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The Role of CEO Characteristics and Ownership Structure in Carbon Emission Disclosure: Evidence from Indonesian Listed Firms

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Abstract

This study examines the effect of CEO characteristics foreign educational CEO and foreign ownership along with CEO Founder and CEO Age on carbon emission disclosure (CED) among firms listed on the Indonesia Stock Exchange from 2020 to 2023. Grounded in Upper Echelons Theory (UET), the study argues that observable attributes of top executives shape their cognitive perspectives and strategic preferences, thereby influencing environmental disclosure decisions. Using panel regression analysis on 1,623 firm-year observations from annual reports, sustainability reports, and ESGI data, the findings show that foreign educational CEO and CEO age have a positive and significant effect on carbon emission disclosure. In contrast, foreign ownership and CEO founder status do not exhibit significant effects in the main OLS models, while CEO founder shows a negative association in the GLS robustness test. These results suggest that individual CEO attributes play a more decisive role in shaping carbon disclosure practices than ownership structure. This study provides important implications for corporate governance, investors, and policymakers by highlighting the importance of executive characteristics in enhancing environmental transparency in emerging markets.

Keywords: Carbon emission disclosure, foreign educational CEO, foreign ownership, CEO founder, CEO age

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INTRODUCTION

In an era where sustainability challenges are one of the major global discussions, companies are increasingly held accountable for their carbon emission and overall environmental impact. Transparently revealing carbon emission has become crucial, not just to meet legal requirements but also to meet the growing demands of investors and customers for environmentally friendly corporate practices Cai, Geng, and Yang (2024). A key component of corporate governance is assessing carbon emission statements, which provide insight into a company's involvement in sustainability and chances for success Bedi and Singh (2024a).

Carbon emission disclosure (CED) in Indonesia has experienced growing attention, yet overall reporting practices remain inconsistent across firms. Many companies still disclose environmental information selectively, with limited quantitative data on emissions or mitigation strategies. Recent studies highlight that firms in emerging markets often exhibit varying levels of disclosure quality due to weak regulatory enforcement and the praedominance of voluntary reporting frameworks sguidelines, the absence of mandatory carbon-specific standards continues to produce heterogeneous reporting outcomes. However, rising global investor pressure, increasing ESG awareness, and Indonesia's national commitments toward emission reduction have begun to drive more comprehensive carbon disclosure practices among publicly listed firms Haigh and Shapiro (2012); Saka and Oshika (2014). Building ons this context, the phenomenon of CED in Indonesian reflects a developing but increasingly significant trend. Although Indonesia is among the countries with substantial carbon emissions due to industrial activities, energy consumption, and land-use change, corporate practices related to CED remain uneven and largely voluntary Nursulistyo and Aryani (2023). Most companies provide only general environmental information without presenting quantitative data on carbon emissions or detailed mitigation strategies. The absence of mandatory regulations specifying standardized carbon reporting requirements has resulted in considerable variation in the quality, depth, and consistency of disclosures across firms Fuadi, Sinatria, and Fadhilah (2025). Nonetheless, Indonesia's growing commitment to energy transition, net zero emission targets, and increasing pressure from global investors regarding ESG transparency have begun to encourage more companies to disclose carbon-related information in a more comprehensive and structured manner Wibowo, Suhendro, and Amelia (2022).

CEO characteristics play a critical role in shaping corporate strategic decisions, including sustainability initiatives and carbon emission disclosure (CED). Observable attributes such as education, experience, age, and leadership status influence how CEOs interpret environmental issues and determine the extent of transparency adopted by their firms. Within this context, the characteristics of a Foreign Educational CEO introduce meaningful variation in sustainability behavior. CEOs who have studied abroad are often exposed to international governance norms, stakeholder accountability, and environmental responsibility Siregar and Khomsiyah (2023). This global academic exposure enhances their understanding of international sustainability standards and strengthens their preference for transparent reporting practices Claudya and Raharja (2023); Fuadi et al. (2025). Firms led by foreign educated CEOs are therefore more inclined to adopt comprehensive CED strategies aligned with global expectations, particularly in emerging economies Bai, Tsang, and Xia (2020); Suherman et al. (2023). In addition, Foreign Ownership serves as an external governance mechanism that reinforces environmental transparency. Foreign investors typically require higher-quality disclosures to reduce information asymmetry and assess managerial performance Hasan, Hussainey, and Aly (2022); Singhania and Bhan (2024), thereby exerting stronger pressure on firms to adopt rigorous carbon reporting practices Muhammad and Aryani (2021); Rokhmawati (2021); Wulan (2022).

The CEO's role becomes even more influential when the leader holds founder status. A CEO Founder generally possesses stronger emotional attachment to the firm, a long-term vision, and a

heightened concern for organizational reputation Alfredo Cristiano (2020); Bai et al. (2020). This unique position often leads to greater personal responsibility for environmental practices, motivating founder-led firms to emphasize transparent CED as part of preserving corporate legitimacy and legacy Suherman et al. (2023). Likewise, age of CEO introduces additional variation in environmental disclosure behavior. Older CEOs may aim to enhance their professional legacy and strengthen the firm's long-term sustainability positioning Batam and Batam (2024); Elsayih, Datt, and Hamid (2021), whereas younger CEOs often prioritize short-term performance metrics over environmental reporting Abdul Majid et al. (2023); Batam and Batam (2024); Shan, Tang, and Zhang (2021). Understanding how age of CEO influences CED is therefore essential for explaining generational differences in corporate transparency, particularly in relation to sustainability priorities Claudya and Raharja (2023).

This study is grounded in Upper Echelons Theory (UET), which posits that organizational outcomes reflect the characteristics and values of top executives (Hambrick & Mason, 1984). From this perspective, CEO attributes such as age, educational background, and founder status shape how environmental issues are interpreted and prioritized within firms. Accordingly, differences in carbon emission disclosure practices can be understood as reflections of executives' cognitive frames and strategic orientations rather than purely firm-level responses to external pressure.

