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Research Paper

THE IMPACT OF FEMALE DIRECTORS, PROFITABILITY, AND CEO AGE ON CARBON EMISSION DISCLOSURE: THE MODERATING ROLE OF INSTITUTIONAL OWNERSHIP IN INDONESIA

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ABSTRACT

This study investigates the effect of female directors, defined as women serving on the board of directors within Indonesia's two-tier governance system, profitability, and CEO age on carbon emission disclosure, with institutional ownership assessed as a moderating variable. The research is driven by the persistently limited transparency of carbon emissions in Indonesia and the need to understand how governance attributes contribute to environmental accountability. A quantitative approach is applied using secondary data from non-financial firms listed on the Indonesia Stock Exchange for the 2020–2024 period. The analysis employs fixed-effect panel regression with robust standard errors, incorporating logarithmic transformations to ensure model stability and interpretability. The empirical results show that female directors on the board of directors have a significant negative effect on carbon emission disclosure, while profitability and CEO age exhibit no direct influence. The moderation analysis indicates that institutional ownership weakens the effect of profitability, strengthens the influence of CEO age, and shows no moderating role in the relationship between female directors on the board of directors and disclosure. These findings imply that institutional investors in Indonesia remain financially driven, although they tend to reinforce the long-term orientation of senior CEOs in promoting transparency. Overall, this study underscores the importance of aligning governance mechanisms with stakeholder expectations to advance carbon emission disclosure as a substantive component of corporate sustainability.

Keywords: Carbon Emission Disclosure, CEO Age, Female Directors on the Board of Directors, Institutional Ownership

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INTRODUCTION

Pressure from investors and stakeholders to manage economic, environmental, and social risks has strengthened corporate governance practices that emphasize long-term sustainability (OECD, 2023). Global commitment to this agenda is reflected in the Paris Agreement, in which 195 countries agreed to limit global temperature increases to below 2°C and emphasized the role of governments and society in the transition toward a low carbon economy (Jakučionytė-Skodienė & Liobikienė, 2022). In line with this development, carbon emission disclosure (CED) has become a central focus in reporting frameworks such as GRI and CDP. In 2023, more than 21,000 companies worldwide reported climate related information through CDP, representing a 24% increase from the previous year (CDP, 2024). This trend underscores the critical position of CED in the global sustainability reporting agenda.

Southeast Asian countries maintain diverse sustainability reporting requirements, reflecting their varied economic and environmental conditions (Vardhanabindu, 2024). A regional assessment of the ASEAN-6 shows that only 30% of publicly listed companies disclosed carbon emissions in 2021, significantly lagging behind the European Union, where disclosure levels exceed 90% (Mansour et al., 2025). In Indonesia, although CED has shown an upward trend, its disclosure remains relatively limited and largely voluntary (Santika & Sari, 2022). This is reflected in the concentration of disclosures primarily within the energy and manufacturing sectors (Nilasakti et al., 2024), as well as the persistent gap between the magnitude of national carbon emissions and the low level of reporting undertaken by firms (Sari & Nisa, 2020).

Prior studies have identified internal factors such as managerial characteristics and financial performance as determinants of carbon disclosure (Beauchamp & Cormier, 2022; Fuadi et al., 2024). However, empirical findings remain inconsistent. For instance, (Caby et al., 2024) found that female board representation does not significantly influence CED, while profitability has been shown to positively affect disclosure levels (Cormier & Beauchamp, 2021b). Yet, these findings are not always generalizable across countries, particularly because institutional dynamics and stakeholder pressures in developing economies often differ. Local evidence in Indonesia shows that profitability is statistically irrelevant for CED (Purwanti et al., 2022; Ratmono et al., 2021). These discrepancies indicate that the relationship between internal firm characteristics and CED is highly context dependent. Furthermore, (Jibril, 2024) reported that female directors significantly enhance carbon disclosure in Nigeria, although institutional ownership does not moderate this relationship, reinforcing the importance of contextual and interaction-based examinations in understanding CED determinants in developing countries.

Although institutional ownership has often been examined as a direct determinant of corporate governance outcomes, its role as a moderating variable in the relationship between managerial characteristics and carbon emission disclosure remains underexplored, particularly in developing countries. Institutional investors may affect disclosure through at least three channels: monitoring managerial decisions, engaging management through voting and dialogue, and creating reputational pressure for firms to align with sustainability expectations. (Brilliani et al., 2023) demonstrated that institutional ownership can strengthen the link between carbon disclosure and internal firm attributes, suggesting that institutional investors may encourage transparency and influence disclosure practices. However, (Jibril, 2024) found that institutional ownership does not moderate the relationship between female board representation and carbon disclosure, highlighting that the moderating influence of institutional investors varies according to jurisdictional structures, stewardship orientation, and power dynamics.

