

The Role of CEO Characteristics in Enhancing Carbon Emission Disclosure: Evidence from Indonesia

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Abstract

This study aims to investigate the influence of CEO characteristics, namely gender, age, and education level, on the disclosure of carbon emissions in manufacturing companies listed on the Indonesia Stock Exchange. Data analysis was conducted through three main stages: classical assumption testing, descriptive statistics, and application of multiple linear regression. This data testing utilized the STATA 14.0 statistical tool to evaluate the influence of CEO characteristics on carbon emissions disclosure. This study's results show that female CEOs, older CEO age, and higher CEO education levels significantly increase corporate carbon emissions disclosure. Female CEOs tend to be more concerned about environmental welfare, while older and highly educated CEOs are more understanding and committed to transparency and corporate social responsibility. This study provides practical implications for companies considering executive characteristics to improve their social performance. In addition, the results also emphasize the importance of gender diversity and investment in education to improve carbon emissions disclosure practices.

Keywords: Carbon Emissions Disclosure; CEO Age; CEO Education; CEO Characteristics; Female CEO

INTRODUCTION

Greenhouse gas emissions are a major cause of global climate change, and companies that contribute to carbon emissions face legal and social pressure to address this issue (Hossain et al., 2023). One way to monitor corporate accountability for this issue is by disclosing carbon emissions. Therefore, disclosure of carbon emissions is essential to current business practices. Previous literature shows that companies do not necessarily walk the talk regarding responsibly managing the natural environment (Kim & Yoon, 2021; Raghunandan & Rajgopal, 2023; Shapira & Zingales, 2017).

The complexity of doing business with environmental concerns to meet stakeholder expectations is costly and impacts the company's financial performance (Chapple et al., 2013). The complexity of the problems arising from climate change and its associated costs make it difficult for companies to reduce carbon emissions because companies are also required to maintain their growth and financial performance. This complexity certainly involves many aspects, such as the risk of declining financial performance and corporate reputation.

On the one hand, reducing carbon emissions frequently necessitates significant expenditures in green technologies, supply chain adjustments, and business process reorganization, all of which can have a negative impact on a company's financial performance. This hypothesis may explain why many firms throughout the world are unwilling to significantly reduce carbon emissions and instead seek to implement symbolic environmental policies aimed at boosting their social image (Cowan & Deegan, 2011; MacKay & Munro, 2012; Nyberg et al., 2013; Talbot & Boiral, 2015). On the other hand, more and more stakeholders are paying attention to environmentally friendly practices, so reducing carbon emissions can also improve the company's image and increase the company's value in the long run. Therefore, companies need to report their environmental responsibilities through carbon emission disclosure as a form of transparency and to provide positive signals to stakeholders; thus, it is important for both companies and stakeholders. Implementing carbon emission disclosure is a follow-up to Law No. 17 of 2004 on the Ratification of the Kyoto Protocol to The United Nations Framework Convention on Climate Change (Kyoto Protocol to The United Nations Framework Convention on Climate Change).

Previous research indicates that company carbon emission policies are influenced by organizational structure, board composition, listing status, financial restrictions, and stakeholder pressure (Akey & Appel, 2021; Bartram et al., 2018; Goetz, 2019; Naaraayanan et al., 2021; Shive & Forster, 2020). In addition, the role of the CEO in corporate decision-making, including carbon emissions disclosure, is seen as critical (Hossain et al., 2023). CEOs play an important role in most corporate decisions, including decisions related to greenhouse gas emissions (Cassell et al., 2012). However, there is little empirical evidence on the role of CEOs in corporate carbon emissions disclosure. This study investigates how CEO Characteristics (Gender, Age & Education) can influence corporate carbon emissions disclosure.

