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ENVIRONMENTAL MANAGEMENT ACCOUNTING, CARBON DISCLOSURE EMISSION, AND THEIR EFFECTS ON ENVIRONMENTAL PERFORMANCE WITH GREEN COMPETITIVE ADVANTAGE AS A MODERATING VARIABLE

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Abstract:
This study aims to determine whether Environmental Management Accounting and carbon Emission Disclosure affect Environmental Performance by using Green Competitive Advantage as a moderating variable. Respondents in this study were 45 respondents. Analysis Method using Moderate Regression Analysis. Environmental Management Accounting (EMA) integrates various tools for environmental performance control and carbon emission reporting. This study analyzes environmental disclosures, competitive advantages, and tests data reliability, normality, and goodness of fit. The results showed that Environmental Management Accounting did not affect Environmental Performance. Carbon Emission Disclosure Affects Environmental Performance. This research finds that Environmental Management Accounting does not have a positive effect on Environmental Performance. On the other hand, Carbon Emission Disclosure has a positive effect. Eco-Friendly Competitive Advantage does not strengthen the influence of either. Green Competitive Advantage has yet to be proven to moderate the influence of Environmental Management Accounting on Environmental Performance. Green Competitive Advantage has not been proven to moderate the effect of Carbon Emission Disclosure on environmental performance.

Keywords: Environmental Management Accounting, Carbon Emission Disclosure, Green Competitive Advantage

INTRODUCTION

According to the Intergovernmental Panel on Climate Change (IPCC), the average temperature on Earth has increased by 1oC over the past three centuries due to the rise in greenhouse gas emissions in the Earth's atmosphere, with the most significant contribution coming from carbon dioxide. Data from the Carbon Dioxide Information Analysis Centre (CDIAC) indicates a rapid increase in carbon dioxide emissions, with more than 400 billion metric tons of CO2 released into the atmosphere since 1751, primarily due to the consumption of fossil fuels and cement production. This condition continues to escalate in line with the increasing industrial activities worldwide. In 2014 alone, approximately 9.9 billion metric tons of CO2 were released into the atmosphere from fossil fuel combustion, marking a 0.8% increase from the emissions in 2013 (Ischazilatul & Badingatus, 2019).

Indonesia's efforts to reduce carbon emissions include ratifying the first Kyoto Protocol on July 28, 2004, through the issuance of Law Number 17 of 2004 concerning the Ratification of the Kyoto Protocol to The United Nations Framework Convention on Climate Change. Additionally, Indonesia has issued Presidential Regulation Number 61 of 2011 on the National Action Plan for Greenhouse Gas Emission Reduction as the basis for implementing the reduction of greenhouse gas emissions. Article 4 of this regulation states that the public and business entities also play a role in efforts to reduce greenhouse gas emissions. Business entities, such as companies, contribute to these efforts