Research on CED remains urgent due to the limited understanding of what drives firms in emerging economies to disclose climate-related information. Much of the recent literature continues to focus on firm size, profitability, industry sensitivity, or external regulatory pressure as determinants of disclosure Haigh and Shapiro (2012); Siregar and Khomsiyah (2023). However, the influence of leadership characteristics such as CEO Age, CEO Founder, and Foreign Educational CEO along with ownership structures such as Foreign Ownership, has not been sufficiently explored. Studies that incorporate these CEO level attributes and ownership dimensions as predictors of carbon emission disclosure remain scarce, leaving a significant empirical and conceptual gap in literature. Since executive attributes play a critical role in shaping firms' sustainability decisions, examining these variables is essential for generating deeper insights into carbon reporting behavior Batam and Batam (2024); Wagner and Fischer-Kreer (2024). Addressing these gaps is necessary to strengthen theoretical understanding and provide evidence-based implications for corporate governance and sustainability practices in emerging markets.

This study aims to fill the existing gap by examining how CEO Age, CEO Founder, Foreign Ownership, and Foreign Educational CEO determine a company's CED. This study looks for any connections between data from Indonesian-listed companies that could conduct academic discussions and real-world corporate sustainability strategies. In the end, knowing how one of the CEO characteristics effect CED may contribute to stakeholders and support ethical standards in business while knowing if foreign educational CEO, foreign ownership, CEO founder and CEO age might influence the assessment in company's carbon emission disclosure in Indonesia's expanding economy. The author raises the topic foreign educational CEO, foreign ownership, CEO founder, and CEO age in determining carbon emission disclosure

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

1. Upper Echelons Theory (UET)

Upper Echelons Theory (UET), originally introduced by Hambrick and Mason (1984), posits that organizational outcomes are a direct reflection of the cognitive base, values, and observable characteristics of top executives. The theory emphasizes that leaders shape firm strategies based on how they interpret information, perceive risks, and define organizational priorities. Recent scholarship reinforces that executives' demographic and experiential traits function as proxies for

deeper psychological constructs that drive strategic choices, particularly in complex domains such as sustainability reporting Silva and Lunkes (2017).

Under UET, decision-making is understood as being filtered through the personal experiences, professional backgrounds, and value systems of top managers rather than occurring in a neutral or purely rational environment. These cognitive filters influence how executives evaluate environmental challenges, long-term risks, and the strategic importance of transparency, especially in emerging sustainability practices such as carbon emission disclosure Cai et al.(2024); Wagner and Fischer-Kreer (2024). As a result, firms' sustainability outcomes are seen not merely as organizational responses to external pressures but as reflections of the leadership's psychological and interpretive processes.

Overall, Upper Echelons Theory provides a robust theoretical lens for understanding why firms exhibit varied sustainability behaviors and disclosure practices. It underscores that heterogeneity in organizational outcomes including the degree of environmental transparency can be traced back to differences in top executives' cognitive frameworks and personal characteristics. This theoretical foundation highlights the central role of managerial interpretation in shaping strategic responses to environmental issues Elsayih et al. (2021); Zhang and Dong (2023).

2. Carbon Emission Disclosure (CED)

This research shows that carbon reports can provide various perspectives for investors to invest in a company and also can enhance the company's performance Haigh and Shapiro (2012). Companies that implement sustainability strategies benefit not only the environment and society but also their long-term financial performance Sailesh and Reddy (2024). This is because they often gain easier access to capital and can reduce operational costs through more efficient resource use Rahim, Safitra, and Putra (2024). Therefore, to achieve optimal sustainability performance, companies should focus on actions that truly add value Hidayat et al. (2022); Kartikasari and Laela (2023); Pham et al. (2021).

CED has emerged as a critical dimension of corporate reporting as climate change increasingly threatens organizational continuity, and Indonesia is no exception. Such disclosures, commonly presented in annual and sustainability reports, provide insights into a firm's environmental accountability and strategic orientation. Accordingly, CED reflects not only external regulatory or stakeholder pressures but also the underlying cognitive frameworks of corporate leaders, reinforcing the notion that environmental transparency is shaped by those at the top of the organizational hierarchy Saka and Oshika (2014); Thams and Rickley (2024).

According to Hardiyansah, Agustini, and Purnamawati (2021) in their research showed that the greater the CED, the greater the companies can improve their operational performance measured by their profitability level. Increasing CED positively impacts financial performance when using the accounting-based measures (ROA) yet negatively impacts on the market-based financial performance measures.

3. Foreign Educational CEO

Foreign Educational CEO reflects the significance of international academic exposure in shaping corporate sustainability practices. CEO who have studied abroad are typically exposed to global governance standards, stricter environmental regulations, and broader stakeholder-oriented perspectives, all of which influence their strategic decision-making when leading firms in emerging economies. Such international education often strengthens their awareness of global sustainability trends and reinforces their commitment to transparency and accountability Siregar and Khomsiyah (2023).

Empirical evidence shows that firms led by foreign-educated CEO tend to adopt more proactive environmental strategies, including higher levels of carbon emission disclosure. Their familiarity with internationally recognized reporting frameworks, such as the Global Reporting Initiative (GRI), encourages more structured and comprehensive disclosure practices that align with global expectations Bai et al. (2020); Elsayih et al. (2021). Foreign-educated CEO may also better understand the reputational advantages and investor-related benefits associated with transparent carbon reporting.

Conversely, CEO without foreign educational backgrounds may rely more heavily on local norms and may not place the same emphasis on carbon disclosure, particularly in environments where such reporting remains voluntary. Overall, the literature consistently indicates that Foreign Educational CEO characteristics have a positive influence on carbon emission disclosure, driven by broader global insight, stronger stakeholder orientation, and greater appreciation for sustainabilitydriven value creation Suherman et al. (2023).

4. Foreign Ownership

Foreign ownership is widely recognized as an important external governance mechanism that can enhance corporate transparency, including environmental disclosure. Foreign shareholders generally require higher-quality information to reduce information asymmetry and to evaluate firms' environmental risks and long-term sustainability prospects. Their expectations are shaped by international reporting standards and global ESG practices, which often motivate firms to adopt more credible and comprehensive carbon emission disclosure Hasan et al. (2022).

Empirical evidence shows that firms with greater foreign ownership tend to disclose more extensive environmental information, as foreign investors exert monitoring pressure on management to align reporting practices with global norms Singhania and Bhan (2024). This influence is particularly relevant in emerging markets, where carbon disclosure regulations are often voluntary or less stringent. In such contexts, foreign shareholders can play a pivotal role in encouraging firms to adopt structured and transparent reporting frameworks.