Ernst and Young (2010) performed a survey-based study among 300 executives of significant corporations from 16 different countries, and respondents claimed that the CEO is directly accountable for climate change in their organizations (Hossain et al., 2023). This study focuses on CEO Characteristics (Gender, Age, Education) because it is motivated by the argument that Female CEOs are seen as more concerned about the environment, and older and highly educated CEOs are more pro-social and environmental issues. Recent research reveals that female directors have a good impact on corporate sustainability and social responsibility, play an essential role in ethically managing sustainable company activities, and stimulate the implementation of ethical standards (Gulzar et al., 2019; Muhammad Nadeem et al., 2020; Muhammd Nadeem et al., 2017). Younger CEOs may be less willing to make long-term investments such as CSR, whose

results will only be visible in the future (Fabrizi et al., 2014). Meanwhile, older CEOs are considered more ethical and conservative and tend to reduce conflicts between personal and corporate interests (Mudrack, 1989; Peterson et al., 2001; Sundaram & Yermack, 2007). Educated individuals tend to realize the importance of openness in social and environmental activities and have higher environmental awareness. They are more likely to implement green management for the company's sustainable development (Amore et al., 2019).

Our study contributes to literature in a variety of ways. First, our research contributes to the scant evidence of executive influence on voluntary reporting habits in underdeveloped countries (Daily & Dalton, 2003; Ting et al., 2015; Zhang et al., 2013). Third, it contributes to the literature of developing nations, particularly Indonesia, by delving into the more specific topic of Carbon Emissions Disclosure (Huang & Lien, 2012; Malik et al., 2020). In addition, our findings are consistent with existing research and pertinent theory.

LITERATURE REVIEW

Upper Echelon Theory (UET)

The Upper Echelon Theory (UET), a popular theory in behavioral literature such as psychology and finance, is appropriate for evaluating individual beliefs, attitudes, and behaviors (Hambrick & Mason, 1984). According to this idea, specific observable personal characteristics might restrict or stimulate the decision-making process, including the decision to report carbon emissions. Nielsen & Nielsen (2011) state that the more complicated a strategic decision is, the more vital it is to consider the decision-maker's attributes. He goes on to explain that managers' education, tenure, gender, and age are all characteristics that influence company strategy and structure, resulting in strategic decisions and corporate performance.

Female CEOs and Carbon Emissions Disclosure

The Upper Echelon Theory (UET) perspective discusses top-level management's values, beliefs, and mindsets that can influence corporate decisions (Hambrick & Mason, 1984). UET shows that the company's top management plays an important role because it influences the choices and decisions made by the company. UET regards gender as an essential construct to explore in the context of corporate social performance (Vintila & Gherghina, 2012).

Gender plays an important role in choosing the right strategic choices (Barako et al., 2006; Malik et al., 2020). Some researchers argue that female directors are more sensitive in fulfilling stakeholder desires, thus making other boards also aware of disclosure (Daily & Dalton, 2003; Zhang et al., 2013). Krüger, (2009) states that companies with female boards tend to pay more attention to employee welfare and the environment. It suggests that diversity in corporate boards with altruistic preferences will result in more pro-social corporate behavior. According to Braun, (2010) women are more

environmentally conscious and committed to green entrepreneurial programs than males. According to Liao et al., (2015) the proportion of female directors has a favorable relationship with greenhouse gas emissions disclosure. Muhammad Nadeem et al., (2017) found that gender diversity improves CSR disclosure in Australian enterprises. These results provide a clear picture of how the presence of women in managerial ranks can influence organizational decisions and outcomes. Given the above arguments, we hypothesize the following hypotheses:

H1: Female CEOs have a significant positive impact on Carbon Emissions Disclosure.

CEO Education and Carbon Emissions Disclosure

The quality of top management education plays an important role in determining a company's disclosure policy. Upper Echelon Theory states that CEOs' professional knowledge is expected to have an influence on their personal understanding and analytical skills (Hambrick & Mason, 1984). A person's educational background is often used as a basis for thinking and acting, including moral and ethical approaches (Manner, 2010). Based on this theoretical foundation, highly educated CEOs are more innovative and voluntarily accept challenges (Jensen & Zajac, 2004; King et al., 2016). Highly educated CEOs are proven to be better decision-makers with better knowledge and open-mindedness (Hambrick & Mason, 1984; Herrmann & Datta, 2002). This aligns with previous research, which found that educated individuals realize the importance of openness in social and environmental activities. They also have higher environmental awareness and implement green management for the company's sustainable development (Amore et al., 2019). Therefore, this study believes that the CEO's higher level of education will significantly impact the company's environmental performance, including the disclosure of carbon emissions. This is done as a form of responsibility and transparency to stakeholders. Therefore, the second hypothesis proposed is as follows:

H2: CEO education positively affects Carbon Emissions Disclosure.

