Carbon Emission Disclosure: Evidence from Manufacturing Company

Kelvin Yauri[1] * | Luky Patricia Widianingsih[2] ⓘ

[1]Universitas Ciputra, Department of Accounting, Surabaya, Indonesia
[2]Universitas Ciputra, Department of Accounting, Surabaya, Indonesia

*Correspondence to: Kelvin Yauri, Department of Accounting, Universitas Ciputra, CitraLand CBD Boulevard, Surabaya, Jawa Timur, 60219, Indonesia
E-mail: Yauri_Kelvin@yahoo.com

Abstract: This study aims to examine variables that affect carbon emissions disclosure. The variables tested in this study include media exposure, environmental performance, leverage, and firm size. Carbon emission disclosure is measured using a checklist based on the information request sheet provided by the Carbon Disclosure Project (CDP). The research sample was 34 manufacturing companies listed on the IDX selected from 2016-2020. Data analysis used pooled least squares. The result of this study indicates that the variables of media exposure, environmental performance, and company size have a significant positive effect on carbon emissions disclosure. Meanwhile, leverage has a significant negative impact on carbon emissions disclosure. This study implies that manufacturing companies need to change the perception that disclosing carbon emissions will only increase costs because disclosing carbon emissions also benefits companies and other stakeholders. The value of the study confirms the "inside and outside" drivers that can contribute to changes and improvements in carbon emission disclosure performance.

Keywords: carbon emission disclosure, environmental performance, leverage, media exposure.

INTRODUCTION

Global warming is starting to become an issue that attracts the world's attention today (Kılıç & Kuzey, 2019; Ulfa & Ermaya, 2019). Global warming can trigger climate change (Laksani et al., 2020). The occurrence of climate change is inseparable from human activity itself. Climate change that occurs with global warming is caused by increased carbon dioxide (CO_2) emissions resulting from industrial activities resulting in the effect of Greenhouse Gases (GHG) (Rokhmawati & Gunardi, 2017). Data from the Intergovernmental Panel on Climate Change (IPCC) states that the increase in GHG emissions in the Earth's atmosphere has resulted in the average temperature on Earth in the last three centuries increasing by 0.8 degrees Celsius, with carbon dioxide gas as the largest contributor (Ministry of Environment and Forestry, 2020). According to the World Meteorological Organization's Greenhouse Gases Bulletin, emissions from fossil combustion and cement production operating 31.5 billion metric tons of carbon dioxide are the leading causes of this temperature increase (World Meteorological Organization, 2021). Furthermore, Tabel 1 shows the ten countries that produce the most carbon dioxide (CO_2) in the world.

Table 1 List of CO2-Producing Countries

No.	Countries	Total Carbon Emission (MtCO2e)
1	China	10.715
2	America	5.285
3	India	2.616
4	Russia	1.678
5	Japan	1.107
6	Iran	780
7	Germany	702
8	Indonesia	618
9	South Korea	611
10	Saudi Arabia	582

Source: Global Carbon Atlas (2019)

Based on the Table 1, Indonesia is the fifth-largest contributor of carbon dioxide (CO_2) in Asia after China, India, Japan, and Iran. Indeed, Indonesia is often known as the lungs of the world because it has a very large forest. Directorate General of Forestry Planning and Environmental Management (2021) states that the total forest area in Indonesia is 95.6 million hectares or 50.9% of the total land area. Nevertheless, Indonesia's forests are experiencing deforestation due to land clearing for business needs (Wiratno & Muaziz, 2020). Forests that initially worked to absorb carbon dioxide and release the oxygen needed to revive humans have now turned to burning carbon dioxide (Ministry of Environment and Forestry, 2020).

Countries that ratify the agreement are committed to reducing emissions of carbon dioxide (CO_2), methane (CH_4), nitrogen dioxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs), as well as cooperating in emissions trading to address global warming (Deantari et al., 2019). In this regard, Indonesia also supports the world's commitments by seeking to reduce GHG emissions from 26% in 2020 to 29% in 2030 to 41% if it receives international support (Laksani et al., 2020).

The company's efforts as an economic actor to reduce GHG emissions can be seen in the carbon emissions disclosure (Deantari et al., 2019). This is in line with Apriliana et al. (2019) who state that carbon emission disclosure is one of the corporate social responsibilities used to determine whether a company has made efforts to reduce GHG emissions (including carbon emissions). In Indonesia, disclosure of information related to carbon emissions is essentially a voluntary disclosure by business entities. Whether or not disclosure is made depends on each company (Abdullah et al., 2020).