In contrast, firms with minimal or no foreign ownership face fewer external pressures to meet global disclosure expectations, which may lead to less comprehensive carbon reporting. Overall, the literature indicates that foreign ownership positively influences carbon emission disclosure, driven by stronger oversight, adherence to international standards, and investor preferences for transparent sustainability practices Muhammad and Aryani (2021); Rokhmawati (2021).

5. CEO Founder

CEO Founder refers to a chief executive who also established or co-established the company. This background often shapes the CEO's approach to organizational direction, as founders tend to carry a deeper personal connection to the firm and a strong sense of responsibility for its development Bai et al. (2020); Batam and Batam (2024). A CEO Founder may display distinct decision-making tendencies that stem from their early involvement in building the company, including how they prioritize strategic initiatives and respond to organizational challenges.

In many cases, a CEO Founder is more closely linked to the company's identity and long-term goals, which can influence the level of attention they give to various managerial practices. Their personal investment in the firm's growth and reputation may lead them to be more attentive to areas that reflect the company's performance and public image Abdul Majid et al. (2023); Suherman et al. (2023).

Conversely, a CEO who is not a founder may not share the same depth of personal attachment or historical involvement in the organization. Their strategic focus may differ, shaped more by

professional experience and external career considerations rather than by the company's origins Bai et al. (2020); Hasan et al. (2022).

Overall, the CEO Founder characteristic captures whether the top leader has played a foundational role in the creation of the firm, which can shape their managerial style, commitment, and strategic orientation in ways that differ from non-founder CEO Bai et al. (2020); Raquel and Da (2025).

6. CEO Age

Research on the role of CEO Age highlights that the demographic profile of top executives can influence corporate sustainability decisions. Older CEO are often associated with greater caution, stronger reputation awareness, and a long-term orientation, which can motivate them to support more transparent environmental reporting practices, including carbon emission disclosure (CED) Elsayih et al. (2021). In contrast, younger CEO may prioritize immediate financial outcomes and place less emphasis on voluntary sustainability disclosures that do not provide short-term benefits Abdul Majid et al. (2023).

Empirical evidence shows that firms led by older CEO tend to adopt more proactive environmental and sustainability strategies. These executives may give greater attention to carbon reporting as part of maintaining responsible corporate conduct and meeting stakeholder expectations Shan et al. (2021). Meanwhile, younger CEO may treat carbon-related disclosure as a secondary consideration, resulting in lower levels of environmental reporting in some organizations. Overall, the literature suggests that CEO Age plays an important role in shaping carbon reporting behavior. Older CEO are generally more supportive of comprehensive CED due to their long-term perspective and heightened concern for organizational reputation, whereas younger CEO may focus more heavily on short-term performance metrics and give less priority to voluntary environmental disclosure Baroroh and Harto (2025).

7. The Role of Foreign Educational and CEO Carbon Emission Disclosure

Foreign Educational CEO is closely linked to the level of carbon emission disclosure (CED), as international educational experiences can shape how executives interpret strategic issues, including sustainability. CEO who study abroad are exposed to global governance standards, advanced regulatory environments, and stronger sustainability expectations, which influence how they evaluate environmental responsibilities within their firms. Prior studies indicate that foreigneducated CEO bring broader perspectives and tend to incorporate stakeholder-oriented considerations into decision-making, leading to greater openness toward environmental transparency Bai et al. (2020); Suherman et al. (2023). This suggests a clear relationship in which foreign educational experience encourages a more proactive approach to carbon reporting.

Empirical evidence supports this linkage, showing that CEO with foreign academic backgrounds often emphasize professionalism, individual competence, and internationally accepted governance norms. These perspectives align with increased attention to environmental and social impacts, motivating leaders to adopt more comprehensive disclosure practices Batam and Batam (2024); Thams and Rickley (2024). Firms led by foreign-educated CEO are therefore more likely to disc(lose carbon emissions in a structured and transparent manner to meet the expectations of global investors, regulators, and broader stakeholder groups. Previous research consistently finds that such CEO recognize the strategic value of sustainability practices, including CED, as a means of enhancing competitiveness in international markets Bai et al. (2020).

When viewed through the lens of Upper Echelons Theory (UET), the influence of foreign education becomes clearer. UET assea. Foreign-educated CEO possess distinct cognitive frames shaped by international exposure, which influence how they perceive environmental issues and the

importance of disclosure. These cognitive differences result in a stronger inclination to adopt higherquality sustainability reporting, including carbon emission disclosure. Thus, guided by UET, foreign education can be understood as an experiential attribute that shapes executive judgment and leads to higher levels of CED .

H1: Foreign educational CEO has a positive impact on carbon emission disclosure.

8. The Role of Foreign Ownership and Carbon Emission Disclosure

Foreign investors who care about the environment and more obedient to ecological laws than local investors will give more pressure on the company Hasan et al. (2022). Which means that an increase in the percentage of foreign ownership leads to a reduction in carbon emission growth. The reduction of carbon emissions is related to the tendency of companies to control the environmental effects of production Singhania and Bhan (2024). There is still little research that has not directly discussed the relationship between the composition foreign ownership and their influence on carbon disclosure in Indonesia, which is the main background of this research Wulan (2022). Therefore, we can conclude that foreign Ownership has a positive impact on CED. Because foreign ownership effectively improves CED and the sustainability governance mechanism.

Research on foreign ownership shows that international investors often demand higherquality environmental information to evaluate firms' sustainability performance. Foreign shareholders typically have greater awareness of global environmental standards and tend to exert stronger pressure on firms to improve environmental practices, including carbon emission disclosure Hasan et al. (2022). Empirical findings indicate that companies with higher levels of foreign ownership are more likely to reduce carbon emissions and adopt stricter controls over environmental impacts, reflecting the expectations of international investors who prioritize responsible production practices Singhania and Bhan (2024). Foreign investors' expectations for clearer, more standardized information can encourage companies to strengthen their disclosure mechanisms and improve accountability.