CEO Age and Carbon Emission Disclosure

According to the Upper Echelon Theory, top management qualities impact firm policies. Recent accounting and psychology literature has focused on more specific variables that indicate a positive association between age and individual behavior. Previous research discovered that elder executives possess higher experience and expertise than younger executives (Farh et al., 1998). Waldman et al., (2006) discovered that CEO intellectual stimulation greatly influences CSR implementation tactics. Both monetary and non-monetary incentives can influence individuals.

Young CEOs are still hesitant to make long-term investments and prefer to focus on short-term performance due to reputation and career path concerns (Yuan et al., 2019). Young CEOs tend to focus on short-term performance improvements that the market can immediately recognize and utilize to evaluate their success positively. As a result, people may need more time to be ready to make long-term investments, such as focusing on CSR that only yields positive observable future results (Fabrizi et al., 2014). Furthermore, the older the CEO, the smaller the conflict between personal and company interests. Older CEOs are regarded as more ethical and conservative than younger ones (Mudrack, 1989;

Peterson et al., 2001; Sundaram & Yermack, 2007). These findings paint a clear picture of how the age of persons in leadership positions influences organizational decisions and outcomes. Given the arguments presented above, we propose the following hypothesis:

H3: CEO age has a positive effect on Carbon Emissions Disclosure

METHODOLOGY

This study uses secondary data from the company's financial statements from the Indonesia Stock Exchange and company websites. The population in this study are manufacturing companies listed on the Indonesia Stock Exchange (IDX) from 2016 to 2020. This study uses a purposive sampling technique to determine sample selection. The sample selection criteria that our research uses are as follows:

- (1) Companies listed on the Indonesia Stock Exchange (IDX) during the 2016-2020.
- (2) Manufacturing sector companies listed on the Indonesia Stock Exchange (IDX) in the 2016-2020 period.
- (3) The company has complete data

The operational definitions of the variables in this study are explained in the following table.

Table 1. Operational definition of variables

Variable	Measurement	References	Data Source
<i>Dependent Variable</i>			
Carbon Emission Disclosure (CED)	The carbon emission disclosure score obtained is based on 18 disclosure items developed by Choi 2013	Choi et al., 2013	<i>Annual Report</i>
<i>Independent Variable</i>			
Female CEO	“1” IF CEO of the firm is female otherwise “0”	Fabrício et al., 2022; Malik et al., 2020	<i>Annual Report</i>
CEO Age	CEO age in years	Fan et al., 2023; Malik et al., 2020	<i>Annual Report</i>
CEO Education	Dummy variable “1” represents CEO with postgraduate education otherwise 0	Darmadi, 2013; Saidu, 2019; Ujunwa, 2012	<i>Annual Report, Website</i>
<i>Control Variable</i>			
Size	Natural log of total assets	Malik et al., 2020	<i>Annual Report</i>
Leverage	Total liabilities scaled by total assets	Fan et al., 2023	<i>Annual Report</i>
ROA	Return on Asset	Saidu, 2019	<i>Annual Report</i>

Source: Data Processed

In this study, data analysis was conducted through three main stages: classical assumption testing, descriptive statistics, and the application of multiple linear regression. This data testing utilizes the STATA 14.0 statistical tool to evaluate the influence of female CEOs, CEO education, and CEO age on carbon emissions disclosure. The following is the regression model equation used in this study.

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \epsilon \quad (1)$$

where Y represents the dependent variable in this study, carbon emission disclosure, and indicates the extent of disclosure (Choi et al., 2013). Furthermore, X_1 , X_2 , and X_3 in the equation represent CEO Characteristics, which act as our independent variables, namely Gender, Age, and Education (Darmadi, 2013; Malik et al., 2020; Saidu, 2019; Ujunwa, 2012). Finally, X_4 , X_5 , X_6 , and X_7 in the equation represent the control variables in this study, namely the Size of the Company, Leverage, Return on Asset, and Institutional Ownership (Fan et al., 2023; Malik et al., 2020; Saidu, 2019; Zhou et al., 2024).