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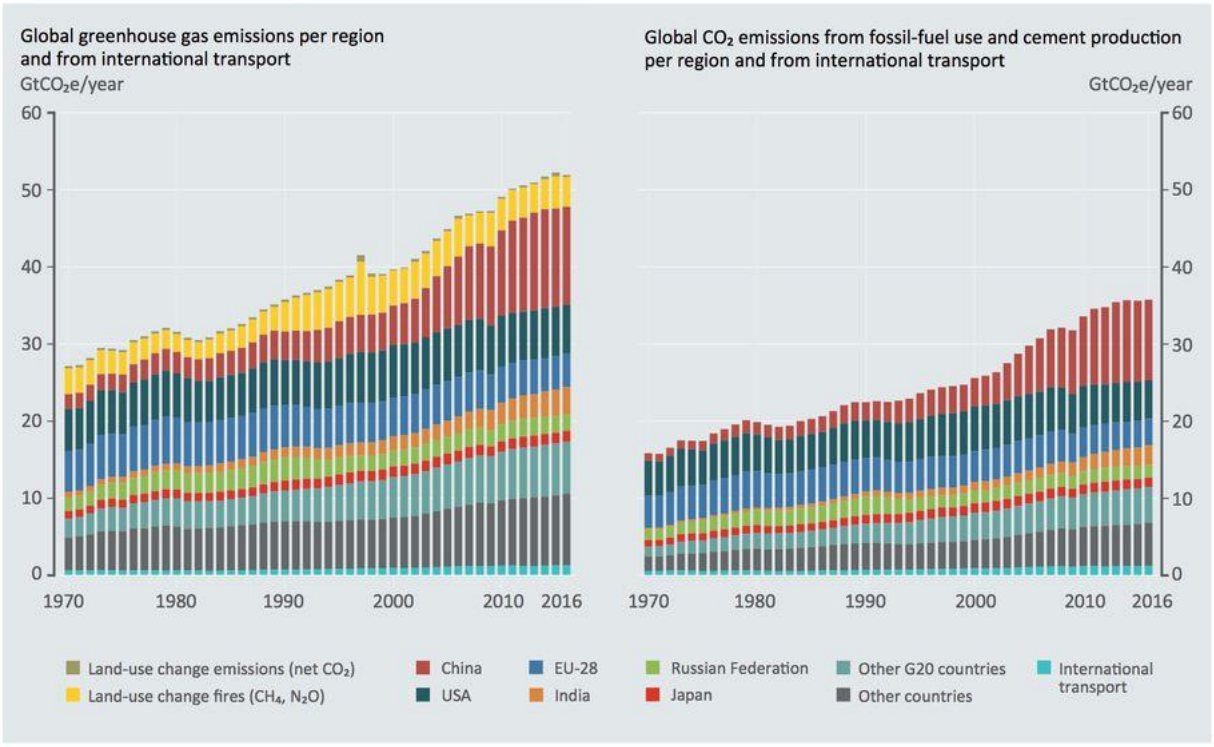
by disclosing carbon emissions. Companies are expected to be more transparent by disclosing carbon emissions related to all their activities (Halimah & Yanto, 2018).

Figure ES.1.a: Global greenhouse gas emissions for top six emitting countries and regions (excluding land use, land-use change and forestry), international transport emissions, and land use, land-use change and forestry emissions.

Figure ES.1.b: Global carbon dioxide emissions per region from fossil fuel use, cement production and other processes.



Source: World Resources Institute Indonesia, 2017

Figure 1. Global Greenhouse Gas (GHG) and Global CO2 Chart

The various environmental issues in Indonesia are among the most crucial factors to consider, given the increasingly evident impact of poor environmental management. Natural disasters such as floods and landslides across Indonesia, forest fires in Sumatra and Kalimantan, and floods in Sidoarjo, East Java, which need to be adequately addressed, indicate companies' insufficient attention to the environmental impact of their industrial activities.

Recently, the use of Environmental Management Accounting (EMA) has been explored and discussed in the context of carbon management and accounting (Ascui, 2014; Burritt et al., 2011; Schaltegger & Csutora, 2012; Stechemesser & Günther, 2012). Governments worldwide have sought to influence corporate responses to climate change by introducing emission trading schemes, taxes, reduction regulations, and disclosure requirements to reduce carbon emissions. The expectation that the initial step towards reducing corporate carbon emissions is to enhance transparency and disclose these emissions has led to initiatives such as the Carbon Disclosure Project (CDP). The CDP collects and publishes voluntary disclosures of greenhouse gas emissions from the largest manufacturing companies in Indonesia.

Effective environmental management can prevent claims from the public and government and enhance product quality, ultimately improving environmental performance. This research uses

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EMA, Carbon Emission Disclosure on environmental performance, using Green Competitive Advantage as a moderating variable.