Given the limited research on the interaction between ownership structure and managerial characteristics in carbon reporting, especially in developing economies, this study adopts an interactive approach by examining whether institutional ownership amplifies or weakens the influence of internal managerial attributes on disclosure practices. While governance mechanisms such as board size, independence, and managerial incentives have been widely studied as direct determinants of environmental performance, research that positions these mechanisms as moderating variables in the relationship between managerial characteristics and carbon emission disclosure remains scarce (Lu & Wang, 2021; Velte, 2022). In this study, institutional ownership is not assumed to be uniformly supportive of sustainability. When institutional investors emphasize long-term stewardship, their monitoring and engagement can amplify disclosure; however, when they prioritize short-term financial returns, they may constrain costly voluntary reporting. This possibility makes moderation testing theoretically relevant in the Indonesian setting.

This study offers a conceptual contribution by integrating internal managerial characteristics such as gender, CEO age, and profitability with external governance structures in the form of institutional ownership. More specifically, the study focuses on female directors serving on the board of directors within Indonesia's two-tier governance context. Although institutional ownership has been shown to influence managerial decisions related to environmental disclosure (Beauchamp & Cormier, 2022), research examining how it simultaneously moderates the relationship between managerial characteristics and carbon reporting remains limited. Therefore, this study seeks to enrich the theoretical foundation based on stakeholder theory and provide contextual insights for regulators and stakeholders to strengthen the strategic and accountable implementation of carbon emission disclosure.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Theoretical Considerations

Stakeholder theory posits that firms must manage the interests of all stakeholders both internal and external so that decisions taken are not solely oriented toward shareholders but also consider non-financial aspects that influence long-term sustainability (Mahajan et al., 2023). The theory is built on the assumption that corporate continuity depends on the firm’s ability to meet stakeholder expectations, including those of employees, customers, investors, governments, and the wider community (Allam & Diyanty, 2020). Its relevance has become increasingly prominent as demands rise for reassessing the role of corporations in sustainability issues (Bridoux, 2022). A series of corporate scandals and global financial crises have intensified social pressure on firms to demonstrate stronger commitments to social responsibility. This momentum has driven the establishment of global initiatives, including the United Nations’ 17 Sustainable Development Goals (Amis et al., 2020), which underscore that a stakeholder-oriented approach forms an essential foundation for environmental disclosure and public accountability. Due to its flexibility in capturing ESG dynamics, stakeholder theory remains highly relevant for analyzing carbon emission disclosure as a strategic manifestation of corporate responsibility.

Carbon Emission Disclosure (CED) is understood as a strategic response to external pressures, particularly from stakeholders who place strong emphasis on climate-change issues (Allam & Diyanty, 2020). From the stakeholder theory perspective, firms tend to align managerial decisions with stakeholder expectations. Such pressure is typically more pronounced among organizations with high reputational exposure and visibility, especially regarding sustainability issues (Cormier & Beauchamp, 2021). As the demand for carbon reporting increases, corporate environmental practices are subjected to closer scrutiny. Although greenhouse gas disclosure regulations exist, many remain limited or voluntary, requiring managers to weigh the benefits of voluntary disclosure despite the associated costs (Beauchamp & Cormier, 2022).

The representation of women on corporate boards is perceived as an embodiment of inclusivity and equality demanded by stakeholders (Prabowo & Setiawan, 2021; Zahari et al., 2024). Female involvement in board structures also reflects ethical sensitivity in addressing social issues, thereby strengthening stakeholder perceptions of the firm's commitment to sustainability (Zahari et al., 2024). This expectation arises from the assumption that women generally exhibit higher ethical awareness and empathy. Increasing the proportion of female directors is believed to enhance the board's collective understanding of corporate social responsibility initiatives (Ludya & Dewi, 2024). More broadly, gender diversity improves governance quality and strengthens corporate responsiveness to social expectations, effects that are closely linked to economic performance.

Beyond gender diversity, profitability also shapes carbon emission disclosure. Although profitability does not consistently exhibit significant influence on disclosure (Purwanti et al., 2022), stakeholder relations remain central in supporting sustainability practices. Carbon emission disclosure enhances corporate accountability, strengthens reputation, and builds investor trust, although in Indonesia such disclosure is still largely voluntary and limited in scope (Dharma et al., 2024). Profitability also provides firms with greater capacity to allocate financial resources for sustainability reporting (Allam & Diyanty, 2020).