RESULTS AND DISCUSSION

This study uses secondary data obtained from annual reports during the time from 2016 to 2020. This data was obtained through various sources including the official website www.idx.co.id as well as the official websites of each company. This study obtained a total of 275 observations. The approach used in sampling is a purposive sampling method which involves determining predetermined criteria. The determination of the criteria eventually resulted in the number of samples studied

Table 2. Sample Selection Results

No	Description	Total
1	Companies listed on the Indonesia Stock Exchange (IDX) during the 2016-2020	3550
2	Manufacturing sector companies listed on the Indonesia Stock Exchange (IDX) in the 2016-2020 period	1045
3	The company has complete data	315
4	Number of firm-year observations after subtracting outlier data	275

Source: Data Processed

Table 3. Results of Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CED	275	0.121	0.024	0.044	0.176
FEMALECEO	275	0.073	0.26	0	1
CEOAGE	275	58.262	9.571	35	81
CEOEDU	275	0.225	0.419	0	1

SIZE	275	23.872	5.312	12.41	30.58
LEVERAGE	275	0.424	0.289	0.02	2.9
ROA	275	0.062	0.198	-2.64	0.921
INST	275	0.454	0.262	0	0.997

Source: Output Stata 14.0

Table 3 shows descriptive statistics on the variables of this study which include independent variables, dependent variables and control variables. The average value for the dependent variable Carbon Emissions Disclosure (CED) is 0.121 or 12.1%. This shows that the manufacturing companies sampled in this study have a relatively low level of disclosure of carbon emissions.

Furthermore, the independent variable in this study Female CEO (FEMALECEO) in this study shows that the majority of companies are led by Male CEOs (>85%) based on the sample of this study. The CEO age variable (CEO AGE) in this study shows that the average company is led by a CEO aged 58 years. The Female CEO Education variable (CEO EDU) in this study reveals that CEOs lead the organizations selected with an undergraduate education level (69%), an S2 / S3 education level (22%), and the rest with a high school/comparable education level (9%).

Table 4. Normality Test Results

Jarque Bera	Prob.	Description
1,302	0,5215	Normal

Source: Output Stata 14.0

The normality test determines whether the residual data follows a normal distribution. For the normality assumption to be met, the probability value (p-value) must exceed the significance level set by the researcher (Fuadi et al., 2024; Sholihin & Anggraini, 2021). The test results show that the residual data in this research model is normally distributed, as indicated by the Jarque-Bera value of 1.302 ($p > 0.05$). Therefore, the residual data in this study are normally distributed.

Table 5. Heteroscedasticity Test Results

Breusch-Pagan	Model
Prob > Chi2	0,8402
Description	There is no Heteroscedasticity problem

Source: Output Stata 14.0

The assumption of homoscedasticity requires that the residuals of the regression analysis have constant variance (Sholihin & Anggraini, 2021). The Breusch-Pagan test method is used to test this. The test results show no heteroscedasticity, as indicated by the *Prob > Chi 2* value, greater than the significance value of 0.05.

Table 6. Multicollinearity Test Results

	VIF	1/VIF
LEVERAGE	1.376	.727
ROA	1.337	.748
CEOEDU	1.275	.785
CEOAGE	1.243	.804
INST	1.179	.848
SIZE	1.166	.857
FEMALECEO	1.106	.904
Mean VIF	1.24	.

Source: Output Stata 14.0

The multicollinearity test is carried out to ensure that the data is free from multicollinearity problems that can occur when there is a strong correlation between the independent variables in the regression model to be tested (Sholihin & Anggraini, 2021). This problem can be detected by calculating the variance inflation factor (VIF). If the VIF value exceeds 10, it can be concluded that there are indications of multicollinearity problems in each independent variable and as a whole (Sholihin & Anggraini, 2021). The test results show that the two models do not experience multicollinearity problems, as indicated by the VIF value of less than 10 in each independent variable.