Environmental Management Accounting (EMA). According to Hansen and Mowen (2015), disclosing environmental costs can provide information related to the distribution of environmental costs that is beneficial for improving and controlling environmental performance. Environmental cost disclosure is considered adequate when it provides cost information based on the type of activity. If the reporting of environmental costs is separated based on the type of activity, the company can quickly identify the costs incurred for each activity. These activities include:

1. Environmental Prevention Costs are costs related to the prevention of waste or garbage.
2. Environmental Detection Costs are related to determining whether products, processes, and other company activities comply with established environmental standards.
3. Environmental Internal Failure Costs. These costs are incurred for activities conducted due to the production of waste and garbage but are not released into the external environment.
4. Environmental External Failure Costs. These costs are incurred for activities conducted after releasing waste or garbage into the environment.

In a study conducted by Aristha (2017), it was found that disclosing environmental costs and systematically allocating costs based on activities in environmental accounting can contribute positively to environmental performance. A company's environmental disclosure sends a positive signal to investors, indicating that the company has performed well environmentally, with the expectation that it will positively impact the company's value.

EMA involves physical procedures for the consumption of materials and energy, flows, and final disposal, as well as monetary procedures for costs, savings, and income related to activities or material flows with potential environmental impacts (Burritt et al., 2002; UNDSD, 2001; IFAC, 2005 in Qian, 2017). Previous research has focused on the technical aspects of EMA applications. This study focuses on using EMA in broader sustainability management that impacts Environmental Performance. The investigation is conducted for manufacturing companies in Indonesia. Based on this, hypotheses can be developed as follows:

H1: Environmental Management Accounting (EMA) positively impacts Environmental Performance.

Carbon Emission Disclosure. Carbon Emission Disclosure, or Carbon Emission Reporting, is an example of environmental disclosure that is part of a report stating that entities may also present, separate from financial statements, reports on environmental aspects and value-added statements, especially for industries where environmental factors play a crucial role and for industries that consider employees as a significant user group of the report. Environmental performance measurement is an essential part of environmental management systems. Environmental performance assessment is based on environmental policies, objectives, and targets (ISO 14004, from ISO 14001).

H2: Carbon Emission Disclosure (CED) positively influences Environmental Performance.

Green Competitive Advantage. Ansoff (1965), as cited in Lin (2016), was the first to use the concept of competitive advantage in corporate strategy. According to Hofer and Schendel (1978), competitive advantage can imply the exploitation of resources that result in a distinctive organizational position compared to competing firms. Additionally, companies view acquiring new knowledge as a way to gain and determine the factors of green competitive advantage: the role of maintaining competitive advantage (Danskin et al., 2005). This study defines green competitive advantage as a crucial factor for companies to enhance the achievement of sustainable development.

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H3: Green Competitive Advantage strengthens the relationship between Environmental Management Accounting (EMA) and Environmental Performance.

H4: Green Competitive Advantage strengthens the relationship between Carbon Emission Disclosure (CED) and Environmental Performance.

Research Model.

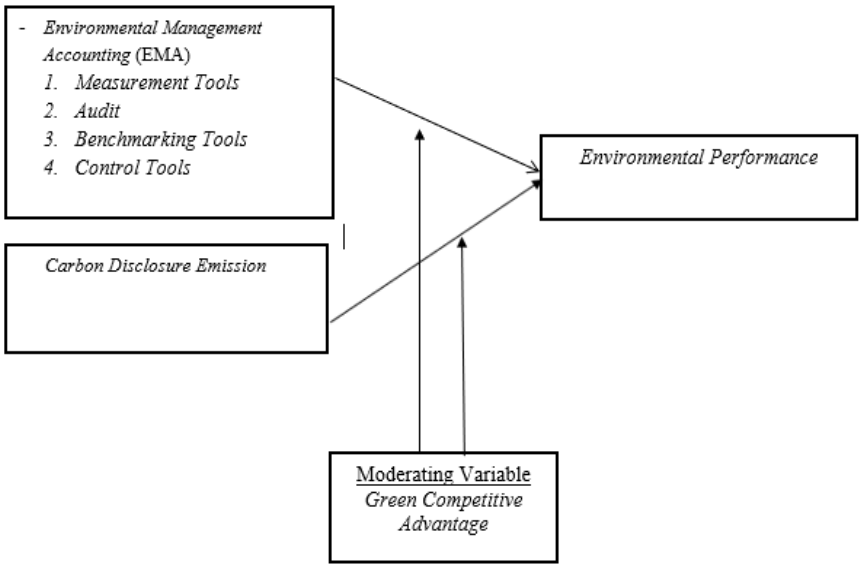

Figure 2. Research Model.

