CARBON EMISSIONS DISCLOSURE IN ASIA PACIFIC: THE ROLE OF CARBON AND FINANCIAL PERFORMANCE IN HIGH IMPACT SECTORS

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Abstrak

Background: Carbon emissions disclosure has gained increasing attention in the corporate world due to growing concerns over climate change and sustainability. Companies are expected to be more transparent in reporting their environmental impacts, particularly in carbon-intensive industries

Objective: This study aims to analyze the influence of carbon performance and financial performance on carbon emissions disclosure among industrial companies in the Asia-Pacific, focusing on the energy, chemical, and utilities sectors.

Research Methods: A quantitative approach was employed using panel data regression analysis. The study analyzed a sample of 108 companies across three industrial sectors from 2019 to 2023. Data were collected from the LSEG Analytics Workspace via the Refinitiv financial database.

Research Results: The findings reveal that Carbon Performance (CP) has a positive and significant effect on Carbon Emissions Disclosure (CED). Financial Performance (FP) also shows a positive relationship with CED, although with lower statistical significance. This indicates that companies with higher carbon efficiency are more likely to disclose carbon emissions transparently.

Originality/Novelty of Research: This study contributes to the existing literature by offering recent empirical evidence from Asia-Pacific industrial sectors and highlighting the comparative roles of environmental and financial factors in influencing carbon disclosure practices.

Keywords: Carbon Emissions Disclosure, Carbon Performance, Financial Performance, Sustainability, Asia-Pacific.

Introduction

Climate change has become one of the most urgent global challenges of the 21st century, primarily driven by rising concentrations of greenhouse gases, particularly carbon dioxide (CO_2) (Lindsey, 2024). A key indicator of this is carbon emissions per capita, which measure individual contributions to global emissions through economic and industrial activities. Between 1990 and 2018, global emissions showed a consistent upward trend, with a brief decline in 2019 and 2020, largely influenced by reduced economic activity during the COVID-19 pandemic (World Bank, 2023). This decline also reflects the initial success of global emission reduction strategies, such as the shift to renewable energy and increased awareness of carbon accounting (Rokhmawati et al., 2018; Stridsland et al., 2023). These strategies promote transparent

emission monitoring, enabling governments and companies to manage environmental impacts more effectively. Approaches like green accounting and carbon disclosure have become essential tools in ensuring that environmental considerations are integrated into financial decision-making (Najm Abed & Singh, 2024; Zik-Rullahi & Jide, 2023). The Asia-Pacific region is the largest contributor to global carbon emissions due to its rapid industrialization and high energy consumption across sectors such as oil and gas, chemicals, metals, mining, and utilities (Clarkson et al., 2008; Sari, 2022). Despite its significant contribution, empirical research on carbon emission disclosure practices in this region remains limited (Al-Rabab'a et al., 2024). The complexity of industrial activities, diverse regulatory frameworks, and heterogeneous economic conditions present unique challenges that have not been fully understood (Afrizal et al., 2023; Yuliana & Wedari, 2023). Therefore, investigating this region is academically important to provide insights into the effectiveness of emission reduction strategies, identify gaps in corporate accountability, and support policy development tailored to the specific needs of Asia-Pacific countries, particularly developing economies (Kristari & Teruna, 2022).

Countries such as China, India, Japan, South Korea, and Indonesia -lead emissions in this region through activities in manufacturing, energy production, and transportation (IEA, 2023). China's coal-based power generation and India's growing industrial demands pose substantial challenges, despite efforts to implement green energy transitions (Agarwal & Sharma, 2023). Meanwhile, advanced economies like Japan and South Korea have integrated low-carbon technologies and improved emissions reporting using international standards such as the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP) (Luo & Tang, 2023). Corporations like Toyota and Samsung lead the way in reporting carbon emissions with precision (Comello et al., 2023; Sra, 2022). Malaysia continues to rely heavily on its oil and gas sector (Zik-Rullahi & Jide, 2023), while Singapore's rapid urbanization contributes significantly to environmental pressures (PwC, 2021).