CEO age further influences corporate responses to stakeholder pressures. (Rahmatulloh et al., 2025) highlight that older CEOs tend to place greater emphasis on ESG disclosure due to shorter career horizons and higher risk aversion. This aligns with stakeholder theory, which emphasizes the need for firms to balance financial interests with social and environmental accountability. CEO age thus functions as an internal attribute influencing managerial sensitivity toward stakeholder expectations, especially in safeguarding long-term reputation and sustainability (Lassoued & Khanchel, 2023). These findings also reinforce the notion that boards serve as intermediaries between corporations and stakeholder groups (Siregar et al., 2023).

Institutional ownership represents a form of stakeholder influence exercised by professional institutions and may affect carbon disclosure through monitoring intensity, direct engagement with management, and reputational pressure (Bedi & Singh, 2024). Institutional investors can use voting rights, board oversight, and portfolio reallocation to press firms to provide more credible environmental information. Yet this influence is not unidirectional: when institutions prioritize short-term returns, they may discourage voluntary disclosures perceived as costly; when they adopt stewardship and ESG-oriented preferences, they can strengthen transparency commitments (Brilliani et al., 2023; Budanti et al., 2025). Accordingly, institutional ownership is theoretically positioned in this study as a moderator rather than merely a direct governance determinant.

Thus, stakeholder theory provides a robust conceptual foundation for explaining linkages between internal and external corporate factors and carbon emission disclosure decisions. It is therefore employed as the primary theoretical basis of this study, as it not only elucidates firms' motivations and responses to stakeholder pressures but also offers an evaluative framework for analyzing the consistency of corporate sustainability strategies, particularly in the context of carbon emission disclosure.

Female Directors on the Board of Directors and Carbon Emission Disclosure

The representation of women on corporate boards constitutes a critical element of inclusive and sustainability-oriented governance structures. In the context of Indonesia's two-tier governance system, female directors (FBD) in this study refer specifically to women who hold executive positions on the board of directors, not the board of commissioners (Purwa & Setiawan, 2021).

Empirical evidence indicates that female presence on boards enhances transparency in environmental reporting. Prior studies have shown that female directors are associated with higher levels of voluntary disclosure, including diversity related disclosures (Moussa et al., 2023; Shohaieb et al., 2022). Consistently, (Ben-Amar et al., 2017) find that greater female participation strengthens corporate awareness of environmental issues and encourages more proactive reporting strategies in response to stakeholder demands.

Gender diversity introduces broader perspectives on social and environmental risks and promotes more ethical governance practices (Prabowo & Setiawan, 2021). Mechanistically, female directors are perceived to demonstrate stronger alignment with social and sustainability values, reflected in inclusive decision-making and heightened consideration of environmental impacts. Such attributes reinforce a company's commitment to responsible reporting as a form of accountability to stakeholders.

H1: Female directors on the board of directors positively and significantly influence carbon emission disclosure.

Profitability and Carbon Emission Disclosure

Corporate profitability is a key indicator of a firm's capacity to generate earnings from its operational activities (Dirman, 2020). Metrics such as Return on Assets (ROA) reflect the efficiency of resource utilization and the availability of financial capacity to support carbon emission disclosure initiatives (Pradana & Laksito, 2023; Saraswati et al., 2021). Several studies indicate that firms with higher profitability are more capable of fulfilling their social and environmental responsibilities, particularly through efficient resource allocation (Wahyuningrum et al., 2023). (Darus et al., 2020) also document that higher profitability significantly increases carbon emission disclosure, representing firms' reputational incentives to demonstrate transparency in environmental performance.

However, empirical evidence remains mixed. In Indonesia, (Kholmi et al., 2020) note that the profitability disclosure relationship may vary depending on contextual factors. Conversely, (Pradana & Laksito, 2023) report that ESG disclosure positively affects ROA and ROE, indicating that sustainability reporting can simultaneously reflect and support improved financial performance. Mechanistically, profitable firms possess stronger incentives to disclose carbon information as part of reputation building and accountability strategies.

H2: Profitability positively and significantly influences carbon emission disclosure.

CEO Age and Carbon Emission Disclosure

CEO age has been identified as an influential factor in shaping corporate sustainability practices (Sannino et al., 2020). Age affects managerial risk preferences: older CEOs tend to adopt conservative strategies, limit R&D spending, and proceed cautiously in strategic decisions, whereas younger CEOs are generally more growth-oriented and risk-tolerant (Naseem et al., 2020). Consistent with this, (Nguyen et al., 2018) suggest that rising CEO age may reduce financial performance. (Kusumasari, 2018) adds that younger CEOs are often more adaptive to global changes and quicker in decision-making, supporting competitive advantage.