METHODS

Research Design. This research employs a quantitative approach. The population of this study consists of manufacturing companies in Indonesia. The study uses non-probability sampling techniques. Samples are chosen based on specific conditions that indicate the population's characteristics (Daito, 2011). The samples have key characteristics that allow for examination and selection based on scientific considerations, namely:

a. The sample consists of companies in Indonesia.
b. Companies listed in the Program for Environmental Performance Rating (PROPER) issued by the Ministry of Environment and Forestry for 2019-2020.

Operational Definition and Measurement of Variables.

Environmental Management Accounting (EMA) is a broad term encompassing various accounting and performance control tools (Bouten & Hooze, 2013; USEPA, 1998). Richardson et al. (2005) consider EMA a form of managerial technology that includes various tools and techniques for targeted information collection, analysis, and communication.

Carbon Emission Disclosure. Carbon Emission Disclosure, or Carbon Emission Reporting, is one example of environmental disclosure that is part of a report stating that entities may also present, separate from financial statements, reports on environmental aspects and value-added statements, especially for industries where environmental factors play a crucial role and for industries that consider employees as a significant user group of the report. These additional reports fall outside the scope of Financial Accounting Standards and cover greenhouse gases and costs (RC/Reduction and Cost) and carbon emission accountability (AEC/Accountability of Emission Carbon).

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Green Competitive Advantage. Environmental performance measurement is an essential part of environmental management systems. Environmental performance assessment is based on environmental policies, objectives, and targets (ISO 14004, derived from ISO 14001).

Data Collection Procedures. The data used in this research consists of secondary and primary data, specifically data from companies listed in the Program for Environmental Performance Rating (PROPER) published by the Ministry of Environment and Forestry for 2019-2020. Data collection methods include surveying through various techniques such as distributing questionnaires directly, utilizing the Internet, and using Google Forms.

Test the Quality of Research Instruments. According to Ghozali (2018), the validity test is used to measure the legitimacy or validity of a questionnaire. A questionnaire is considered valid if its questions express what it intends to measure. The validity test in this study is conducted through bivariate correlation between each indicator score and the total score of the construct. The results of the bivariate correlation analysis can be determined by examining the output of Cronbach's Alpha in the Correlated Item – Total Correlation column. The testing is done at a significance level of 5% or 0.05, with the testing criteria stating that if the Pearson correlation value is < t table, the questionnaire item is considered not valid, whereas if the Pearson correlation value is > t table, the questionnaire item is considered valid.

Reliability Test. According to Imam Ghozali (2018), the reliability test measures a questionnaire, an indicator of a variable or construct. A questionnaire is considered reliable if a person's answers are consistent or stable over time. The reliability test is conducted using the internal consistency reliability approach, which employs the Cronbach Alpha test to identify how healthy items in the questionnaire are related to each other. High reliability is indicated by a value of 1.00, and reliability considered satisfactory or high is ≥ 0.70.

Data Normality Test. The normality test aims to examine whether, in a regression model, there are disturbance variables or residuals that have a normal distribution. In this study, a statistical test, the non-parametric Kolmogorov-Smirnov (K-S) test, was used to determine whether the population data is normally distributed or not, with a significance level above 0.05 (> 0.05). Data is normally distributed if the Kolmogorov-Smirnov test results show a significance level above 0.05 or > 0.05.

Description of Research Variables. In this stage, each research variable, consisting of exogenous and endogenous variables, is analyzed to examine the theoretical and actual ranges by considering their standard deviations.