Asia-Pacific countries demonstrate varying levels of commitment to carbon disclosure, with developed countries more engaged in transparent reporting than their developing counterparts. Developing economies often face structural and financial limitations in implementing green technology and emission disclosure frameworks (Comello et al., 2023). This divergence complicates regional efforts to address carbon emissions uniformly, highlighting the need for tailored national approaches. Countries also differ in their regulatory priorities and readiness to comply with international environmental standards, underscoring the importance of examining carbon disclosure practices in the context of local conditions (United Nations ESCAP, 2023). Recognizing this diversity allows policymakers and corporations to design context-specific strategies that align with both environmental goals and economic realities (Dimabuyu, 2023).

Carbon accounting has emerged as a critical strategy for businesses to manage and disclose their carbon footprints effectively (Isiksal et al., 2023). It involves the systematic measurement, reporting, and management of emissions produced by business operations. With growing environmental awareness and mounting pressure from stakeholders including governments, investors, and consumers companies in the Asia-Pacific region are increasingly adopting carbon accounting (Ifada & Jaffar, 2023; Leung, 2021). It not only helps firms comply with environmental regulations but also enhances their reputational standing and market competitiveness. Failure to disclose emissions data may lead to loss of investor trust and regulatory penalties (Sergio et al., 2023). Thus, carbon accounting has become an integral part of corporate sustainability strategy and risk management.

Carbon disclosure, as a component of carbon accounting, enhances corporate transparency concerning environmental impacts (Agung et al., 2023). Structured disclosure frameworks like Time-Consistent Corporate Carbon Reporting (TCCR) provide standardized methods for evaluating and improving corporate carbon transparency (Comello et al., 2023). In the Asia-Pacific region, international initiatives such as CDP, GRI, and ISO 14064 have encouraged broader adoption of carbon accounting disclosure (Cismaș et al., 2023; Wong et al., 2022). These standards ensure comparability, consistency, and reliability in environmental reporting. Moreover, firms are increasingly expected to provide Carbon Accounting Information Disclosure (CAID) to support sustainable development and research investment (Liu et al., 2023). This evolution signals a shift toward integrating environmental goals within core corporate reporting systems.

Carbon performance and financial performance are closely interlinked dimensions in environmental disclosure research (Adu et al., 2023; Miah et al., 2021). Carbon performance reflects how effectively a company reduces its greenhouse gas emissions, which can be measured through total emissions, emission intensity, and the outcomes of reduction initiatives (Apriliani et al., 2024; Putri & Murtanto, 2023). Financial performance, on the other hand, captures a firm's economic strength using indicators such as Return on Assets (ROA), Return on Equity (ROE), and Net Profit Margin (NPM) (Putra & Musthofa, 2023; Winarno, 2019). The interaction between these variables provides insights into how economic success can align with environmental responsibility, offering a pathway for integrating sustainability within business strategies.

Previous studies, including those by (Sitompul et al., 2023), have found a significant relationship between carbon and financial performance, suggesting that efficient carbon performers often achieve better financial outcomes due to improved resource management, reduced operational costs, and enhanced stakeholder trust. Recent studies emphasize the increasing importance of integrating environmental

accountability with financial metrics, particularly in rapidly industrializing regions such as Asia-Pacific (Afrizal et al., 2023; Al-Rabab'a et al., 2024; Yuliana & Wedari, 2023). Despite these advancements, there remains a lack of comprehensive analysis examining how carbon and financial performance jointly influence carbon disclosure across different industries and countries within the Asia-Pacific region. This region hosts diverse economies with varying environmental challenges and regulatory frameworks (Almas et al., 2023). Given its economic weight and high carbon footprint, such analysis is crucial to provide industry specific insights and inform effective carbon management policies (Afrizal et al., 2023; Yuliana & Wedari, 2023). Including Indonesia further enriches the study by addressing unique issues faced by developing countries, such as deforestation, land degradation, and high fossil fuel reliance (Keh et al., 2023; Mardiatmoko, 2022). However, little is known about how carbon and financial performance jointly affect carbon disclosure practices among firms operating in this region. Therefore, this study aims to fill this theoretical and practical gap. The findings are expected to contribute both academically and practically, offering strategic guidance for sustainability-oriented governance and corporate practices.

Thus, this study contributes to filling the gap in the literature by providing a comprehensive analysis of how financial and carbon performance jointly influence carbon disclosure across diverse industries in the Asia-Pacific region. This approach contributes the academic discourse on corporate environmental accountability and offers strategic insights for policymakers and practitioners aiming to foster sustainable economic growth.