Demographic characteristics background, experience, and power are associated with environmental disclosure practices, although age remains understudied (Mahran & Elamer, 2024), offering opportunities for deeper examination. Older CEOs typically demonstrate greater sensitivity to long-term risks and stakeholder expectations. Their conservative approach and concern for reputation motivate more transparent environmental disclosure, especially amidst rising climate-related pressures.

H3: CEO age positively and significantly influences carbon emission disclosure.

The Moderating Role of Institutional Ownership

Institutional ownership refers to the involvement of institutional investors such as financial institutions, pension funds, or other professional entities in corporate shareholding. These investors exert considerable influence on managerial behavior and the adoption of responsible governance practices (Zahari et al., 2024). As moderators, institutional investors may shape disclosure through monitoring intensity, direct engagement with management, and reputational pressure arising from stewardship expectations.

Regarding gender diversity, institutional shareholders may strengthen the influence of female directors on the board of directors when they translate board diversity into concrete monitoring agendas, request climate-related accountability, and support directors who promote broader disclosure. Under this mechanism, institutional ownership helps convert gender representation into substantive governance pressure rather than symbolic inclusion alone (Prabowo & Setiawan, 2021; Budanti et al., 2025).

In relation to profitability, institutional monitoring can operate in two directions. On the one hand, it may encourage profitable firms to use their financial slack for sustainability reporting. On the other hand, when institutional investors focus primarily on short-term efficiency and return targets, they may pressure firms to limit voluntary disclosure costs. This dual mechanism explains why institutional ownership may strengthen or weaken the profitability-disclosure relationship (Purwanti et al., 2022; Bedi & Singh, 2024).

The relationship between CEO age and disclosure may also be shaped by institutional pressures. Older CEOs are often more cautious about long-term reputation and risk exposure, while institutional investors can reinforce this orientation through monitoring, engagement, and demands for credible non-financial reporting. As a result, institutional ownership may amplify the disclosure tendency of senior CEOs when both parties share a long-term accountability perspective (Freeman, 2018; Lassoued & Khanchel, 2023). Thus, the following hypotheses are proposed:

H4: Institutional ownership strengthens the positive effect of female directors on the board of directors on carbon emission disclosure.

H5: Institutional ownership strengthens the positive effect of profitability on carbon emission disclosure.

H6: Institutional ownership strengthens the positive effect of CEO age on carbon emission disclosure.

Based on the hypothesis development above, the conceptual framework of this research can be illustrated as follows:

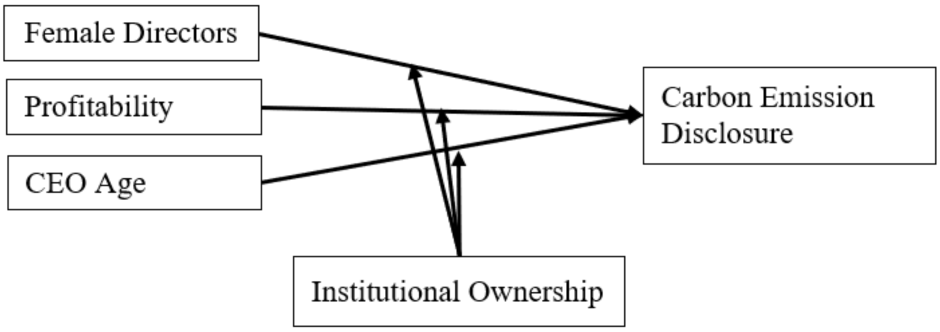

Figure 1. Research Conceptual Framework

RESEARCH METHODOLOGY

Research Design

This study employs a quantitative approach using panel data regression analysis. The method is selected because the dataset consists of a combination of time series and cross-sectional observations, covering non-financial firms listed on the Indonesia Stock Exchange (IDX) over the 2020–2024 period. This period was selected because it provides the most recent five-year window with relatively comparable availability of annual reports, sustainability reports, and governance data across IDX non-financial firms, while also capturing the phase in which carbon disclosure in Indonesia remained largely voluntary but increasingly salient. The primary objective is to examine the effect of female directors on the board of directors, profitability, and CEO age on carbon emission disclosure (CED), as well as to analyze the moderating role of institutional ownership.