Statistical data on trends in carbon dioxide emissions in Indonesia from 1960 to 2018 can be seen in Figure 1, obtained from the World Development Indicators. Since 1966, CO_2 emissions in Indonesia have increased from year to year. In 2013 the trend began to show a decline. But in 2018, the movement of CO_2 emissions was at its peak, which was 2,178 metric tons of CO_2.

This increasing trend has caused the Indonesian government to take action to reduce GHG emissions by encouraging companies in specific industries that are conducive to CO_2 emissions to mitigate and disclose

carbon dioxide emissions to the public (Nasih et al., 2019). Furthermore, the Indonesian government also implemented a carbon tax in the Coal Steam Power Plant sector on April 1, 2022, through a tax mechanism based on emission limits (cap and tax). The carbon tax rate of IDR, 30 per kilogram of CO_2 equivalent, applies if the emissions exceed the predetermined cap. Through this regulation, the Indonesian government aims to change the behavior of economic actors to switch to low-carbon green economic activities to reduce GHG emissions (Ministry of Finance, 2021).

In addition to carrying out its operational activities, the company is committed to protecting the environment by focusing on the quality of carbon emissions disclosure or other actions that can preserve the environment (Wiratno & Muaziz, 2020). This is in accordance with the stakeholder theory, which explains that the company is not an entity that only operates the company but an entity that also provides more benefits to its stakeholders, such as shareholders, creditors, consumers, suppliers, government, communities, and other stakeholders (Wiratno & Muaziz, 2020). The company tries to take various steps to satisfy its stakeholders because its survival depends on the stakeholders (Nasih et al., 2019). Carbon emissions disclosure is seen as a form of communication between companies and their stakeholders and is a way to demonstrate environmental responsibility to stakeholders (Zanra et al., 2020).

Figure 2 shows the results of carbon emissions from the manufacturing sector from 2015 to 2019. Based on this figure, carbon emissions in the manufacturing sector experienced growth from 2017 to 2019, and the most significant increase in carbon emissions occurred from 2018 to 2019. The data in Figure 2 is related to Table 1 and Figure 1. In 2019, the result of carbon emissions from the manufacturing sector reached their peak, which was 138,932 GG CO2e. The same year, Indonesia was ranked 8th as the world's highest carbon dioxide-producing country and 5th in Asia (Table 1). Furthermore, from 2017 to 2019, the manufacturing sector generated growth in carbon emissions. This is in accordance with the trend of carbon emissions in Indonesia from 2016 to 2018, which experienced a significant increase (Figure 1).
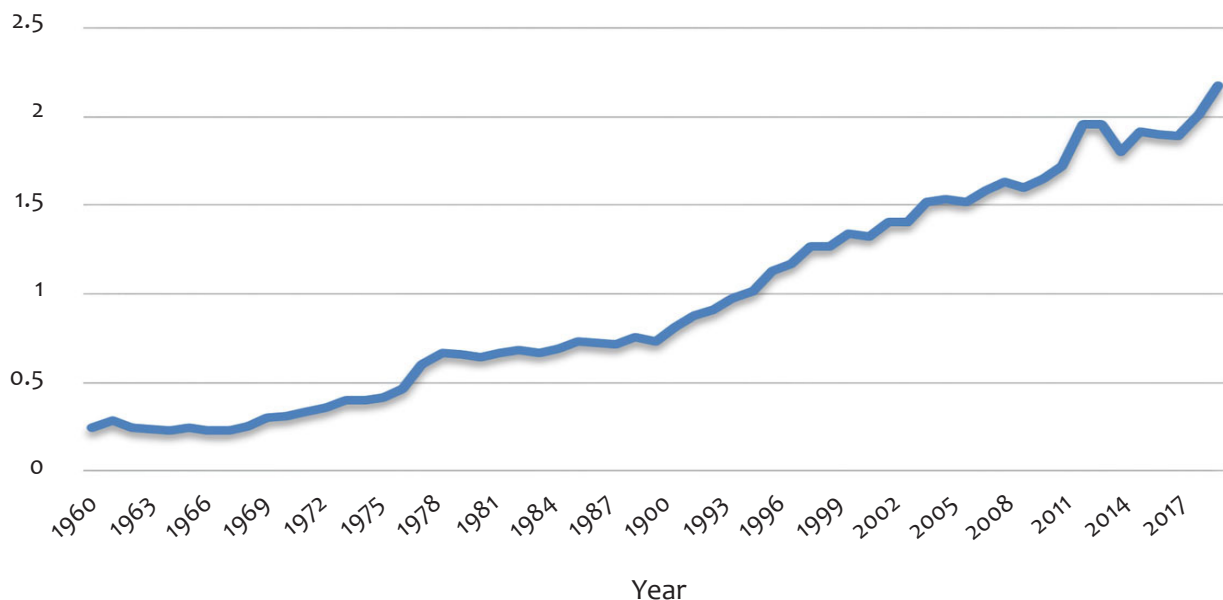
Source: World Development Indicators–data.worldbank.org