Literature Review

Legitimacy and Signaling Theory

Legitimacy Theory suggests that organizations must align their operations with societal expectations to maintain support and avoid sanctions. This concept of legitimacy is rooted in the idea that an entity's actions must be seen as desirable and appropriate according to socially constructed norms (Suchman, 1995). In this study, Legitimacy Theory explains why companies with higher carbon and financial performance are motivated to disclose carbon emissions: such disclosures enhance their legitimacy and strengthen public trust, helping them secure long-term social acceptance (Chandra et al., 2021; Deegan, 2019). Conversely, firms with weaker performance may provide limited disclosure to avoid negative scrutiny (García-Olalla & Vázquez-Ordás, 2024).

Meanwhile, Signaling Theory on the other hand, emphasizes the role of communication in reducing information asymmetry between firms and their stakeholders (Spence, 1973). Companies that achieve

strong financial and carbon performance voluntarily disclose their emissions to indicate transparency and responsible environmental management, thereby attracting socially conscious investors and improving access to capital (Li et al., 2023; Rahmawati et al., 2024; Wang et al., 2023). This theory helps to interpret how firms use disclosure to differentiate themselves and reduce information asymmetry (Sunani et al., 2024). By integrating these theories, the study conceptualizes carbon disclosure not only as a compliance mechanism but also as a strategic tool to maintain legitimacy and convey positive signals to stakeholders. Both theories underscore the importance of transparent environmental reporting in maintaining a company's reputation and securing long-term success in a socially and environmentally conscious market. This theoretical integration underpins the hypotheses linking carbon performance and financial performance to carbon disclosure and helps explain possible variations in disclosure practices across firms and industries (Chariri et al., 2023; Yuliana & Wedari, 2023).

Carbon Performance

Carbon performance refers to a company's ability to manage carbon emissions from its operations, aligning with sustainability principles that integrate economic, social, and environmental aspects (Al-Rabab'a et al., 2024). According to legitimacy theory, carbon performance is essential for companies to maintain social support and legitimacy (Chariri et al., 2023) To ensure business sustainability, companies must meet environmental responsibility expectations. Carbon Emission Intensity (CEI) is commonly used to measure carbon performance, considering total carbon emissions, particularly Scope 1 and Scope 2 emissions (Benkraiem et al., 2022a; Bhatia & Ranganathan, 2004). Scope 1 includes direct emissions from owned or controlled sources, while Scope 2 includes indirect emissions from purchased energy consumption.

CEI reflects a company's efficiency in managing emissions relative to its operational scale. Factors such as board independence and company size also influence carbon performance, with larger firms having more resources to manage emissions and independent directors improving sustainability oversight. GRI Standard 305 provides guidelines for transparent emission reporting, covering Scope 1, Scope 2, and Scope 3 emissions (GRI, 2023). Reporting under GRI enhances accountability and strengthens legitimacy with stakeholders. A low CEI is considered an indicator of environmental responsibility, improving social legitimacy (Yuliana & Wedari, 2023). Additionally, GRI reports detail mitigation strategies, such as energy efficiency and low-carbon technology investments, enhancing the company's sustainability strategy and operational performance (Candra & Lindrianasari, 2024).

Financial Performance

Financial performance is crucial in assessing a company's ability to meet its economic goals, covering aspects like profitability, liquidity, solvency, and asset efficiency (Dewi & Nurleli, 2024). Metrics like Return on Assets (ROA) are key indicators for decision-making by management and stakeholders, reflecting how efficiently a company uses its assets to generate profit (Lubis et al., 2024). Signal theory explains that companies with strong financial performance use this information to send positive signals to stakeholders, attracting investment and building reputation (Rahmawati et al., 2024).

ROA also plays a strategic role in supporting business decisions and company sustainability. A high ROA signals operational efficiency and competitiveness, which are attractive to investors. The GRI strengthens signaling theory by linking financial performance with social and environmental impacts, such as risks from climate change (Kılıç & Kuzey, 2019). Thus, both signal theory and ROA help analyzed the relationship between financial performance, investor trust, and corporate sustainability (Apriliani et al., 2024; Sidiq et al., 2021; Yuliana & Wedari, 2023).