Overall, prior studies suggest that foreign ownership can positively influence carbon emission disclosure, as firms respond to external pressure from international shareholders by enhancing the quality and comprehensiveness of their sustainability reporting Muhammad and Aryani (2021); Rokhmawati (2021).

H2: Foreign ownership has a positive impact on carbon emission disclosure.

9. The Role of CEO Founder and Carbon Emission Disclosure

Research on CEO Founder emphasizes that executives who establish or co-establish a company often display distinct managerial behaviors that influence strategic decisions, including carbon emission disclosure (CED). As founders, these CEO typically possess a deeper personal connection to the organization, a long-term orientation, and a strong sense of responsibility for the company's development. Empirical studies indicate that CEO Founder characteristics can lead to more attentive consideration of environmental issues, as founders may be more aware of how operational activities affect stakeholders and the broader community Abdul Majid et al. (2023); Shen et al. (2020). This heightened awareness can translate into stronger support for carbon disclosure practices.

From the perspective of Upper Echelon Theory (UET), such unique characteristics play a crucial role in shaping strategic outcomes. UET posits that organizational decisions are reflections of executives' personal values, experiences, and cognitive frames Silva and Lunkes (2017). In this context, a founder CEO's entrepreneurial mindset, risk-taking behavior, and strong identification with the firm serve as cognitive lenses influencing strategic policies, including sustainability and transparency initiatives like CED.

At the same time, some studies show that CEO Founder may behave differently when balancing internal and external demands. For example, founder CEO may concentrate more on maintaining control or pursuing internal priorities, which can influence their decisions regarding voluntary disclosure practices, including CED Bai et al. (2020). These findings highlight that CEO Founder characteristics can shape disclosure outcomes in different ways depending on managerial focus and organizational context.

Despite these mixed findings, prior research generally suggests that CEO Founder has the potential to positively affect CED. Their early involvement in building the company and their broad understanding of the firm's long-term direction may lead them to recognize the value of providing transparent carbon information to stakeholders. CEO Founders are often described as more entrepreneurial, visionary, and willing to innovate, which may result in a greater willingness to improve and expand carbon disclosure practices Abdul Majid et al. (2023).

H3: CEO founder has a positive impact on carbon emission disclosure.

10. The Role of CEO Age and Carbon Emission Disclosure

Upper Echelons Theory suggests that older CEO may hold different perspectives on sustainability compared to younger CEO due to differences in experiences, values, and cognitive frames Luo, Wu, and Zhang (2021). These life-long experiences shape how executives interpret environmental issues and influence their willingness to engage in transparent reporting. As noted by Siregar and Khomsiyah (2023), CEO age can affect a leader's dedication to environmental initiatives and the extent to which carbon emissions are disclosed, which in turn may shape shareholder perceptions and overall governance quality. This relationship highlights how CEO characteristics, particularly age, can influence CED and the firm's broader sustainability strategies Singhania and Bhan (2024).

Although many studies support a positive relationship between CEO age and CED, some research shows that the effect is not always consistently positive Chow (2024); Oware and Awunyo Vitor (2021). These mixed findings indicate that while older CEO may be more inclined to engage in sustainability-related decisions, the impact can vary across organizational contexts. Prior work also emphasizes the importance of CEO characteristics in shaping disclosure outcomes, noting that governance mechanisms such as the presence of environmental committees may further strengthen CED practices Bedi and Singh (2024b).

Overall, the literature demonstrates that CEO age plays a meaningful role in carbon reporting behavior. Older CEO tend to possess broader experience, greater risk awareness, and stronger valuedriven perspectives, which may enhance their commitment to sustainability and environmental transparency Chow (2024); Siregar and Khomsiyah (2023). These tendencies support the expectation that CEO age positively influences carbon emission disclosure.

H4: CEO age has a significant positive effect on carbon emission disclosure.