The regression analysis is conducted using the ordinary least squares (OLS) estimator with the inclusion of industry and year dummy variables to control for time invariant sectoral differences and cross period variations. Accordingly, the model is equivalent to OLS with industry year fixed effects. In addition, robust standard errors clustered at the firm level are applied to obtain consistent estimates in the presence of heteroskedasticity and autocorrelation.

Prior to estimation, the variables are transformed using natural logarithms (LN). This transformation aims to correct skewed distributions, reduce outlier influence, and facilitate interpretation of regression coefficients in elasticity form. The use of log transformation is also common in accounting and finance research, as it enhances the validity of empirical findings.

Research Objects

The objects of this study are non-financial firms listed on the Indonesia Stock Exchange (IDX) that consistently publish annual reports and sustainability reports throughout the 2020–2024 period. The sample is selected using purposive sampling based on predefined criteria. Firms included in the final sample are those that:

1. operate outside the financial sector,
2. provide publicly accessible annual and sustainability reports during the observation period, and
3. disclose relevant information on carbon emissions and corporate governance.

Although purposive sampling is categorized as non-probability sampling and therefore limits generalizability, it is appropriate for this study because the focus lies on the quality of disclosure rather than sample size.

Operational Definition of Variables

Table 1. Operational Definition of Variables

Variable	Category	Definition
Carbon Emission Disclosure (CED)	Dependent Variable	Natural logarithm of total carbon emissions
Female Directors on the Board of Directors	Independent Variable	The proportion of women serving on the board of directors relative to the total number of directors in the board of directors.
Profitability	Independent Variable	Measured using the Return on Assets (ROA) ratio.
CEO Age	Independent Variable	Age of the CEO at the end of the fiscal year.
Institutional Ownership	Moderating Variable	Percentage of outstanding shares owned by institutional investors.
Leverage	Control Variable	Total liabilities divided by total assets.
Firm Size	Control Variable	Natural logarithm of total assets.
Industry Sector (SIC)	Control Variable	Categorized based on IDX's official sector classification, covering ten major sectors—Energy, Basic Materials, Industrials, Consumer Noncyclical, Consumer Cyclicals, Healthcare, Property and Real Estate, Technology, Infrastructure, and Transportation & Logistics. The financial sector is excluded.
Firm Age	Control Variable	Number of years since the company's establishment.

Data Collection Technique

Data are collected using the documentation method by downloading annual reports and sustainability reports from the official IDX website and the respective firms' websites. All data are manually extracted according to predefined indicators. This method is considered appropriate for research focusing on evaluating the quality of sustainability disclosure.

Data Analysis Method

The data are analyzed using ordinary least squares (OLS) regression with industry and year fixed effect controls. This approach enables the model to capture both sector specific characteristics and temporal variations, resulting in more representative estimates. To ensure reliable statistical inference, robust standard errors clustered at the firm level are employed so that the estimates remain consistent even in the presence of heteroskedasticity and autocorrelation within panel data.

Natural logarithm transformation is applied to several key variables to improve skewed distributions, mitigate outlier influence, and facilitate elasticity-based interpretation. The estimated model evaluates the effects of the independent variables female directors on the board of directors, profitability, and CEO age on carbon emission disclosure, while also testing the moderating role of institutional ownership through its interaction with the main variables. All analyses are conducted using statistical software capable of handling panel regression with robust inference to ensure that the empirical results are consistent, efficient, and valid.

RESULTS AND DISCUSSION

1. Descriptive and Correlation Analysis

Descriptive Statistic

Table 2. Descriptive Statistic of Variables

Variable	N	Mean	Standard Deviation	Minimum	Maximum
CED	850	10.575	3.442	-0.971	17.946
lnFBOD	850	0.120	0.137	0.000	0.470
lnPROF	676	-3.066	1.284	-8.694	0.654
lnCEOAGE	850	4.023	0.173	3.526	4.394
lnFIRMSZ	850	3.284	0.204	2.632	3.484
lnLEV	850	0.947	0.662	-3.036	0.722
lnFAGE	850	3.554	0.508	1.946	4.682
lnINOWN	850	0.475	1.162	-6.266	4.213

The descriptive statistics results show that Carbon Emission Disclosure (CED) has an average value of 10.575 with a standard deviation of 3.442, a minimum of -0.971, and a maximum of 17.946. The mean indicates a moderate level of carbon emission disclosure among sampled firms, while the wide range reflects considerable variation. This variation highlights that some firms still disclose minimal information, whereas others provide more comprehensive carbon-related reporting (Nilasakti et al., 2024).