Carbon Emissions Disclosure

Carbon emissions disclosure is the process by which companies report greenhouse gas emissions resulting from their operational activities, reflecting their commitment to environmental sustainability. Transparency in this disclosure has become increasingly important as global awareness of climate change rises, pushing companies to adhere to stricter reporting standards. Studies show that companies with strong carbon disclosures receive positive market responses, as they are seen as more transparent and responsible (Afrizal et al., 2023). Additionally, the Emissions Score is used to measure a company's effectiveness in reducing carbon emissions, evaluating environmental policy performance, and attracting sustainability-conscious investors (Potharla & Turubili, 2024).

To improve transparency, companies in countries like Japan and South Korea have adopted stricter carbon disclosure guidelines (Jae & Yeon, 2024). Organizations such as the Carbon Disclosure Project (CDP) and Global Reporting Initiative (GRI) provide standardized frameworks to help companies report emissions consistently. For example, GRI 305: Emissions allows companies to report Scope 1, Scope 2, and Scope 3 emissions, offering a comprehensive view of environmental impacts across the company’s value chain (GSSB, 2016). While transparent disclosures enhance corporate reputation and strengthen stakeholder trust, companies face challenges such as the cost of data collection and emission analysis, especially in complex industries (Saha et al., 2019). However, with regulatory support and international organizations' guidance, these challenges can be overcome, allowing companies to gain a competitive edge,

increase customer loyalty, and enhance their position in the global market. Effective carbon disclosure not only contributes to environmental sustainability but also positively impacts long-term financial performance (Dewi & Nurleli, 2024).

Carbon Performance and Carbon Emissions Disclosure

The relationship between good carbon performance and carbon emissions disclosure is positively supported by Legitimacy Theory, where companies that demonstrate environmental responsibility aim to strengthen their positive image in society. Companies with excellent carbon performance have the incentive to be more transparent in reporting to maintain their legitimacy status. Research by (Dharma et al., 2024; Rahmawati et al., 2024) shows that companies with better environmental performance are more likely to disclose carbon information transparently, as they seek to leverage their positive performance to enhance their public image. Signaling Theory also plays a role, as the disclosure of good carbon performance acts as a positive signal to the market and investors, affirming that the company has stable long-term prospects and is responsible. A study by (Bhandary, 2024) found that companies with higher carbon performance tend to disclose more carbon information as a strategy to attract investors who consider ESG criteria in their investment decisions. Therefore;

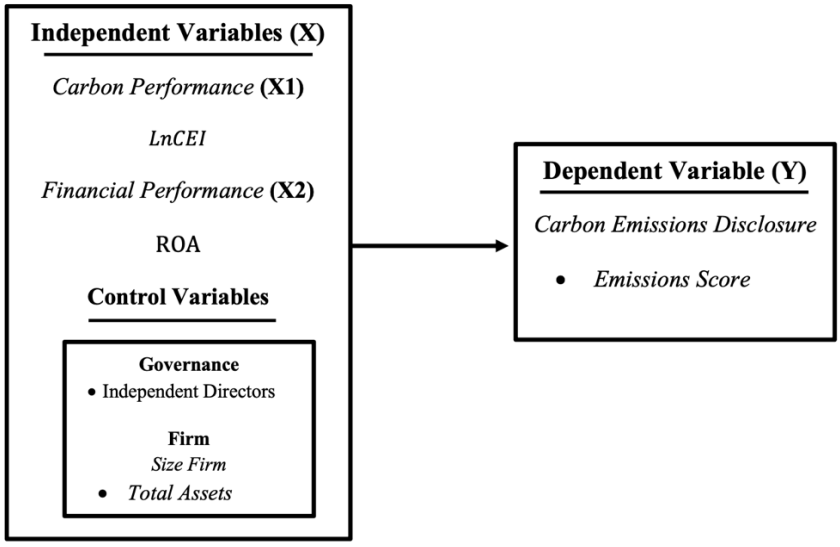
H1: Carbon performance has a significant positive effect on carbon emissions disclosure.