Uji Goodness of Fit. The F-test aims to determine the independent variables' simultaneous (together) influence on the dependent variable. It assesses whether variable Y has a linear relationship with X1, X2, and X3. The test is conducted with a significance level 0.05 (α = 5%). The F statistic is used to conduct the F-test by comparing the calculated F value with the critical F value from the table. If the calculated F value is greater than the critical F value, then the null hypothesis (Ho) is rejected in favor of the alternative hypothesis (Ha), and vice versa.

Coefficient of Determination Test. The coefficient of determination essentially measures how well the model explains the variation in the dependent variable. The R-squared value ranges between 0 and 1 ($0 \leq R2 \leq 1$). The purpose of calculating the coefficient of determination is to assess the influence of independent variables on the dependent variable. The R-squared value has an interval between 0 and 1 ($0 \leq R2 \leq 1$). The closer the R-squared value is to 1, the better the results for that regression model. As it approaches 0, the independent variables, as a whole, cannot explain the dependent variable.

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Hypothesis testing. The t-test statistic indicates how much influence an individual independent variable has in explaining the variation in the dependent variable with a significance level of 5%. The steps in conducting the t-test are as follows.

1. Formulate a Hypothesis
   Ho: β = 0 means no significant influence among independent variables (X1, X2) on the dependent variable (Y). Ha: β ≠ 0 means a significant influence between independent variables (X1, X2) on the dependent variable (Y).
2. Determining Significance Levels. The significance level in this research is 5%, meaning the risk of decision-making error is 5%.
3. Decision-making
   a. If the probability (sig t) > α (0.05), then Ho is accepted, meaning there is no significant partial influence from independent variables (X1 and X2) on the dependent variable (Y).
   b. If the probability (sig t) < α (0.05), then Ho is rejected, meaning there is a significant partial influence from independent variables (X1 and X2) on the dependent variable (Y).
   c. The regression model in this study is stated as follows:

$$EP = \alpha + \beta 1\ EMA + \beta 2\ CED + e$$

Description:
EP = Environmental Performance
EMA = Environmental Management Accounting
CED = Carbon Emission Disclosure
e = error

Moderate Regression Analysis Test. In this test, the moderating variable is examined. The moderating variable is an independent variable that strengthens or weakens the relationship between other independent variables and the dependent variable. The moderating variable in this study is organizational culture. In this stage, a moderation regression analysis is conducted with the regression model:

$$EP = \alpha + \beta 1\ EMA + \beta 2 EMA*GCA + e$$
$$EP = \alpha + \beta 1\ CED + \beta 2 CED*GCA + e$$

Description:
EP = Environmental Performance
EMA = Environmental Management Accounting
CED = Carbon Emission Disclosure
GCA = Green Competitive Advantage
e = error

RESULT AND DISCUSSION

Descriptive Statistics.

Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EMA01	45	2.00	6.00	4.0889	.87444
EMA02	45	2.00	6.00	4.2000	.89443
EMA03	45	2.00	6.00	4.1333	.91949
EMA04	45	2.00	6.00	4.0222	.83907
EMA05	45	2.00	6.00	4.1333	.91949

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EMA06	45	3.00	6.00	4.1556	.79646
EMA07	45	3.00	6.00	4.1778	.80591
EMA08	45	2.00	6.00	4.1778	.83364
EMA09	45	2.00	5.00	4.1333	.84208
EMA10	45	3.00	6.00	4.2889	.78689
EMA11	45	1.00	6.00	4.0667	.96295
EMA12	45	3.00	6.00	4.2444	.77329
EMA13	45	3.00	6.00	4.3111	.76343
Valid N (listwise)	45				

Based on Table 1, it is explained that for the variable EMA, the average respondent answers at point 4.

B2. Carbon Emission Disclosure. This variable is measured with 18 statements, symbolized by the code CED.

B3. Environmental Disclosure. This variable is measured with the Proper Rating.

B4. Green Competitive Advantage. This variable is measured using 14 statements, each symbolized by GAC. Table 4.2 below explains the respondents' responses regarding the statements presented. On average, respondents agreed with the statements presented by the researcher.

Validity and Reliability Test of EMA.