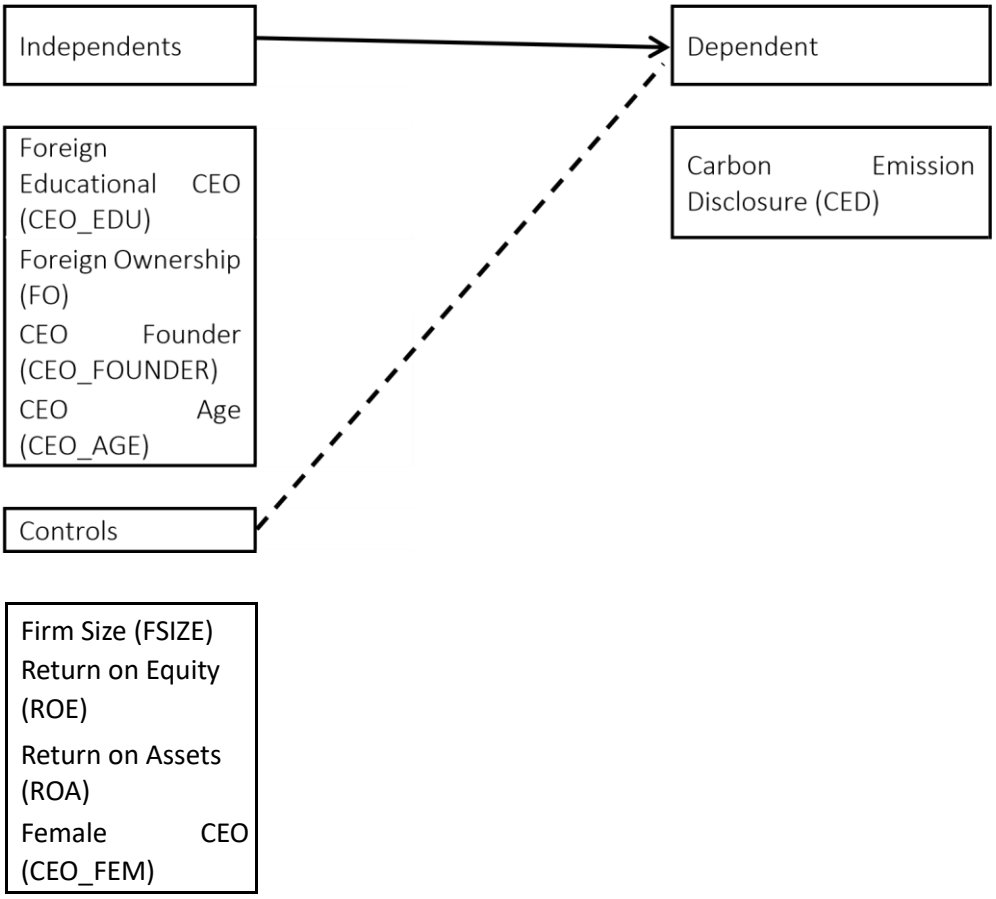

Figure 1. Proposed Research Model

RESEARCH METHOD

Sample and Data

The current work examines the relationship between CED and CEO age, CEO Founder, Foreign Educational CEO, and Foreign Ownership using a sample of 712 Indonesian publicly listed firms from 2020–2023. This period is selected due to increasing regulatory attention and stakeholder pressure on environmental transparency in Indonesia. The study focuses on IDX-listed firms because they face stricter reporting expectations and more consistent disclosure practices. The financial sector is excluded as it operates under distinct regulations and reporting frameworks and does not generate operational emissions comparable to non-financial industries, ensuring greater sample homogeneity and comparability.

Table 1. Sample Selection Criteria

CRITERIA	TOTAL
Indonesian publicly listed companies on the IDX from 2020 to 2023	3148
Missing Data	(1525)
Number of firms used as research objects	712
Total Firm-Year observations	1623

Source: Author

Table 2 shows the sample distribution across eleven industries from 2020 to 2023, totaling 1,623 firm-year observations. The number of observations increased steadily from 111 in 2020 to 712 in 2023, reflecting broader data coverage over time. Consumer Noncyclicals (285), Consumer Cyclicals (250), and Basic Materials (215) dominate the sample, while Technology (69) and Healthcare (82) contribute smaller portions. Overall, the dataset provides a well-diversified industry representation, enhancing the robustness and generalizability of the study's results.

Table 2. Sample Distribution by Industry and Year

SIC	2020	2021	2022	2023	Total
1. Energy	20	47	59	73	199
2. Basic Materials	16	29	79	91	215
3. Industrials	6	11	50	63	130
4. Consumer Noncyclicals	25	34	107	119	285
5. Consumer Cyclicals	6	18	103	123	250
6. Healthcare	9	12	28	33	82
7. Property and Real Estate	8	25	66	75	174
8. Technology	1	5	26	37	69
9. Infrastructure	17	20	49	60	146
10. Transportation and Logistic	3	2	30	38	73
Total	**111**	**203**	**597**	**712**	**1,623**

Source: Created by author with Stata application

2. Model Equation

To examine the relationship between CEO education (CEO_EDU), foreign ownership (FO), CEO founder status (CEO_FOUNDER), and CEO age (CEO_AGE) and CED, we constructed an empirical model, as shown in equation (1) below:

$$CED\_it = \beta 0 + \beta 1\ CEO\_AGE\_it + \beta 2\ CEO\_FOUNDER\_it + \beta 3\ CEO\_EDU\_it + \beta 4\ FO\_it + \beta 5\ FSIZE\_it + \beta 6\ ROA\_it + \beta 7\ ROE\_it + \beta 8\ CEO\_FEM\_it + YEARFE + SICFE + \varepsilon\_it \quad (1)$$

Where:

- CED_{it}= carbon emission disclosure of firm $i$in year t
- CEO_AGE_{it}= CEO age (or natural log thereof)
- $CEO\_FOUNDER_{it}$= dummy variable (1 if CEO is founder)
- CEO_EDU_{it}= dummy (1 if CEO studied abroad/has foreign education)
- FO_{it}= foreign ownership percentage
- $FSIZE_{it}$= firm size (often log of total assets)
- ROA_{it}, ROE_{it}= profitability measures
- CEO_FEM_{it}= female CEO dummy
- $YEARFE$= year fixed effects
- $SICFE$ = SIC fixed effects
- ε_{it}= error term

3. Variable Measurement

Table. 3 Variable Definitions

Variable Name	Measurement	Source
Independent Variable		
Carbon Emission Disclosure (CED)	Carbon emissions disclosed by the company	ESGI
Dependent Variables		
Foreign Educational CEO (CEO_EDU)	Dummy variable equals one if the CEO has foreign education (not in Indonesia) otherwise zero	Annual Report
Foreign Ownership (FO)	The number of shares outstanding held by nonIndonesian divided by total of shares outstanding	Annual Report
CEO Founder (CEO_FOUNDER)	Dummy variable equals one if the CEO is the firm’s founder otherwise zero	Annual Report
CEO Age (CEO_AGE)	Natural logarithm of the CEO age	Annual Report
Control Variables		
Firm Size (FSIZE)	Natural logarithms of total assets	Annual Report
Return on Equity (ROE)	Net income of the company divided with shareholder's equity	Annual Report
Return on Assets (ROA)	Net income of the company is divided with the company’s total assets	Annual Report
Female CEO (CEO_FEM)	Dummy Variable equals one if the CEO is female otherwise zero	Annual Report

Source: Author

Table 3 presents the definitions, measurements, and data sources for all variables used in this study. The independent variable, CED, is measured based on the amount of carbon emissions disclosed by each company, obtained from the ESGI database.

The dependent variables include CEO-related characteristics CEO_AGE, CEO_FOUNDER, and Foreign Educational CEO (CEO_EDU) as well as FO. These variables are derived from annual report disclosures, with CEO_AGE measured as the natural logarithm of the CEO age, and dummy variables applied for founder status and foreign education background. Several control variables are also included to account for firm specific factors, namely FSIZE, ROE, ROA, and Female CEO (CEO_FEM). All control data are extracted from companies' annual reports.

A. Dependent Variable

Carbon Emission Disclosure

Carbon Emission Disclosure refers to the extent, quality, and transparency of information that a company publicly shares about its carbon emissions. The purpose of carbon emission disclosure is to provide stakeholders such as investors, regulators, and the public with insight into the company's environmental impact and its efforts to manage and reduce its carbon emissions.