The female directors on the board of directors (FBD) variable has a mean of 0.120 with a standard deviation of 0.137, ranging from 0.000 to 0.470. These figures underscore the limited representation of women in executive board positions in Indonesia (Karina et al., 2023). Consistent with prior evidence, gender diversity in Indonesian boardrooms remains relatively low despite growing global attention to gender inclusivity in leadership (Karina et al., 2023).

Profitability (PROF) has a mean of –3.066 and a standard deviation of 1.284, indicating that many firms experience relatively low profitability, with some recording significantly negative values. CEO Age (lnCEOAGE) has a mean of 4.023, ranging from 3.526 to 4.394, reflecting substantial variation in executive leadership age across firms. This variation represents diversity in managerial characteristics that may influence ESG disclosures, as age-related leadership traits can shape a firm's openness to change, including voluntary disclosure practices (Rahmatulloh et al., 2025).

The control variable Firm Size (FIRMSZ) has an average of 3.284 with relatively small variability (SD 0.204), suggesting that most sampled firms fall within the medium to large category.

Correlation Matrix

Table 3. Correlation Matrix

	CED	lnFBOI	lnPROF	lnCEOAGE	lnFIRMSZ	lnLEV	lnFAGE	lnINOWN
CED	1.000							

lnFBOD	0.159***	1.000						
	(0.000)							
lnPROF	0.037	0.030	1.000					
	(0.341)	(0.433)						
lnCEOAGE	0.051	0.145***	0.070*	1.000				
	(0.134)	(0.000)	(0.069)					
lnFIRMSZ	0.029	0.117***	0.089**	0.077**	1.000			
	(0.403)	(0.001)	(0.021)	(0.024)				
lnLEV	0.097***	0.013	0.230***	0.041	0.052	1.000		
	(0.005)	(0.705)	(0.000)	(0.230)	(0.126)			
lnFAGE	0.201***	0.005	0.075*	0.096***	0.160***	0.103***	1.000	
	(0.000)	(0.874)	(0.052)	(0.005)	(0.000)	(0.003)		
lnINOWN	0.131***	0.060*	0.010	0.090***	0.014	0.123***	0.027	1.000
	(0.000)	(0.079)	(0.792)	(0.009)	(0.684)	(0.000)	(0.435)	

The correlation analysis indicates that carbon emission disclosure (CED) is positively and significantly associated with lnFBOD, lnLEV, lnFAGE, and lnINOWN. By contrast, its correlations with lnPROF, lnCEOAGE, and lnFIRMSZ are positive but statistically insignificant. These patterns suggest that governance composition, capital structure, firm maturity, and ownership structure are more closely related to disclosure than short-term profitability or CEO demographics at the bivariate level.

2. Regression Result and Interpretation

Table 4. Result of Fixed-Effect Panel Regression

	(1) CED	(2) CED	(3) CED	(4) CED
lnFBOD	-3.456***	-9.919***		
	(-2.88)	(-5.46)		
lnPROF	0.071		0.035	
	(0.63)		(0.31)	
lnCEOAGE	0.637			0.997
	(0.85)			(1.55)
lnFIRMSZ	0.257	0.353	0.709	0.306
	(0.44)	(0.55)	(1.26)	(0.60)
lnLEV	0.519***	0.626***	0.574***	0.268*
	(2.93)	(3.03)	(3.11)	(1.78)

lnFAGE	1.059***	1.349***	1.063***	1.211***
	(4.26)	(3.66)	(4.46)	(5.89)
lnINOWN	0.490***			
	(5.32)			
ln_FBODXINOWN		-0.107		
		(-1.25)		
ln_PROFXINOWN			-0.140***	
			(-5.04)	
ln_CEOAGEXINOWN				0.111***
				(5.28)
_cons	6.304*	11.844***	6.950***	3.586
	(1.80)	(4.07)	(3.23)	(1.17)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
F	8.517	6.673	9.010	10.428
r2_a	0.170	0.229	0.155	0.157
N	676	435	676	850

H1 – Female Directors on the Board of Directors (FBD)

The results show that the presence of female directors on the board of directors has a significantly negative effect on carbon emission disclosure, thereby failing to support the initial hypothesis predicting a positive relationship. Contextually, this finding reflects the limited substantive influence of women in strategic decision-making processes within Indonesia, where female board representation often remains symbolic and lacks the institutional authority needed to promote transparency (Chika & Widianingsih, 2024). This outcome contrasts with prior studies asserting that female board presence enhances environmental reporting and strengthens corporate awareness of sustainability issues (Saadah et al., 2024). In Indonesian firms, female directors still tend to hold symbolic rather than strategic roles, restricting their capacity to drive carbon transparency (Chika & Widianingsih, 2024).

