, 2016).

4.3.1 Normality Test

The normality test is carried out to test whether the data is normally distributed or not. Normally distributed data can increase the objectivity of the assessment. The normality test used is the Jarque-Bera test with the assumption that the p-value> 0.05 then the data is normally distributed. The results of this test are as follows:

Figure 4: Normality Test



Based on Figure 4.1 the result of Jarque-Bera is 2.17 and p-value 0.33> 0.05 so it can be assumed that the data is normally distributed.

4.3.2 Multicollinearity Test

Multicollinearity test is a test to determine whether there is a high correlation between independent variables in the regression model. This test uses the assumption that if the correlation value between independent variables <0.80 then the data is free from multicollinearity symptoms. The results of this test are as follows:

Table 4. 5Multicollinierity Test

	X1_CED	**X2_GI**	**X3_ECO**
X1_CED	1.000000	0.244377	0.052149
X2_GI	0.244377	1.000000	0.200496
X3_ECO	0.052149	0.200496	1.000000

The results of table 4.5 explain the correlation value of X1 and X2 of 0.244, X1 and X3 of 0.052, X2 and X3 of 0.200 which is < 0.80 so that the results of this test indicate that there is no multicollinearity problem between the independent variables.

4.4 Panel Data Regression Analysis

The relationship between the independent variables and the dependent variable is examined using panel data regression. Panel data is a mixture of cross-section data and time series data. This analysis used 80 observed data. The test produced the following results:

Table 4. 6 Panel Data Regression Analysis

Estimation Command: LS(?. CX=R) Y C X1 X2 X3
Estimation Equation: Y = C(1) + C(2)*X1 + C(3)*X2 + C(4)*X3 + [CX=R]
Substituted Coefficients: Y = 0.283832164382 + 0.626767498752*X1 + 0.430048772875*X2 + 0.11969078757*X3 +[CX=R]

It can be concluded from the panel data regression equation above that:

1. Constant (α) in this regression model produces a regression coefficient value of 0.2838. It is assumed that if each Constant (α) in this regression model produces a regression coefficient value of 0.2838. It is assumed that if each independent variable has a value of 0, then the dependent variable, namely firm value, is worth 0.2838.
2. Variabel X1 (Carbon Emission Disclosure) provides a regression coefficient β_1 0,626. This shows that if carbon emission disclosure increases by 1% with the assumption that other variables are constant, the firm value will increase by 0.626.
3. Variabel X2 (Green Innovation) variable produces a regression coefficient valueβ_2 0,430. This shows that if green innovation increases by 1%, the firm value will increase by 0.430.
4. Variabel X3 (Eco-Efficiency) The regression coefficient value β_3 shows a result of 0,119. This shows that if eco-efficiency increases by 1%, the firm value will increase by 0.119.

4.5 Goodness of Fit Test

4.5.1 F Test Results

The F test is used to determine whether there is a simultaneous influence of the independent variable on the dependent variable by looking at the f-count> f-table value and the significance value <0.05. The results of the F test are attached to the following table:

Table 4. 7 F Test Results

Weighted Statistics			
R-squared	0.135596	Mean dependent var	0.438373
Adjusted R-squared	0.101475	S. D. dependent var	0.241438
S. E. of regression	0.228860	Sum squared resid	3.980646
F-statistic	3.973954	Durbin-Watson stat	0.827294
Prob(F-statistic)	0.010962		

Based on Eviews output in table 4.7, it shows that the calculated F value is 3.97> F table (2.72) and the significance value is 0.01 < 0.05. So it can be concluded that carbon emission disclosure, green innovation, and eco-efficiency variables simultaneously affect firm value.

4.5.2 Adjusted R Square

The coefficient of determination test is carried out to determine how strong the ability of the independent variable is in explaining the dependent variable.

Table 4. 8 Determination Coefficient *Adjusted R Square*

Weighted Statistics			
R-squared	0.135596	Mean dependent var	0.438373
Adjusted R-squared	0.101475	S. D. dependent var	0.241438
S. E. of regression	0.228860	Sum squared resid	3.980646
F-statistic	3.973954	Durbin-Watson stat	0.827294
Prob(F-statistic)	0.010962		

Based on table 4.8, the adjusted R Square value is 0.101, which means that the carbon emission disclosure, green innovation, and eco-efficiency variables are able to explain the firm value variable by 10.1%, while the percentage of 89.9% is explained by other variables.