The measurements that we used are based on *GRI 305: Emissions 2016,* Any disclosures from GRI 305-1 through GRI 305-7 that are relevant to the organization's emissions-related impacts Bedi and Singh (2024a). Here are the measurement variables for Carbon Emission Score adopted from the main author's article:

$$Carbon\ Emission\ Score = Carbon\ Emission\ Disclosure / Carbon\ Emission\ Index$$

B. Independent Variable

CEO Age

CEO Age is defined as the number of years that the Chief Executive Officer (CEO) has lived, typically measured from the date of their birth to the current date or the date of interest (e.g., the date they assumed the CEO role). Taking the logarithm of CEO age is often done to normalize the variable, especially if it is being used in statistical models where a log-transformation can help meet assumptions of linearity or reduce the impact of age outliers.

Here are the measurement variables for CEO Age adopted from the main author's article:

$$Log\ CEO\ Age = log(CEO\ Age)$$

In this model, CEO Age represents the actual age of the chief executive officer, measured in years. Meanwhile, the term *log* denotes the natural logarithm, which is commonly applied in empirical studies to normalize data distribution and reduce potential skewness in variables with large value ranges Chow (2024).

CEO Founder

A CEO Founder refers to a Chief Executive Officer who also serves as the founder or cofounder of the company. This dual role may influence the CEO's leadership style and strategic decision-making, as founders often possess a deeper personal attachment to the organization. In this study, CEO Founder is measured as a binary variable, where a value of 1 indicates that the CEO is the founder of the company, and a value of 0 indicates that the CEO is not the founder Bai et al. (2020).

Foreign Educational CEO

Foreign Educational CEO refers to a chief executive who has pursued higher education at a university or college located outside their home country. For instance, an Indonesian CEO is considered to have foreign education if they completed their studies abroad, such as in the United States, the United Kingdom, or any other foreign country. In this study, the variable is measured using a binary classification, where a value of 1 indicates that the CEO holds at least a foreign

bachelor's degree, while a value of 0 indicates that the CEO's foreign education is below the bachelor's level Bai et al. (2020).

Foreign Ownership

Foreign Ownership refers to the percentage or proportion of a company's shares that are owned by investors, institutions, or entities that are based outside of Indonesia. This calculates the percentage of the company's shares that are owned by foreign investors, indicating the level of foreign investment in the company. Here are the measurement variables for foreign ownership adopted from the main author's article:

$$Foreign\ Ownership = Number\ of\ shares\ held\ by\ non-Indonesians / Total\ number\ of\ shares\ outstanding$$

Foreign ownership refers to the proportion of company shares held by non-Indonesian shareholders. This reflects the extent to which international investors participate in the firm's ownership structure. The measurement is based on the percentage of shares owned by foreign nationals relative to the company's total shares outstanding, which represent the total number of shares issued by the firm Wulan (2022).

C. Control Variable

Firm Size

Firm Size is often calculated as the logarithm of Total Assets. This transformation helps to normalize the data and handle large variations across firms of different sizes, making it especially useful in regression analyses and financial studies.

Here are the measurement variables for firm size adopted from the main author's article:

$$Firm\ Size = log(Total\ Assets)$$

Total assets represent the overall value of all resources owned by the company, including current and non-current assets. In this study, firm size is measured using the natural logarithm of total assets, where the use of *log* helps normalize the data distribution and reduce scale-related variability Hapsoro and Falih (2020).

Return on Assets

ROA is a profitability ratio that measures how efficiently a company uses its assets to generate profit. It shows the percentage of profit a company earns in relation to its overall assets Rahim et al. (2024).

Here are the measurement variables for return on assets adopted from the main author's article:

$$ROA = (Net\ Income\ /\ Total\ Assets) \times 100\%$$

Return on Equity

ROE is a profitability ratio that measures a company's ability to generate net income from its shareholders' equity. It reflects how effectively the company uses the capital invested by its owners to produce profit. A higher ROE indicates stronger financial performance and greater efficiency in utilizing equity to create value for shareholders Rahim et al. (2024).

Here are the measurement variables for ROE adopted from the main author's article:

$$ROE = (Net\ Income\ /\ Shareholders'\ Equity) \times 100\%$$

Female CEO

A female CEO refers to a woman who occupies the role of Chief Executive Officer, bearing responsibility for the strategic direction, overall management, and organizational performance of the company. Although still underrepresented in many sectors, female CEO contribute meaningfully to corporate governance and organizational dynamics Ilmiah, Ludya, and Dewi (2024). In this study, the female CEO variable is measured as a binary indicator, where a value of 1 denotes that the

company is led by a female CEO, and a value of 0 indicates that the CEO is not female Suherman et al. (2023).

RESULTS AND DISCUSSION

Descriptive Statistics

The results show that 35.61% of CEOs in the sample that have foreign educational backgrounds (CEO_EDU = 1), 55.58% are firm founders (CEO_FOUNDER = 1), and 7.39% are female (CEO_FEM = 1), indicating substantial variation in CEO profiles. The natural logarithm of CEO_AGE has a mean of 1.731 (range: 1.462–1.934), reflecting moderate variation in CEO age across firms. The mean value of FO is 0.071, suggesting relatively low foreign ownership among the firms. The average CED score is 2.191, which points to a moderate level of carbon emission disclosure across the sample. As for firm-level variables, FSIZE averages 12.304, while profitability measures ROA and ROE have mean values of 0.027 and 0.126 respectively, reflecting generally positive performance despite dispersion. Collectively, these descriptive results demonstrate heterogeneity in both firm and executive characteristics, providing a robust basis for the subsequent empirical analyses.

Table 4. Statistic Descriptive

	Mean	Median	Minimum	Maximum
FO	0.071	0.000	0.000	0.933
CEO_AGE	1.731	1.740	1.462	1.934
CED	2.191	2.000	0.000	7.000
FSIZE	12.304	12.369	3.458	15.363
ROA	0.027	0.034	-9.498	4.693
ROE	0.126	0.066	-19.472	72.356
Frequency	0		1	
CEO_EDU	64.39%		35.61%	
CEO_FOUNDER	44.42%		55.58%	
CEO_FEM	92.61%		7.39%	

Source: Created by author with Stata application

Pearson Correlation

The Pearson correlation matrix reveals the relationship between the dependent variable (CED) and the key independent variables. The results show that CED is positively and significantly correlated with CEO education (CEO_EDU) ($r = 0.128$, $p < 0.01$), indicating that firms led by CEO with international educational backgrounds tend to disclose carbon information more extensively. CED also demonstrates a positive and significant correlation with foreign ownership (FO) ($r = 0.092$, $p < 0.01$), suggesting that firms with greater foreign investor participation are more inclined toward transparent carbon reporting.