Figure 1 CO2 Emissions Trend in Indonesia
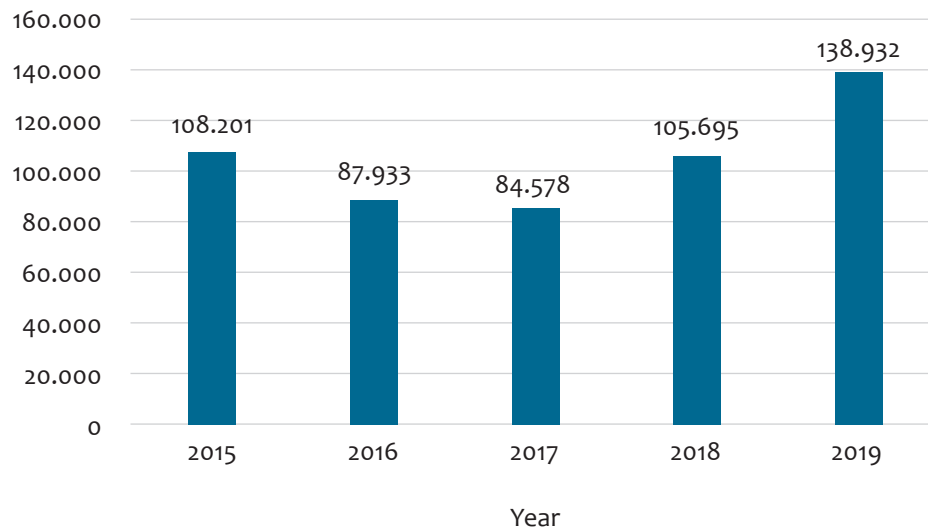
Source: Ministry of Environment and Forestry (2021)

Figure 2 Carbon Emissions in Indonesia's Manufacturing Sector

This study focuses on manufacturing companies because manufacturing companies are one of the sectors that produce the most carbon emissions in Indonesia, and the operating activities of manufacturing companies have a direct and more significant impact on the surrounding environment (Ministry of Environment and Forestry, 2021).

The importance of carbon emissions disclosure has prompted many researchers to study the factors that influence carbon emission disclosure. Several factors used in previous research are company size, profitability, leverage, and environmental performance (Abdullah et al., 2020). On the other hand, Darlis et al. (2020) used the variables of media exposure, growth, the reputation of the Public Accounting Firm, institutional ownership, and managerial ownership. Meanwhile, Ulfa & Ermaya (2019) used media exposure, environmental performance, and industry-type variables. Then, Amaliyah & Solikhah (2019) used the variables of environmental performance, managerial ownership, institutional ownership, independent commissioner, board of directors, audit committee, age of the board of directors, and education level of the commissioner. Also, Kılıç & Kuzey (2019) use board size, board composition, board diversity, and board committee variables.

Based on stakeholder theory, any information issued by the company through various information media aims to demonstrate corporate social responsibility to employees, customers, and other stakeholders (Ulfa & Ermaya, 2019). If the media also actively observes the company's environmental activities, it will be more motivated to disclose information about its environmental activities (Ulfa & Ermaya, 2019; Laksani et al., 2020). Ulfa & Ermaya's (2019) research found a positive relationship between media exposure and carbon emission disclosure. In addition, environmental disclosure can be used to inform stakeholders, especially investors, about a company's environmental performance (Deantari et al., 2019). According to Widianto & Sari (2020), companies with poor environmental performance avoid disclosing carbon emissions to avoid getting negative views from stakeholders, while companies with good environmental performance make voluntary disclosures of carbon emissions as a competitive strategy for companies. Research by Deantari et al. (2019) and Widianto