Table 7. Autocorrelation Test Results

Breusch-Godfrey LM test for autocorrelation	Model
Prob > F	0,6504
Description	There is no autocorrelation problem

Source: Output Stata 14.0

The classic assumption that needs to be tested next is the autocorrelation test because it ensures that regression residuals in two different periods are not correlated (Fuadi et al., 2024; Sholihin & Anggraini, 2021). Testing is done using the Breusch-Godfrey test. The test results show that the Prob> F value of 0.6504 is greater than 0.05, which means there is no autocorrelation problem in the research model.

Table 8. Regression Analysis Results

Dependent: CED	Coef.	Std. Error	t-value	p-value
FEMALECEO	0.012	0.006	2.03	.044**
CEOAGE	0.000	0.000	1.81	.071*
CEOEDU	0.008	0.004	2.10	.036**
SIZE	0.000	0.000	-0.51	.608
LEVERAGE	0.005	0.006	0.89	.374
ROA	-0.003	0.008	-0.42	.674

INST	0.011	0.006	1.73	.086*
Constant	0.098	0.015	6.73	.000***
Mean dependent var	0.121			
R-squared	0.062			
F-test	2.542			
Akaike crit. (AIC)	-1275.979			

Source: Output Stata 14.0

Table 8 above displays the regression analysis results between Female CEOs, CEO Age and CEO Education on Carbon Emissions Disclosure in manufacturing companies listed on the Indonesia Stock Exchange. The F-test results show that this research model is fit, characterized by an F-test value of 2.54 and a probability of 0.0151, lower than the 5% significance level. The R Square value is 0.0625 or 6.25%, indicating that the independent variables can explain 6.25% of the variability in the dependent variable, while the rest is influenced by other variables not examined.

Table 8 also shows the test results on the three hypotheses proposed and shows that the first hypothesis, Female CEO (FEMALECEO), has a coefficient value of $\beta = 0.1159$ ($p < 0.05$), the second hypothesis, CEO Age (CEOAGE) has a coefficient value of $\beta = 0.0002$ ($p < 0.10$). CEO Education (CEOEDU) has a coefficient value of $\beta = 0.0008$ ($p < 0.05$). That is, the results of this study indicate that Female CEO, CEO Age and CEO Education have a positive and significant effect on Carbon Emissions Disclosure. In addition, the control variable tested, namely Institutional Ownership (INST), has a coefficient value of $\beta = 0.1011$ ($p < 0.10$), indicating a positive and significant effect. Institutional ownership has a positive effect on carbon emission disclosure. Institutional ownership has a positive effect on carbon emission disclosure. This result is consistent with the results of research conducted by (Zhou et al., 2024). Institutional investors pressure company managers to prioritize their long-term policies, care more about the environment, be more ethical, and pay more attention to applicable regulations (Fuadi et al., 2024). Meanwhile, company size, leverage, and ROA do not influence carbon emissions disclosure.

The results of this study provide several important results. First, this study shows that female CEOs positively affect carbon emissions disclosure. The results of this study support Upper Echelon Theory, which states that upper management's values, beliefs, and mindsets can influence corporate decisions (Hambrick & Mason, 1984). UET considers gender as an important construct to study in the context of corporate social performance (Vintila & Gherghina, 2012). This study supports that argument and shows that the presence of female CEOs in the top management team can increase corporate carbon emissions disclosure. In addition, the results of this study are also in line with the findings of previous studies which found that companies with boards that have female members tend to pay more attention to employee welfare and the environment, resulting in more pro-social corporate behaviour (Braun, 2010; Krüger, 2009; Muhammd Nadeem et al., 2017). The results of this study provide empirical evidence that female CEOs are also

positively associated with carbon emissions disclosure and support the argument that female CEOs are more pro-environment.