Financial Performance and Carbon Emissions Disclosure

Strong financial performance enables companies to have more resources to conduct more comprehensive and transparent carbon disclosures. From the perspective of Signaling Theory, good carbon disclosure serves as a positive signal to stakeholders, including investors, that the company is not only able to meet environmental standards but also effectively manage environmental risks. Companies with strong financial performance are more motivated to disclose carbon information as they have the capability to meet the environmental standards expected by society. Carbon disclosure from financially successful companies sends a positive signal that they have the adequate capacity to manage environmental risks and maintain long-term business stability. Research by (Chariri et al., 2023; Méndez et al., 2024) shows that companies with high profitability are more open in their carbon disclosures because they seek to strengthen their reputation as entities committed to sustainable business practices. Therefore;

H2: Financial performance has a significant positive effect on carbon emissions disclosure.

Figure 1. Conceptual Framework



Research Methods

Research Design

This study employs a quantitative approach with panel regression analysis to examine the relationship between carbon performance and financial performance on carbon emissions disclosure The dependent variables are Carbon Performance (CP), proxied by the natural logarithm of the Carbon Emission Intensity (LnCEI = CO2 Scope 1 dan Scope 2 (Total Carbon Emissions)/ multiplied by -1 (creating a higher value to indicate better carbon performance)), and Financial Performance (FP), proxied by Return on Assets (ROA). The independent variable is Carbon Emissions Disclosure (CED), with control variables including Firm Size (FS) measured by total assets, and Independent Directors (IDs).

Population, Sample, and Sampling Technique

The population of this study consists of 2,730 companies in the energy, chemical, and utilities sectors across 16 Asia-Pacific countries, classified according to the Thomson Reuters Business Classification (TRBC). A purposive sampling method was applied to select 108 companies from 11 countries in the region. The sample was based on two main criteria: (i) availability of relevant carbon emissions and financial performance data in company reports, and (ii) reporting of CO2 emissions, revenue, ROA, total assets, and board composition over five years (2019-2023). The sample is detailed in Table 1

below, which outlines the criteria used for sample selection. Based on these criteria, the study includes 108 companies, resulting in a total of 540 firm-year observations.

Table 1. Sample Selection

	Sample Selection Criteria	Companies
1	The industrial companies in the "Energy, Chemical, and Utilities" sectors, with the availability of corporate reports and relevant disclosures related to carbon emissions disclosure and financial performance.	2.730
2	The industrial companies in the "Energy, Chemical, and Utilities" sectors, with the availability of corporate reports and relevant disclosures related to carbon emissions disclosure and financial performance.	(2.622)
	Number of Samples	108
	Observation Period	5 Tahun
	Total Observations	540

Operational Definitions and Measurements of Variables

Table 2. Operational Definition Table of Variables

Variable	Definition	Measurements	Reference
Dependent Variable			
Carbon Emissions Disclosure (CED)	Carbon emissions disclosure reflects a company's commitment and effectiveness in reducing carbon emissions, serving as an indicator of its environmental performance evaluation	*Emissions Score* which measures a company's commitment and effectiveness in reducing environmental emissions throughout its production and operational processes, is obtained from the Thomson Reuters Refinitiv Eikon database.	(Thomson Reuters Refinitiv Eikon)
Independent Variable			
Carbon Performance (CP)	Carbon performance refers to a company's effectiveness or ability to manage the carbon emissions resulting from its operational activities.	$\text{LnCEI} = \text{Ln}\ \frac{Total\ Carbon\ Emissions}{Revenue} - 1$	(Al-Rabab'a et al., 2024; Benkraiem et al., 2022b; Selviana, 2019)
Financial Performance (*Return on Assets (ROA)* (FP)	Financial performance is fundamental in assessing a company's ability to achieve its economic objectives. ROA is a ratio that reflects the company's efficiency in utilizing its assets to generate profits.	$\text{ROA} = \frac{Net\ Income}{Total\ Aset}$	(Wijaya, 2019)

Variable	Definition	Measurements	Reference
Control Variable			
Firm Size (Total Aset *(FS)*)	Firm size is an indicator used to measure the scale or magnitude of a company.	Firm Size = Ln Total Aset	(Hapsoro & Falih, 2020; Yuliana & Wedari, 2023)
(Independent Directors) (IDs))	Independent directors are members of the board who have no business or financial relationships with the company other than their role as board members.	The percentage of independent board members as reported by the company.	(Arora & Soni, 2023; Farida & Sofyani, 2018; Setiawan et al., 2022)