& Sari (2020) found a positive effect between environmental performance and carbon emission disclosure. However, companies with high leverage ratios prefer to use their funds to pay off debts to creditors rather than disclose carbon emissions (Luo et al., 2013). This is in line with Wiratno & Muaziz (2020), who states that the level of leverage has a negative effect on carbon emission disclosure because large debt and interest payments will limit the company's ability to carry out carbon emission reduction and disclosure strategies. Research by Deantari et al. (2019), Zanra et al. (2020), and Ratmono et al. (2021) found a negative relationship between leverage and carbon emission disclosure. Furthermore, large companies receive more pressure from stakeholders due to their operational activities producing carbon emissions, so companies disclose carbon emissions as evidence of their environmental concerns (Deantari et al., 2019). According to Wiratno & Muaziz (2020), large companies are believed to be more able to provide quality voluntary disclosures and disclose their carbon emissions voluntarily. Research by Deantari et al. (2019) and Nasih et al. (2019) found a positive relationship between company size and carbon emission disclosure.

From the explanation above, this study aims to examine the effect of media exposure, environmental performance, leverage, and company size on carbon emission disclosure in manufacturing sector companies in Indonesia. The value of the study confirms the "inside and outside" drivers that can contribute to changes and improvements in carbon emission disclosure performance. The contribution of this research will be helpful for companies in helping management to determine the determinants that need to be considered in increasing carbon emission disclosure.

METHODS

This research uses data pooling, which combines cross-section and time-series data. Data collection uses historical data by collecting data through the websites of each company or the IDX official website (www.idx.co.id) and the official website of the Ministry of Environment (www.menlhk.go.id). The population in this study were manufacturing companies listed on the Indonesia Stock Exchange (IDX) from 2016 to 2020. The research sample was determined using a non-probability method, namely purposive sampling. Based on purposive sampling, this study uses 117 total observational data from 34 manufacturing companies listed on the IDX.

Carbon emission disclosure is a disclosure that assesses the results of a company's carbon emissions and strategies to reduce them (Ulfa & Ermaya, 2019). In this study, carbon emission disclosure was measured using the index developed by Choi et al. (2013), a checklist based on an information request sheet provided by the Carbon Disclosure Project (CDP). Carbon emission disclosure in the CDP is divided into five main factors: climate change, calculating GHG emissions, calculating energy consumption, GHG costs and reductions, and accountability for carbon emissions.

Media Exposure is the disclosure of the good value of the company through the disclosure of carbon emissions activities using corporate media (Darlis et al., 2020). According to Laksani et al. (2020), media exposure measurement utilizes a dummy variable. Number 1 is given to companies that disclose information about carbon emissions through the company's media and published by external parties. Meanwhile, the number 0 is given to companies disclosing information about carbon emissions through the company's media but has yet to be published by external parties.

Environmental performance is a voluntary mechanism or action a company takes that integrates environmental concerns and concerns into business operations (Widianto & Sari, 2020). According to Tjoa & Widianingsih (2022), Gunardi et al. (2021), and Ulfa & Ermaya (2019), environmental performance measurement

uses the level of the Company Performance Rating Program in Environmental Management (PROPER). PROPER Secretariat Ministry of Environment and Forestry (2019) did not explicitly mention that Carbon Emission Disclosure is the assessment criteria of PROPER. The PROPER itself is divided into five ranks based on the color shown in the Table 2.

Table 2 PROPER Colour's Rank

Colour's Rank	Description
Gold	Very good at managing the environment
Green	Good at managing the environment
Blue	Sufficient at managing the environment
Red	Bad at managing the environment
Black	Very bad at managing the environment

Source: Ministry of Environment and Forestry (2019)

Leverage is the number of liabilities the company uses to purchase and finance company assets. These include short-term and long-term liabilities (Wiratno & Muaziz, 2020). According to Deantari et al. (2020), the leverage measurement is as follows.

$$\text{Debt to Equity Ratio} = \frac{\text{Total Liability}}{\text{Total Equity}}$$

Company size determines how big or small a company is (Wiratno & Muaziz, 2020). According to Widianto & Sari (2020), the measurement of company size is as follows.

$$\text{Company Size} = \text{Natural Logarithm of Total Assets}$$

Descriptive statistics were used in this study to see the maximum value, minimum value, average value, and standard deviation of the data that has been collected. Data analysis used pooled least squares. Hypothesis testing using adjusted R square, F test, and t-test. The analytical model used in this research was tested using pooled least squares, which is as follows:

$$CED_{it} = \alpha + \beta_1 MED + \beta_2 PROPER + \beta_3 LEV + \beta_4 SIZE + \varepsilon_{it}$$

Note:

α is the model's intercept, β is the value of the regression coefficient of each variable, MED is media exposure, PROPER is environmental performance, LEV is leverage, SIZE is firm size, and ε is the standard error.