In contrast, CED shows a weak and insignificant negative correlation with CEO founder status (CEO_FOUNDER) ($r = –0.019$), implying that founder-led firms do not necessarily engage in

higher carbon disclosure. Meanwhile, CEO age (CEO_AGE) is positively associated with CED (r = 0.118, p < 0.01), suggesting that older CEO exhibit a greater tendency to support environmental transparency.

Overall, the correlation results indicate that firms with internationally educated CEO, higher levels of foreign ownership, and older leaders are more likely to disclose carbon emissions, while founder-led firms do not show a notable relationship with CED.

Table. 5 Pearson Correlation

	CED	CEO_EDU	FO	CEO_FOUNDER	CEO_AGE	FSIZE	ROA	ROE	FEM
CED	1								
CEO_EDU	0.128***	1							
	0								
FO	0.092***	0.351***	1						
	0	0							
CEO_FOUNDER	-0.019	-0.228***	-0.058**	1					
	-0.442	0	-0.02						
CEO_AGE	0.118***	-0.02	0.01	-0.055**	1				
	0	-0.431	-0.678	-0.027					
FSIZE	0.322***	0.096***	0.106***	0.055**	0.112***	1			
	0	0	0	-0.026	0				
ROA	0.048*	-0.017	0.019	0.071***	0.011	0.128***	1		
	-0.052	-0.506	-0.454	-0.004	-0.658	0			
ROE	-0.012	0.019	0	0.025	0.022	0.024	0.045*	1	
	-0.64	-0.45	-0.986	-0.309	-0.366	-0.344	-0.07		
FEM	0.021	-0.009	-0.005	0.068***	-0.03	-0.026	0.009	0	1
	-0.402	-0.731	-0.854	-0.006	-0.223	-0.304	-0.7	-0.9	

Source: Created by author with Stata application

3. Regression

CEO_EDU shows a consistently positive and statistically significant effect on carbon emission disclosure (CED) across all model specifications (β = 0.382–0.423, p < 0.01). This indicates that firms led by CEOs with foreign educational backgrounds tend to exhibit higher levels of carbon emission disclosure. From the perspective of Upper Echelons Theory (UET), foreign education represents an experiential attribute that broadens executives' cognitive frames and exposes them to international sustainability norms and ESG expectations. Such exposure is likely to shape managerial values and strategic preferences toward greater environmental transparency. This finding is consistent with prior studies suggesting that internationally educated executives are more sensitive to global sustainability standards and reporting practices Wagner and Fischer-Kreer (2024). Foreign ownership (FO) exhibits a positive but statistically insignificant relationship with CED across

all models, with coefficients ranging from 0.115 to 0.330. Although firms with higher levels of foreign shareholding are often expected to face stronger demands for transparency, the empirical results suggest that foreign ownership in the Indonesian context does not exert sufficient pressure to significantly influence voluntary carbon disclosure. Consistent with UET, this finding implies that structural governance mechanisms such as ownership composition play a relatively limited role compared to executive-level characteristics that directly reflect managerial cognition and strategic interpretation of environmental issues.

CEO_FOUNDER displays a negative and statistically insignificant coefficient across all model specifications (β = –0.067; –0.054; –0.087; –0.076), indicating that founder status does not meaningfully affect carbon emission disclosure practices. This result suggests that founder CEOs may not prioritize external environmental reporting, potentially due to a greater focus on internal control, operational efficiency, or long-term strategic discretion. Prior studies similarly argue that founderled firms may emphasize internal decision-making processes rather than voluntary disclosure Cai et al. (2024). Within the UET framework, this finding indicates that founder identity alone does not necessarily constitute a cognitive attribute that drives sustainability-oriented disclosure unless it significantly shapes how environmental issues are perceived and prioritized by the CEO.

Finally, CEO_AGE demonstrates a strong and positive significant effect on CED across all models (β = 1.625–2.267, $p < 0.01$). This suggests that older CEOs are more likely to guide firms toward more extensive carbon emission disclosure. In line with Upper Echelons Theory, age serves as a proxy for accumulated experience, broader judgment, and more developed cognitive perspectives, which influence strategic decision-making, including environmental reporting practices. This result supports prior empirical evidence indicating that older executives tend to be more engaged in sustainability disclosure due to heightened reputational concerns and long-term orientation Elsayih et al. (2021).

Table 6. Regression

	(1) CED	(2) CED	(3) CED	(4) CED
CEO_EDU	0.399***	0.423***	0.382***	0.408***
	-3.5	-3.74	-3.4	-3.65
FO	0.291	0.115	0.33	0.127
	-0.95	-0.37	-1.07	-0.41
CEO_FOUNDER	-0.067	-0.054	-0.087	-0.076
	(-0.66)	(-0.54)	(-0.86)	(-0.76)
CEO_AGE	2.267***	2.177***	1.798***	1.625***
	-3.74	-3.6	-2.93	-2.64
FSIZE	0.639***	0.698***	0.621***	0.684***
	-11.36	-11.76	-11.22	-11.85
ROA	1.919***	1.787***	1.514***	1.287***
	-4.06	-3.73	-3.16	-2.64
ROE	-0.171	-0.116	-0.135	-0.066
	(-0.98)	(-0.66)	(-0.78)	(-0.37)
CEO_FEM	0.269	0.269	0.282	0.282
	-1.43	-1.42	-1.51	-1.52
_cons	-9.807***	-11.190***	-8.636***	-9.943***
	(-8.43)	(-9.17)	(-7.23)	(-8.04)
Year FE	No	Yes	No	Yes
SIC FE	No	No	Yes	Yes
r2	0.139	0.152	0.161	0.179
r2_a	0.134	0.146	0.153	0.168
N	1622	1622	1622	1622

Source: Created by author with stata application

A. Robustness test

The robustness test using an alternative measurement of carbon disclosure, the Carbon Emission Score (CES), shows results that remain consistent with the main analysis. CEO_EDU continues to exhibit a positive and significant effect on CES ($p < 0.01$), confirming that CEO with foreign educational backgrounds consistently support more transparent carbon reporting. Similarly, FO maintains a positive but statistically insignificant relationship with CES, indicating that foreign ownership does not meaningfully alter the level of carbon disclosure even under an alternative measurement.