Data Analysis Techniques

This study applies panel data regression analysis supported by descriptive statistics and classical assumption testing. The analysis is performed using Stata 16 software to ensure accuracy and reliability of the results. The most suitable estimation model will be determined through model testing, followed by panel data regression to assess the influence of carbon performance and financial performance on carbon emissions disclosure. The panel regression model used is:

$$\boldsymbol{CED_{it} = \alpha_i + \beta_1 CP_{it} + \beta_2 FP_{it} + \beta_3 FS_{it} + \beta_4 IDs_{it} + \varepsilon_{it}}$$

Where:

$\boldsymbol{CED}$ = *Carbon Emissions Disclosure*
$\boldsymbol{\alpha_i}$ = Constant *(intercept)*
$\boldsymbol{\beta_1 - \beta_2}$ = Coefficient Regression
$\boldsymbol{CP}$ = *Carbon Performance*
$\boldsymbol{FP}$ = *Financial Performance*
$\boldsymbol{FZ}$ = *Firm Size*
$\boldsymbol{IDs}$ = *Independent Directors*
$\boldsymbol{\varepsilon}$ = Error-*term*
$\mathbf{i}$ = Number of Units (Panels)
$\mathbf{t}$ = Number of Observation for Panel Unit $_i$

Results and Discussion

This study aims to analyze the influence of carbon performance and financial performance on carbon emissions disclosure in companies within the "Energy, Chemical, and Utilities" sectors in the Asia-Pacific region. From a total population of 2,730 companies, 108 companies were selected as the final sample, resulting in 540 observations during the period from 2019 to 2023.

Descriptive Statistics

Descriptive statistics, as presented in Table 3, show that the average carbon emissions disclosure (CED) is 71.252 with a standard deviation of 21.564. The average value being higher than the standard deviation indicates that the level of carbon disclosure among companies does not vary greatly. Carbon performance (CP) has an average of 7.698, reflecting the efficiency of companies in managing carbon emissions. Meanwhile, financial performance (FP) has an average of 0.04 with a standard deviation of 0.046, showing significant variation in profitability across companies, including those with losses and substantial profits.

Table 3. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
CED	540	71.252	21.564	7.955	99.847
CP	540	7.698	1.667	3.82	13.62
FP	540	.04	.046	-.137	.355
FS	540	23.072	1.229	19.922	26.702
IDs	540	45.46	18.564	6.897	100

Source: processed data (2024)

Model Estimation Test

Table 4. Chow Test

Mean dependent var	71.205	SD dependent var	21.656
R-squared	0.835	Number of obs	540
F-test	19.575	Prob > F	0.000
Akaike crit. (AIC)	4102.363	Bayesian crit. (BIC)	4583.019
*** p<.01, ** p<.05, * p<.1			

Chow Test

F(107, 428)	16.40
Prob > F	0.0000

Source: processed data (2024)

Table 5. Hausman Test

	Coef.
Chi-square test value	16.548
P-value	.002

Source: processed data (2024)

Based on the estimation tests, the Chow test in Table 4 and the Hausman test in Table 5 indicate that the Fixed Effect Model (FEM) is the most appropriate panel data regression model for this study, as it effectively captures heterogeneity among companies.

Classical Assumption Test – Multicollinearity Test and Heteroscedasticity Test

Table 6. Multicollinearity Test - Pairwise Correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) CED	1.000				
(2) CP	0.276	1.000			
(3) FP	0.050	0.126	1.000		
(4) FS	0.199	-0.116	-0.165	1.000	
(5) IDs	-0.222	-0.043	0.070	-0.209	1.000

Source: processed data (2024)

Table 7. Heterokedastisitas Breusch-Pagan Test

H0: Constant Variance	
Chi2(1)	86.724
Prob>chi2	0.000

Source: processed data (2024)

Based on the results presented in Table 6, the multicollinearity test revealed no high correlation among the independent variables, ensuring no multicollinearity issues in the regression model. However, the heteroscedasticity test indicated non-constant residual variance, as shown in Table 7. Which was corrected using the Variance-Covariance Estimation (VCE) Robust method to ensure more valid and reliable regression estimates.