Table 2. Validity and Reliability Test of EMA

	Pearson Correlation	Cronbach's Alpha if Item Deleted	Data Quality
EMA01	.735	.950	Valid and Reliable
EMA02	.728	.951	Valid and Reliable
EMA03	.830	.948	Valid and Reliable
EMA04	.741	.950	Valid and Reliable
EMA05	.710	.951	Valid and Reliable
EMA06	.768	.950	Valid and Reliable
EMA07	.825	.948	Valid and Reliable
EMA08	.796	.949	Valid and Reliable
EMA09	.733	.950	Valid and Reliable
EMA10	.792	.949	Valid and Reliable
EMA11	.811	.948	Valid and Reliable
EMA12	.824	.948	Valid and Reliable
EMA13	.638	.953	Valid and Reliable

Based on the table above (Table 2), the Pearson correlation values > 0.294 suggest that all constructs from EMA1 to MAS 13 are valid. The Cronbach's alpha values for all constructs in Table 4.3 are> 0.7, suggesting that all constructs in this variable are reliable.

Validity and Reliability Test of Green Competitive Advantage.

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Table 3. Validity and Reliability Test of Green Competitive Advantage

	Pearson Correlation	Cronbach's Alpha if Item Deleted	Data Quality
GAC01	.561	.967	Valid and Reliable
GAC02	.655	.965	Valid and Reliable
GAC03	.796	.962	Valid and Reliable
GAC04	.857	.961	Valid and Reliable
GAC05	.831	.962	Valid and Reliable
GAC06	.799	.962	Valid and Reliable
GAC07	.891	.960	Valid and Reliable
GAC08	.710	.964	Valid and Reliable
GAC09	.889	.961	Valid and Reliable
GAC10	.873	.961	Valid and Reliable
GAC11	.870	.961	Valid and Reliable
GAC12	.827	.962	Valid and Reliable
GAC13	.849	.961	Valid and Reliable
GAC14	.800	.962	Valid and Reliable

Based on the table above, it can be explained that Cronbach's alpha value is > 0.7; thus, it is concluded that all statements are reliable. Meanwhile, for the Pearson correlation value of green competitive advantage > 0.294, the statements GCA01-GCA14 are considered valid.

Data Normality Test.

Table 4. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		45
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	1.04442306
Most Extreme Differences	Absolute	.127
	Positive	.127

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	Negative	-.095
Test Statistic		.127
Asymp. Sig. (2-tailed)		.067[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Based on Table 4, the data in this research is usually distributed because the Asymp. Sig. (2-tailed) value is 0.067, which is greater than 0.05. Thus, it is concluded that the data used in this research is usually distributed.

Uji Goodness of Fit.

Table 5. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	20.804	2	10.402	9.102	.001[b]
	Residual	47.996	42	1.143		
	Total	68.800	44			

a. Dependent Variable: EP
b. Predictors: (Constant), CED, EMA

The results in Table 5 show that the significance value is 0.001, which is smaller than 0.05. It indicates that the research model is suitable for investigation.

Coefficient and Determination Test.

Table 6. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.550[a]	.302	.269	1.06900

a. Predictors: (Constant), CED, EMA
b. Dependent Variable: EP

The R-square value is 0.302, based on Table 6. It indicates that the independent variables in this study can explain 30.2% of the dependent variable. In other words, 69.8% of Environmental Performance (the dependent variable) is explained by other variables outside this research model.

T-statistic Test.

Table 7. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.221	1.040		1.174	.247

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EMA	.010	.020	.070	.486	.629
CED	1.498	.421	.515	3.561	.001
(Constant)	1.221	1.040		1.174	.247

a. Dependent Variable: EP

Based on the results in Table 7, it shows that:

a. The significance value of EMA is 0.629. This means that 0.000 > 0.05. Therefore, hypothesis 1 is rejected. Environmental Management Accounting (EMA) does not positively affect Environmental Performance.
b. The significance value of Carbon Emission Disclosure is 0.000. This means that 0.000 < 0.05. Therefore, hypothesis 2 is not rejected. CED has a positive effect on Environmental Performance.