CEO_FOUNDER also remains negative and insignificant across all robustness models, reinforcing the earlier conclusion that founder status does not influence firms' carbon reporting practices. In contrast, CEO_AGE shows a strong and significant positive association with CES ($p < 0.01$), further supporting the finding that older executives are more inclined to encourage more comprehensive carbon disclosure.

Overall, the robustness test demonstrates that the principal results are stable regardless of whether CED or CES is used as the dependent variable. The direction and significance of the key variables particularly the consistent positive effects of CEO_EDU and CEO_AGE remain unchanged, thereby strengthening the reliability and validity of the study's conclusions.

Table 7. Alternative Measurement

	(1) CES	(2) CES	(3) CES	(4) CES
CEO_EDU	0.057***	0.060***	0.055***	0.058***
	-3.5	-3.74	-3.4	-3.65
FO	0.042	0.016	0.047	0.018
	-0.95	-0.37	-1.07	-0.41
CEO_FOUNDER	-0.01	-0.008	-0.012	-0.011
	(-0.66)	(-0.54)	(-0.86)	(-0.76)
CEO_AGE	0.324***	0.311***	0.257***	0.232***
	-3.74	-3.6	-2.93	-2.64
FSIZE	0.091***	0.100***	0.089***	0.098***
	-11.36	-11.76	-11.22	-11.85
ROA	0.274***	0.255***	0.216***	0.184***
	-4.06	-3.73	-3.16	-2.64
ROE	-0.024	-0.017	-0.019	-0.009
	(-0.98)	(-0.66)	(-0.78)	(-0.37)
CEO_FEM	0.038	0.038	0.04	0.04
	-1.43	-1.42	-1.51	-1.52
_cons	-1.401***	-1.599***	-1.234***	-1.420***
	(-8.43)	(-9.17)	(-7.23)	(-8.04)
Year FE	No	Yes	No	Yes
SIC FE	No	No	Yes	Yes
r2	0.139	0.152	0.161	0.179
r2_a	0.134	0.146	0.153	0.168
N	1622	1622	1622	1622

Source: Created by author with stata application

4. Generalized Least Squares (GLS) Regression

Generalized least squares (GLS) is an estimation technique used to address violations of the classical linear regression assumptions, particularly heteroscedasticity and autocorrelation, which can lead to inefficient and biased standard errors under ordinary least squares (OLS). By adjusting the variance–covariance structure of the error terms, GLS provides more efficient and reliable coefficient estimates, making it an appropriate robustness check for panel data models. In this study, GLS is applied to validate whether the relationships identified in the OLS regressions remain stable after correcting for these potential statistical issues Atanlogun and O (2014).

The results confirm the previous OLS estimations. Among the main variables, CEO_AGE and CEO_EDU have positive and significant effects on carbon emission disclosure (CED) at the 1% level, indicating that older and internationally educated CEOs are more likely to promote environmental transparency. In contrast, CEO_FOUNDER shows a negative significant relationship with CED, suggesting that founder CEOs may be less inclined toward environmental disclosure.

Overall, the GLS estimation reinforces the reliability of the baseline results and demonstrates that the positive effects of CEO demographic and educational characteristics on

carbon disclosure are robust even after accounting for heteroscedasticity and autocorrelation issues.

Table 8. GLS Results

	(1) CED
CEO_EDU	0.413***
	-108.45
FO	0.089***
	-7.98
CEO_FOUNDER	-0.104***
	(-24.94)
CEO_FOUNDER	-0.104***
	(-24.94)
CEO_AGE	1.634***
	-68.71
FSIZE	0.752***
	-191.69
ROA	1.009***
	-65.24
ROE	-0.104***
	(-16.87)
CEO_FEM	0.334***
	-25.48
_cons	-11.050***
	(-111.39)
Year FE	Yes
SIC FE	Yes
F	
p	.
r2_p	
r2_a	
N	1486

Source: Created by author with stata application

CONCLUSION

This study examined the extent to which CEO characteristics namely CEO_AGE, CEO_FOUNDER, CEO_EDU, and FO influence carbon emission disclosure (CED) among publicly listed firms in Indonesia. The results consistently indicate that CEO_AGE and CEO_EDU have positive and significant effects on CED, suggesting that firms led by older CEOs and CEOs with foreign educational backgrounds tend to exhibit higher levels of carbon emission disclosure. These findings imply that

greater managerial experience and international educational exposure are associated with stronger orientation toward environmental transparency.

In contrast, CEO_FOUNDER, FO, ROE, and CEO_FEM do not show significant relationships with CED, indicating that these factors do not play a decisive role in shaping carbon emission disclosure practices in the Indonesian context. At the firm level, FSIZE and ROA are found to have positive effects on CED, highlighting the importance of organizational capacity and financial performance in supporting environmental disclosure.

Overall, the findings support Upper Echelons Theory by demonstrating that managerial attributes reflected in CEO_AGE and CEO_EDU are more influential in determining carbon emission disclosure than ownership structure or founder status. This suggests that executive cognition and experience play a central role in shaping sustainability-related strategic decisions.

Despite its contributions, this study has several limitations. The analysis is confined to a four-year period (2020–2023) and focuses exclusively on Indonesian listed firms, which may limit the generalizability of the results. In addition, the use of secondary data from annual reports and ESG databases may be subject to variations in data quality and completeness, and potential endogeneity between CEO characteristics and CED cannot be fully eliminated.

Future research may address these limitations by extending the analysis to cross-country or multi-industry settings, incorporating additional CEO attributes, and employing longitudinal or dynamic panel methods. Further studies could also explore whether CEO_AGE or CEO_FOUNDER moderates the relationship between CEO_EDU, FO, and carbon emission disclosure.

In conclusion, this study underscores the importance of CEO characteristics particularly CEO_AGE and CEO_EDU in shaping corporate carbon emission disclosure. The findings provide practical implications for corporate boards, regulators, and stakeholders by emphasizing leadership selection and development as key mechanisms for enhancing sustainability reporting quality.

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