RESULTS AND DISCUSSION

Table 3 shows that, on average, only 13.7% of manufacturing companies that produce and disclose their carbon emissions are covered by online media; in other words, online media in Indonesia still needs to be improved in disclosing the carbon emissions of manufacturing companies. Also, on average, the environmental performance

of manufacturing companies in Indonesia gets a blue rating from the Ministry of Environment and Forestry; in other words, manufacturing companies in Indonesia have made environmental management efforts in accordance with applicable laws and regulations. However, manufacturing companies in Indonesia still use debt or loans of as much as 108.9% to fund their operational activities. Even so, the average size of a firm in this study can be classified as a big/large company, which means companies can use their resources/funds to stimulate and run their operational activities. The table below also shows that manufacturing companies in Indonesia only voluntarily disclose carbon emissions by 22.5% of the 18 checklist items.

Table 3 Descriptive Statistical Results

Variables	N	Minimum	Maximum	Mean	Standard Deviation
Media Exposure	117	.000	1.000	.138	.345
Environmental Performance	117	2.000	5.000	3.154	.448
Leverage	117	−1.872	8.232	1.089	1.116
Company Size	117	27.105	32.478	29.971	1.420
Carbon Emission Disclosure	117	.056	.667	.225	.199

Based on Table 4, the data in this study have met the classical assumption test, namely the normality test, multicollinearity test, and heteroscedasticity test.

Table 4 Classic Assumption Test

Description	Statistical Value	Result
Normality Test	,221	Passed
Multicollinearity Test	All tolerance values > 0,1	Passed
	All VIF value < 10	
Heteroskedasticity Test	All sig value > 0.05	Passed

Based on Table 5, the pooled least square equation is obtained as follows:

$$CED_{it} = -1.249 + 0{,}104\,MED + 0{,}181\,PROPER - 0{,}032\,LEV + 0{,}031\,SIZE + \varepsilon_{it}$$

A constant value of −1.249 means that if the values of media exposure, performance environment, leverage, and company size are 0, then the carbon emission disclosure value is −1.249. The coefficient of media exposure is 0.104, environmental performance is 0.181, and company size is 0.031. Those numbers indicate a positive direction between the media exposure variables, environmental performance, and company size on carbon emissions disclosure. Meanwhile, leverage has a coefficient value of −0.032, indicating a negative direction of leverage on carbon emissions disclosure.

Based on Table 6, the value of adjusted R^2 is 0.347. This number indicates that the variable of carbon emission disclosure can be explained by 34.7% using the variable of media exposure, environmental performance, leverage, and company size. While other variables outside the research model explain the remaining 65.3%.

Table 5 Pooled Least Square

Description	B
Constant	−1,249
Media Exposure	0,104
Environmental Performance	0,181
Leverage	−0,32
Company Size	0,031

Table 6 Adjusted R Square and F Test Results

Description	R Square	Adjusted R Square	Std. The error in the Estimate	F Statistics	Significance
Carbon Emission Disclosure	0,369	0,347	0,161	16,378	0,000

Based on Table 6, the value of F statistics is 16.378, and the significance value is 0.000. The F statistics value is 10.207 > F table 2.45, and a significance value of 0.000 < 0.05 means the research model is feasible.

The t-test results in Table 7 show that the media exposure variable has a regression coefficient of 0.104 with a significance level of 0.030. This means that the media exposure variable positively affects carbon emissions disclosure. The environmental performance variable has a regression coefficient 0.181 with a significance level of 0.000. This means that the environmental performance variable has a positive effect on carbon emissions disclosure. The leverage variable has a regression coefficient -0.032 with a significance level of 0.023. This means that the leverage variable has a negative effect on carbon emissions disclosure. The firm size variable has a regression coefficient of 0.031 with a significance level of 0.005. This means that the company size variable has a positive effect on carbon emissions disclosure.

Table 7 T-test results

Variables	B	Significance	Hypothesis Results
Media Exposure	0,104	0,030	Accepted
Environmental Performance	0,181	0,000	Accepted
Leverage	-0,032	0,023	Accepted
Company Size	0,031	0,005	Accepted

The results of testing hypothesis 1 state that media exposure has a positive effect on carbon emissions disclosure, so H1 in this study is accepted. This means that the more online media covering the company's carbon emissions disclosure, the company's disclosure will increase. The results of this study are in accordance with the research of Darlis et al. (2020), which states that media exposure has a positive effect on carbon emissions.