H2 – Profitability (PROF)

The regression results indicate that although more profitable firms exhibit a positive coefficient, profitability does not significantly influence carbon emission disclosure. This insignificant effect may stem from the absence of mandatory regulation and the relatively weak pressures from investors and the public regarding carbon reporting in Indonesia. As a result, higher profits do not necessarily translate into stronger commitments to environmental transparency (Nilasakti et al., 2024). External incentives that theoretically position profitability as a driver of disclosure have not been effectively internalized within corporate governance, aligning with (Kholmi et al., 2020), who note that the relationship between profitability and carbon disclosure in Indonesia remains inconsistent and context dependent.

Within the framework of stakeholder theory, profitability reflects not only financial performance but also the firm's broader relationship with stakeholders who expect a balance between economic accountability and social responsibility (Purwanti et al., 2022). Although financially strong firms possess greater capacity to allocate resources toward sustainability reporting as a legitimacy mechanism (Allam & Diyanty, 2020), the empirical results suggest that such capacity is not fully leveraged in the Indonesian context.

H3 – CEO Age (CEOAGE)

The findings reveal that CEO age does not significantly affect carbon emission disclosure, resulting in the rejection of H3. According to stakeholder theory, executive characteristics such as age are expected to influence how firms respond to stakeholder expectations through greater transparency in carbon reporting (Allam & Diyanty, 2020; Freeman, 2018). However, the empirical evidence indicates that CEO age is not a determining factor, suggesting that disclosure practices are more strongly shaped by regulatory pressures, governance dynamics, and stakeholder demands.

This result is consistent with (Garcia-Blandon et al., 2019), who observe that CEO age does not directly influence firm performance. This contradicts initial expectations, as increased age is typically associated with greater experience, confidence, and decision making maturity (Siregar et al., 2023). (Naseem et al., 2020) further note that CEO age affects firm performance in a nonlinear manner, with performance declining beyond a certain age threshold.

H4 – Interaction between FBD and Institutional Ownership (FBD x INOWN)

The interaction between female directors on the board of directors and institutional ownership yields a negative and insignificant coefficient (-0.107, t-statistic -1.25). This contradicts the expectation that institutional investors would strengthen the influence of female directors in promoting environmental transparency. As highlighted by (Zahari et al., 2024), institutional investors generally play a critical role in monitoring management and encouraging responsible governance practices, including sustainability reporting. (Prabowo & Setiawan, 2021) also emphasize that institutional ownership can reinforce female board participation only when institutional pressure is translated into concrete monitoring and engagement, rather than remaining a symbolic governance signal.

However, the findings suggest that in this context, institutional pressure does not enhance gender-sensitive governance efforts related to carbon disclosure. This implies that monitoring, engagement, and reputational pressure from institutional investors are not yet sufficiently directed toward empowering female directors to influence sustainability reporting agendas.

Comparisons before and after moderation show a notable shift. Prior to considering institutional ownership, female board presence was viewed as potentially enhancing corporate legitimacy through ethical sensitivity toward social and environmental concerns (Freeman, 2018; Zahari et al., 2024). After applying the moderating variable, the effect weakens and becomes insignificant, indicating that institutional investors' expected role as catalysts for environmental transparency is not fully realized. In line with stakeholder theory, this may occur because dominant investor pressures remain primarily focused on short-term financial stability rather than nonfinancial reporting, thereby limiting the effectiveness of gender representation in driving carbon disclosure (Allam & Diyanty, 2020).

H5 – Interaction between Profitability and Institutional Ownership (PROF × INOWN)

The interaction between Profitability and Institutional Ownership generates a significantly negative coefficient (-0.140, t-statistic -5.04, significant at 1 percent). This result indicates that higher institutional ownership weakens the influence of profitability on carbon emission disclosure. Although financially strong firms typically possess greater capacity to invest in sustainability reporting as a form of accountability (Purwanti et al., 2022), institutional investors may redirect corporate priorities toward short-term financial efficiency, thereby diminishing commitments to environmental disclosure.