Table 8. Variance-Covariance Estimation Robust

CED	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
CP	2.306	1.264	1.82	.071	-.2	4.812	*
FP	18.521	20.297	0.91	.364	-21.715	58.757	
FS	10.174	4.693	2.17	.032	.87	19.477	**
IDs	.151	.085	1.77	.08	-.018	.32	*
Constant	-188.887	107.287	-1.76	.081	-401.57	23.797	*

Mean dependent var	71.205	SD dependent var	21.656
R-squared	0.071	Number of obs	540
F-test	3.865	Prob > F	0.011
Akaike crit. (AIC)	3886.363	Bayesian crit. (BIC)	3903.529

**** p<.01, ** p<.05, * p<.1*

Source: processed data (2024)

Based on the VCE robust analysis presented in Table 8 above, shows that Carbon Performance (CP) has a coefficient of 2.306 and is significant at the 1% level ($p < 0.01$), indicating that improved CP leads to higher Carbon Emissions Disclosure (CED). This supports Legitimacy and Signaling Theory, where companies with good carbon performance are more transparent to maintain social legitimacy and attract stakeholders. Firm Size (FS) also significantly influences CED (coefficient 3.619, $p < 0.05$), suggesting that larger companies are better positioned to meet international carbon disclosure standards like CDP and GRI. In contrast, Independent Directors (IDs) have a negative effect on CED (coefficient 0.151, $p < 0.1$), likely due to their focus on efficiency and risk management, reducing emphasis on environmental disclosures.

Financial Performance (FP), measured by Return on Assets (ROA), does not significantly affect CED (p-value = 0.364), indicating that carbon transparency is more influenced by regulations and stakeholder pressure than profitability. The R-squared value of 0.071 shows that the model explains 7.1% of the variability in CED, and the F-test ($p < 0.01$) confirms statistical significance. The analysis remains valid despite heteroscedasticity, ensuring reliable results. This study highlights the importance of carbon performance and firm size in carbon emissions disclosure, while the effects of independent directors and financial performance warrant further research.

Panel Data Regression Analysis

Table 9. Panel Data Regression

Variable	(1) FEM
CP	2.306*
	(1.264)
FP	18.521
	(20.297)
FS	10.174**
	(4.693)
IDs	0.151*
	(0.085)
Constant	-188.887*
	(107.287)
Observations	540
Number of id	108
R-squared	0.071

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: processed data (2024)

Based on the panel data regression test results presented in Table 9 above, the regression equation model in this study can be explained as follows:

$$CED_{it} = \alpha_i + \beta_1 CP_{it} + \beta_2 FP_{it} + \beta_3 FS_{it} + \beta_4 IDs_{it} + \varepsilon_{it}$$
$$CED_{it} = (-188.887)_i + (2.306)CP_{it} + (18.521)FP_{it} + (10.174)FS_{it} + (0.151)IDs_{it} + \varepsilon_{it}$$
$$CED_{it} = -188.887_{\ i} + 2.306CP_{it} + 18.521FP_{it} + 10.174FS_{it} + 0.151IDs_{it} + \varepsilon_{it}$$

The regression results show several conclusions. First, the constant value (-188.887) indicates that without the contribution of independent and control variables, the level of carbon emissions disclosure is very low. Second, Carbon Performance (CP) positively affects Carbon Emissions Disclosure (CED) with a coefficient of 2.306 ($p < 0.1$), meaning that each increase of 1 unit in CP increases CED by 2.306 units. Third, Financial Performance (FP) has a coefficient of 18.521 but is not statistically significant ($p > 0.1$), indicating that it does not directly influence CED. Fourth, Firm Size (FS) significantly positively affects CED (coefficient 0.174, $p < 0.05$), suggesting that larger companies tend to disclose higher carbon emissions. Meanwhile, Independent Directors (IDs) also have a significant positive effect (coefficient 0.151, $p < 0.1$), indicating that an increase of 1 unit in independent directors can improve CED by 0.151 units.

Cross Effect Section – by countries

Table 10. Cross Effect Section – by countries

Variable	*Cross Section Effect*
1. Australia	30.201***
	(4.901)
2. China	27.75***
	(5.029)
3. India	29.48***
	(4.738)
4. Indonesia	17.84***
	(6.423)
5. Japan	34.83***
	(4.976)
6. South Korea	51.77***
	(5.348)
7. Malaysia	23.97***
	(4.989)
8. New Zealand	9.066
	(5.586)
9. Philippines	54.99***
	(9.016)
10. Singapore	5.922
	(4.888)
11. Thailand	41.43***
	(4.170)

Source: processed data (2024)

We tested the regression model across countries using FEM to control for unobserved country-specific effects that could influence the results, with the test results presented in Table 10. The analysis showed a significant impact of various variables on the level of carbon emissions disclosure (CED). Countries like South Korea and the Philippines exhibited much higher levels of carbon emissions disclosure compared to the reference country, with coefficients of 51.77 and 54.99, respectively, indicating strong commitment to carbon reporting.