In this study, media exposure positively affects carbon emissions because the more online media that covers the company, the company will increase its carbon emission disclosure with the aim of good company performance, especially on environmental aspects (Laksani et al., 2020). Media coverage can enhance the

quality of carbon information disclosure (Li et al., 2017). By regularly publishing carbon-related news through the media before its carbon disclosure, a corporation can reduce the market's negative reactions to its report (Lee et al., 2015). The media can help spread knowledge, which will significantly impact carbon dioxide mitigation. Furthermore, the results of this study are also consistent with the stakeholder theory that companies disclose their carbon emissions to demonstrate social responsibility to employees, customers, and other stakeholders. Media is one way to communicate this commitment to stakeholders to convey information more easily (Ulfa & Ermaya, 2019).

The results of testing hypothesis 2 state that environmental performance has a positive effect on carbon emissions disclosure, so H2 in this study is accepted. The higher the environmental performance, the higher the company's carbon emissions disclosure. The results of this study are in accordance with the research of Deantari et al. (2019) and Widianto & Sari (2020), which state that environmental performance has a positive effect on carbon emission disclosure.

In this study, environmental performance has a positive effect on carbon emission disclosure because companies with higher environmental performance will be more motivated to voluntarily disclose carbon emissions to get a positive view from stakeholders (Lee & Cho, 2021; Ratmono et al., 2021 and Widianto & Sari, 2020). Furthermore, the results of this study are also consistent with the stakeholder theory that companies with high environmental performance will disclose their carbon emissions to inform stakeholders about the company's environmental performance (Deantari et al., 2019).

The results of testing hypothesis 3 state that leverage has a negative effect on carbon emissions disclosure, so H3 in this study is accepted. This means that the higher the company's leverage, the lower the company's carbon emission disclosures and vice versa. The results of this study are in accordance with the research of Zanra et al. (2020), which states that leverage has a negative effect on carbon emission disclosure.

In this study, leverage has a negative effect on carbon emission disclosure because a high level of leverage will limit the company's financial ability to disclose carbon emissions, so companies tend to be careful in taking actions that can increase costs, such as disclosing carbon emissions (Zanra et al., 2020). Furthermore, the results of this study are also consistent with the stakeholder theory that companies with high leverage prefer to pay off their debts to creditors rather than disclose carbon emissions (Luo et al., 2013).

The results of testing hypothesis 4 state that company size positively affects carbon emissions disclosure, so H4 in this study is accepted. The greater the company's total assets, the more carbon emission disclosure will increase, and vice versa. The results of this study are in accordance with the research of Deantari et al. (2019) and Nasih et al. (2019), which states that company size has a positive effect on carbon emission disclosure.

In this study, the company's size has a positive effect on carbon emission disclosure because a large company indicates that the company has more adequate resources compared to smaller companies so that large companies can disclose their carbon emissions voluntarily (Wiratno & Muaziz, 2010). Furthermore, the results of this study are also consistent with stakeholder theory, that a larger company's operational activities will be more visible to the public, government, and other stakeholders so that companies get pressure from stakeholders to disclose carbon emissions in an objective and high-quality way as their concern for the environment (Deantari et al., 2019).

CONCLUSION

Based on the results of this research, this study provides conclusions that media exposure, environmental performance, leverage, and company size affect the carbon emissions disclosure of manufacturing companies

in Indonesia. Moreover, media exposure, environmental performance, and company size positively affect carbon emission disclosure. Meanwhile, leverage has a negative effect on carbon emission disclosure. Based on the previous explanation, the results of this study contribute to increasing insight and knowledge, especially in carbon accounting, regarding the variables that affect carbon emission disclosure in manufacturing companies in Indonesia. However, researchers had to discard many research samples in this study because many manufacturing companies did not have a PROPER rating and did not disclose at least 1 item of carbon emission disclosure. Then, based on the researcher's findings, information regarding the disclosure of carbon emissions is presented comprehensively in the sustainability report rather than the annual report. Even so, many companies do not publish sustainability reports, resulting in the average value of carbon emission disclosures in manufacturing companies in Indonesia at only 22.5%.

ORCID

Luky Patricia Widianingsih ⓘ https://orcid.org/0000-0002-2777-6832

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