4.5.3 T Test

Hypothesis testing seeks to determine how independent factors affect the dependent variable. If the significance value is less than 0.05 or the value of the t-count is greater than the t-table, the independent variable is considered to have an influence on the dependent variable. The test results are as follows:

Table 4.9 T Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.283832	0.295601	0.960185	0.3400
X1	0.626767	0.287614	2.179198	0.0324
X2	0.430049	0.204438	2.103569	0.0387
X3	0.119691	0.111936	1.069280	0.2883

Based on the results of the table above, the following is an explanation of the hypothesis based on the data in table 4.9:

1. Variable X1 (Carbon Emission Disclosure) provides a parameter coefficient value (t-count) of 2,179 > 1,99125 (t-table) with a significance level of 0,03 < 0,05. Based on these results, H1 is accepted and it can be said that carbon emission disclosure has a positive and significant effect on firm value.
2. Variable X2 (Green Innovation) provides a parameter coefficient value (t-count) of 2,103 > 1, (t-table) with a significance level of 0,03 < 0,05. Based on these results, H2 is accepted and it can be said that green innovation has a positive effect on firm value.
3. Variable X3 (Eco-Efficiency) provides a parameter coefficient value (t-count) of 1,069 < 1,99125 with a significance level of 0,28 > 0,05. Based on these results, H3 is rejected and it can be said that eco-efficiency has no effect on firm value.

4.6 Discussion

4.6.1 The Effect of Carbon Emission Disclosure on Firm Value

The results of this study show that carbon emission disclosure has a positive and significant effect on firm value. This is indicated by the results of the hypothesis test which shows the carbon emission disclosure variable has a significance value of 0.03 <0.05 and the value of the t-count 2.179> 1.99125 (t-table). So that from these assumptions, H1 in this study can be accepted.

The positive and significant result shows that when the company cares about the disclosure of carbon emissions, the firm value increases. Vice versa, when the company is indifferent and does not care about the disclosure of carbon emissions, the firm value decreases. This is because the firm value contained in the annual report can represent the quality of a company and the disclosure of carbon emissions contained in the sustainability report can show the company's concern for sustainability.

In line with stakeholder theory which explains that companies are not only responsible to shareholders, but also to various parties who have an interest in the company's operations. Transparent disclosure of carbon emissions and real efforts to reduce environmental impacts can improve the company's reputation in the eyes of stakeholders. A good reputation in terms of sustainability and social responsibility can create added value and trust that can ultimately affect the overall value of the company. With the increase in company value, it will have an impact on the increase in stock prices that can prosper stakeholders.

Manufacturing companies that turn raw materials into semi-finished or finished goods require a long process. The production process produces carbon emissions that impact the environment. Companies that disclose carbon emissions have added value for investors. Not only for investors, it also has an impact on consumers who know the company cares about the environment will tend to buy the goods so that sales figures increase.

This research is also in line with research Damas et al (2021), Hardianti&Mulyani (2023), Sari &Budiasih (2022), and Yuliandhari et al (2023)which found that carbon emission disclosure has a significant positive effect on firm value.

4.6.2 The Effect of Green Innovation on Firm Value

The results of this study indicate that green innovation has a positive and significant effect on firm value. This is indicated by the results of the hypothesis test which shows that the green innovation variable has a significance value of 0,03 < 0,05 and the value of the t-count is 2,103 > 1,99125 (t-table). So that from these assumptions, H2 in this study is accepted.

The positive and significant results show that companies that have principles and practice green innovation can make firm value increase. The same thing also happens on the contrary, when the company does not apply green innovation, the firm value decreases. The alarming condition of the earth and the impact of global warming make the concept of green innovation is starting to be widely recognized. Investors tend to be interested in companies that care about environmental sustainability.