Second, the results of this study show that CEO age also positively affects carbon emissions disclosure. The results of this study support the argument that individuals who have a better level of education tend to realize the importance of disclosure of social and environmental activities, and the presence of an educated CEO in the company increases the disclosure of corporate carbon emissions. Previous research suggests that highly educated CEOs are better decision-makers with better knowledge and a more open-minded approach (Hambrick & Mason, 1984; Herrmann & Datta, 2002). Someone with a more open mind tends to think about many things, not only focusing on short-term profits but also concerned with the company's long-term interests. Accordingly, caring for the environment and disclosing more information about social and environmental responsibility may require many costs that can reduce the company's profits in the short term. However, broad-minded individuals certainly consider the long-term benefits obtained by the company through the disclosure of carbon emissions. Finally, the results of this study also support the upper-echelon theory, which states that CEOs' professional knowledge is expected to influence their personal understanding and analytical skills.

Third, this study found that CEO age has a significant positive influence on carbon emissions disclosure. This result is consistent with UET, which states that top management characteristics, including age, influence corporate policies. Older CEOs tend to have more experience and knowledge than younger CEOs, allowing them to understand the importance of carbon emissions disclosure as part of corporate social responsibility and its impact on the company's long-term reputation (Farh et al., 1998). In addition, older CEOs may be more involved in complex strategies, including the implementation of better CSR policies (Waldman et al., 2006). Older CEOs are also more likely to focus on long-term investments such as carbon emissions disclosure, whose benefits may not be immediately visible but have a positive impact in the long run, in contrast to younger CEOs who tend to focus on short-term outcomes (Fabrizi et al., 2014; Yuan et al., 2019). Finally, older CEOs tend to be more ethical and conservative in their decision-making and, thus, more proactive in disclosing their companies' carbon emissions (Mudrack, 1989; Peterson et al., 2001; Sundaram & Yermack, 2007). These findings provide evidence that firms with older CEOs may be more committed to environmental transparency and social responsibility, which may enhance their reputation.

CONCLUSION

This study examines CEO characteristics on carbon emission disclosure in manufacturing companies on the Indonesia Stock Exchange. The test results of this study reveal several important findings. First, the presence of a female CEO is proven to influence carbon emissions disclosure positively. This result supports the Upper Echelon Theory, which states that upper management's values, beliefs, and mindset can influence corporate decisions. The presence of a female CEO in the top management team increases the

company's attention to employee welfare and the environment, resulting in more pro-social corporate behaviour. Second, the CEO's education level also positively influences the disclosure of carbon emissions. CEOs with higher education tend to be more open and better understand the importance of transparency in social and environmental activities. They are also more likely to make decisions that consider the company's long-term interests, including the disclosure of carbon emissions that can provide benefits in the long term, even though it may require costs in the short term. Third, CEO age significantly positively influences the disclosure of carbon emissions. Older CEOs tend to have more experience and knowledge, allowing them to better understand the importance of carbon emissions disclosure as part of corporate social responsibility. They are also more likely to focus on long-term investments and have a more ethical and conservative approach to decision-making, which may increase the company's commitment to environmental transparency and social responsibility.

This study has several important implications for companies and the development of literature on this topic. First, the results show that female CEOs can increase carbon emissions disclosure. Therefore, gender diversity in top management teams is important in increasing attention to environmental and social issues. The findings also emphasize the importance of investing in education and professional development for corporate leaders. In addition, the results suggest that firms may benefit from considering age and experience as factors in CEO recruitment. Secondly, the study emphasizes that companies must make carbon emissions disclosure part of their standard policies. CED will increase transparency and strengthen the company's social and environmental responsibility commitment. In addition, companies are advised to adopt sustainable management practices to achieve a balance between short-term profits and long-term interests. Third, this study supports and extends upper echelon theory by showing that top management characteristics, such as gender, education, and age, significantly affect the disclosure of carbon emissions. This study is expected to be useful for further research and serve as a basis for how these factors influence corporate policies.

We fully acknowledge that this study is not free from limitations. Other characteristics, such as cultural and religious background, that could also be influential factors, were not included in this study. In addition, the data is only from one country, which limits its applicability. Our dependent variable is binary, which does not take into account the quality of CED. Future research may consider these factors. Despite these limitations, this study provides valuable insights. This study suggests further empirical research exploring the relationship between other CEO characteristics, such as cultural and religious background or other relevant experiences with carbon emission disclosure practices.

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