Moderation Regression Analysis Test

Results of the Green Competitive Advantage Test Moderating the Effect of Environmental Management Accounting on Environmental Performance.

Table 8. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.330[a]	.109	.043	1.22300

a. Dependent Variable: EP

b. Predictors: (Constant), EMA_GCA, GCA, EMA

Table 9. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.240	7.122		-.315	.755
	EMA	.064	.135	.460	.479	.635
	GCA	.051	.118	.401	.429	.670
	EMA_GCA	-.001	.002	-.447	-.267	.790

a. Dependent Variable: EP

The table above explains the results of the coefficient of determination with the variable Environmental Management Accounting on Environmental Performance moderated by Green Competitive Advantage. The results show that the adjusted R-square value becomes 0.109 or 10.9%, indicating that the variables EMA and Green Competitive Advantage explain the variable Environmental Performance. The significance of the Environmental Management Accounting value indicates a result of 0.635 > 0.05, meaning that the EMA variable is not significant; the Green Advantage variable shows a result of 0.670 or can be said that 0.670 > 0.05, and the interaction variable between Environmental Performance and Green Competitive Advantage (EMA*GA) can be considered 0.790, meaning that the EMA variable with GA is not significant.

Results of the Green Competitive Advantage Test Moderating the Effect of Environmental Management Accounting on Environmental Performance.

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Table 10. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.555[a]	.308	.258	1.07721

a. Predictors: (Constant), EMA_GCA, GCA, EMA

b. Dependent Variable: EP

Table 11. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.470	1.080		1.361	.181
	EMA	1.300	.535	.446	2.430	.020
	GCA	.004	.019	.033	.223	.825
	EMA_GCA	.006	.010	.122	.645	.522

a. Dependent Variable: EP

The table above explains that the significance of the CED value indicates a result of 0.020 > 0.05, meaning that the Carbon Emission Disclosure variable is significant; the Green Competitive Advantage variable shows a result of 0.825 or can be said that 0.825 > 0.05, meaning that the Green Competitive Advantage variable is not significant; and the interaction variable between Carbon Emission Disclosure and Green Competitive Advantage (CED*GA) shows a result of 0.522 or can be said 0.522 > 0.05, meaning that the interaction variable between Carbon Emission Disclosure and Green Competitive Advantage is not significant.

Environmental Management Accounting Affects Environmental Performance. The test results found that EMA does not positively influence Environmental Performance. This result differs from the study by Qian (2017), which stated that Environmental Management Accounting plays a role in companies.

Carbon Emission Disclosure Affects Environmental Performance. Based on the research results, Carbon Emission Disclosure positively affects Environmental Performance. This result is consistent with the studies of Saka et al. (2014) and Choi et al. (2013), which state that Carbon Emission Disclosure plays an essential role in companies.

Green Competitive Advantage moderates the influence of Environmental Management Accounting on Environmental Performance. Based on the test results, Green Competitive Advantage does not moderate the influence of Environmental Management Accounting on Environmental Performance.

Green Competitive Advantage moderates the influence of Carbon Emission Disclosure on Environmental Performance. Based on the test results, Green Competitive Advantage does not moderate the influence of Carbon Emission Disclosure on Environmental Performance.

CONCLUSION

Based on the conducted tests, it can be concluded that:

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1. Environmental Management Accounting does not have a positive effect on Environmental Performance.
2. Carbon Emission Disclosure has a positive effect on Environmental Performance.
3. Green Competitive Advantage does not strengthen the influence of Environmental Management Accounting on Environmental Performance.
4. Green Competitive Advantage does not strengthen the influence of Carbon Emission Disclosure on Environmental Performance.

Implications. This research's implications include providing input regarding carbon emission disclosure policies so that companies pay more attention to their environmental impact. Companies should not only focus on seeking profits but also on preserving the corporate environment.

Suggestion. Some feedback related to this research includes:

1. Increase the sample size.
2. Extend the questionnaire distribution period.
3. Add independent variables such as organizational structure and board of directors.

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