In line with green innovation, stakeholder theory emphasizes the importance of involvement and support from various stakeholder groups in achieving corporate goals. Green innovation creates opportunities for companies to collaborate with various parties, including governments, non-profit organizations, and business partners. Through active engagement with external stakeholders, companies can build sustainable partnerships, support the implementation of green innovation and increase corporate value. By implementing green

innovation, companies can also minimize environmental and social risks that can affect the company's operations and reputation.

Green innovation can also have a positive impact on a company's operational efficiency. The adoption of more efficient technologies in energy use, raw materials, and production processes can reduce long-term operational costs. By adopting green innovation, companies can improve resource efficiency and reduce waste, which can ultimately contribute to cost savings and increased profitability.

Manufacturing companies are closely related to the production process. Manufacturing companies that use new technologies to reduce energy, use materials that do not pose a threat to the environment, can reprocess the waste produced, and recyclable production components have implemented the concept of green innovation. Green innovation is a thought based on concern for the environment and is realized by the company so as to improve the financial performance of manufacturing companies.

This research is also in line with researchsDewi &Rahmianingsih (2020), Fabiola &Khusnah (2022), and Tonay &Murwaningsari (2022)which found that green innovation has a significant positive effect on firm value.

4.6.3 The Effect of Eco-Efficiency on Firm Value

The results of this study show that eco-efficiency has no significant effect on firm value. This is indicated by the results of the hypothesis test which shows the eco-efficiency variable has a significance value of 0.288> 0.05 and the value of the t-count 1.069 < 1.99125 (t-table). So that from these assumptions, H3 in this study is rejected.

The result of positive insignificance means that eco-efficiency has a positive influence, but it has not been able to influence directly on firm value. Eco-Efficiency as measured by ownership of ISO 14001 certification regarding environmental management systems is one way to gain reputation and views in the eyes of the public. Companies that have ISO certification are also expected to increase the value of the company itself.

Although eco-efficiency aims to improve resource use efficiency and reduce environmental impact per unit of output, it does not always have a significant impact on firm value. Ownership of ISO 14001 certification is considered to be costly and also a formality in carrying out company operations. So, from these thoughts, eco-efficiency does not significantly affect firm value. In the context of stakeholder theory, it is important to identify and understand the needs and expectations of various stakeholders. Eco-efficiency that is only focused on operational efficiency without considering other interests such as employee welfare, customer satisfaction, or social impact can cause a detrimental imbalance in relationships with stakeholders.

Manufacturing companies that have ISO 14001 certification are considered insufficient to increase their company value. Apart from the costs incurred by the company to obtain ISO 14001 certification, other factors can come from investors who see the benefits obtained by the company. If the company already has an ISO 14001 certificate but the net profit received by the company is still relatively small, investors can change their decision to invest. Thus, Eco-efficiency is considered not yet able to increase the value of the company.

This research is also in line with research Safitri& Nani (2021)which found that eco-efficiency has a positive and insignificant effect on firm value.

V. CONCLUSION

5.1 Conclusions

This study was to examine the impact of eco-efficiency, green innovation, and disclosure of carbon emissions on firm value in manufacturing companies listed between 2018 and 2022 on the Indonesia Stock Exchange. The conclusions of this research are as follows:

1. Carbon emission disclosure has a positive and significant effect on firm value in manufacturing sector companies listed on the Indonesia Stock Exchange in 2018-2022. This shows that the more open the company is regarding carbon emissions attached, the morefirm value will increase.
2. Green Innovation has a positive and significant effect on firm value in manufacturing sector companies listed on the Indonesia Stock Exchange in 2018-2022. This shows that the more the company cares about innovation to the environment, the more firm value will increase.
3. Eco-efficiency has a positive and insignificant effect on firm value in manufacturing sector companies listed on the Indonesia Stock Exchange in 2018-2022. This shows that ISO 14001 certification owned by the company is not able to increase firm value.

5.2 Sugestions

Based on the conclusions described above, the researcher provides suggestions in the hope that they can be useful, including the following:

1. For manufacturing sector companies, they can pay attention to variables that have a significant effect on firm value so that they can increase investor interest in investing.
2. For investors and potential investors, they can pay attention to variables that have a significant effect on firm value so that they have a reference in determining investment decisions.
3. For further research, it is hoped that it can add other independent variables that are not examined in this study.

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