Comparison before and after moderation reveals a sharp contrast. Prior to considering institutional ownership, profitability was associated with stronger capacity to respond to external pressures and enhance legitimacy through environmental disclosure (Allam & Diyanty, 2020; Freeman, 2018). Following moderation, the effect weakens substantially, indicating that institutional dominance alters managerial priorities and limits responsiveness to stakeholder expectations regarding sustainability (Allam & Diyanty, 2020; Beauchamp & Cormier, 2022; Cormier & Beauchamp, 2021a). Thus, external legitimacy does not consistently reinforce transparency; instead, it depends on the prevailing interests of influential stakeholders within the ownership structure.

H6 – Interaction between CEO Age and Institutional Ownership (CEOAGE × INOWN)

The interaction between CEO Age and Institutional Ownership yields a significantly positive coefficient (0.111, t-statistic 5.28, significant at 1 percent). This indicates that institutional ownership strengthens the effect of CEO age on carbon emission disclosure. Within the stakeholder theory framework, firms are viewed as social entities accountable not only to shareholders but also to broader stakeholder groups, including regulators, communities, and the environment (Allam & Diyanty, 2020; Freeman, 2018).

Senior CEOs are generally more inclined toward ESG disclosure due to shorter career horizons and heightened risk aversion (Lassoued & Khanchel, 2023). Active institutional monitoring amplifies this tendency, positioning carbon transparency as a strategic accountability mechanism.

Compared to the pre moderation model, CEO age already exhibited a positive tendency, but its statistical significance increases substantially once institutional ownership is considered. Before moderation, the long-term orientation of senior CEOs acted as an internal legitimacy mechanism. After moderation, external stakeholder pressures interact with internal governance, enhancing the role of executive characteristics in shaping corporate responses to environmental transparency demands (Allam & Diyanty, 2020; Cormier & Beauchamp, 2021; Siregar et al., 2023). This indicates that higher institutional ownership strengthens managerial sensitivity to stakeholder expectations.

Overall, the findings support stakeholder theory by demonstrating that corporate legitimacy is shaped through the interaction of internal factors represented by CEO age and external factors such as institutional investor pressure. This synergy encourages firms to position carbon disclosure not merely as a compliance requirement but as a relational strategy for sustaining long-term legitimacy.

CONCLUSION AND SUGGESTION

This study examined the influence of female directors on the board of directors, profitability, and CEO age on carbon emission disclosure, with institutional ownership incorporated as a moderating variable. The findings confirm that the research objectives were achieved and offer empirical evidence on how governance structures and firm characteristics shape sustainability reporting in emerging markets. Female directors on the board of directors demonstrate a significantly negative effect on carbon emission disclosure, indicating that board diversity in Indonesia has not yet evolved into substantive environmental oversight. Profitability and CEO age show no significant effects, suggesting that internal firm characteristics do not always act as decisive drivers of non-financial reporting.

The moderation analysis reveals that institutional ownership weakens the positive association between profitability and environmental transparency but strengthens the effect of CEO age, implying that external monitoring can reinforce long-term environmental accountability among senior leaders. Meanwhile, institutional ownership does not enhance the contribution of female directors on the board of directors, reflecting limited institutional support for gender-based sustainability governance. Overall, carbon emission disclosure in Indonesia appears to be more strongly shaped by external pressures, particularly investor expectations and legitimacy concerns, than by internal managerial attributes.

These results offer theoretical implications by refining stakeholder theory, especially in demonstrating the gap between normative stakeholder expectations and actual sustainability disclosure practices in developing economies. More specifically, institutional ownership appears to operate through different channels - monitoring, engagement with management, and reputational pressure - but these channels do not work uniformly. When institutional investors emphasize long-term stewardship, they reinforce the disclosure orientation of senior CEOs; when they prioritize financial efficiency, they weaken the profitability-disclosure link. Practically, the findings highlight the need for companies to strengthen the substantive roles of female directors in sustainability decision-making, while regulators are encouraged to promote stronger oversight mechanisms that ensure institutional investors integrate sustainability considerations into investment strategies. Stakeholders such as civil society organizations may also utilize these insights to intensify public pressure for stronger carbon transparency.

This study remains limited by its reliance on secondary data, which depends on the quality of publicly disclosed information, and by its relatively short observation period. The 2020–2024 period was chosen to maintain recent and comparable post-pandemic disclosure observations across firms and to reflect the latest phase of voluntary carbon reporting in Indonesia; however, a five-year window is still relatively short for capturing slower-moving regulatory adjustment and longer-term governance change. Future research is encouraged to incorporate external factors such as regulatory pressure, media scrutiny, or sustainability ratings, extend the research timeframe, and conduct cross-country comparisons within Southeast Asia to provide broader insights into regional carbon disclosure dynamics and strengthen the generalizability of findings.

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