Japan also showed significantly higher carbon emissions disclosure compared to the reference country (coefficient 34.83), although still lower than South Korea and the Philippines, suggesting room for improvement in transparency. Other countries such as China, India, Indonesia, Malaysia, and Thailand also showed a positive and significant impact, though with lower coefficients than South Korea and the Philippines.

Discussion

The Impact of Carbon Performance on Carbon Emissions Disclosure

The results show that CP has a significant positive effect on CED, supporting Hypothesis 1. This finding aligns with Legitimacy Theory, which suggests organizations disclose environmental information to secure legitimacy and stakeholder approval (Deegan, 2019; Suchman, 1995). In Asia-Pacific, where regulations tighten and stakeholder awareness rises, firms use disclosure to maintain societal support and avoid negative scrutiny (Al-Rabab'a et al., 2024; Clarkson et al., 2008).

From the Signaling Theory perspective, strong carbon performance disclosure signals a company's proactive and responsible environmental risk management (Wang et al., 2023). This is evident in Japan and South Korea, where stricter standards and low-carbon strategies prevail (Jae & Yeon, 2024; Luo & Tang, 2023). Higher coefficients in these countries reflect disclosure driven by legitimacy and signaling motives.

Conversely, in developing countries like Indonesia and Malaysia, transparent disclosure is growing but constrained by limited resources and weaker regulations (Afrizal et al., 2023; Dimabuyu, 2023). Nonetheless, firms with strong carbon performance leverage disclosure to gain competitive advantages and strengthen market credibility. Thus, these results confirm theoretical expectations and show how regional differences shape disclosure practices.

The Impact of Financial Performance on Carbon Emissions Disclosure

The analysis shows that FP does not significantly affect CED, leading to the rejection of Hypothesis 2. This suggests that profitability alone is not the main motivator for carbon disclosure in Asia-Pacific.

While Signaling Theory posits firms may signal strength through profitability, this study indicates that external regulatory and stakeholder pressures play a stronger role than financial capacity (Matsumura et al., 2014; Rahmawati et al., 2024).

In developed economies like Australia and Japan, strict regulations and investor expectations compel disclosure regardless of profitability (Downar et al., 2021; Luo & Tang, 2023). In developing economies, firms prioritize operational stability over environmental transparency (Mardiatmoko, 2022; Ratmono et al., 2020). Firms increasingly recognize that environmental transparency builds legitimacy and trust, which can outweigh short-term profitability signals (Comello et al., 2023; Siddique et al., 2021). This underscores that disclosure is a strategic tool for long-term sustainability rather than immediate financial signaling.

The Role of Control Variables

The findings indicate that FS positively influences CED, suggesting larger firms have better resources and systems to meet disclosure expectations (Farida & Sofyani, 2018; Hapsoro & Falih, 2020). Bigger firms face greater public scrutiny, increasing legitimacy pressures. Similarly, independent directors (IDs) positively influence CED, supporting the view that strong governance strengthens accountability and transparency (Setiawan et al., 2022). Independent boards help prioritize environmental issues, enhance trust, and signal responsibility to stakeholders.

Regional Context and Implications

The Asia-Pacific region's diverse economic and regulatory contexts shape disclosure practices. Countries like South Korea and the Philippines show high disclosure coefficients due to strong regulatory frameworks and societal pressure (Almas et al., 2023; United Nations ESCAP, 2023). Meanwhile, Indonesia, India, and Malaysia show positive but lower levels, reflecting gradual progress amid structural challenges (Afrizal et al., 2023; Dimabuyu, 2023).

These differences highlight that disclosure is shaped by complex interactions of regulations, societal expectations, and institutional pressures. The findings confirm that carbon performance is key to driving disclosure, while profitability alone is insufficient. Policy interventions should strengthen frameworks and increase stakeholder awareness rather than rely solely on financial incentives. Stronger regional cooperation and harmonized standards can further promote transparency and support the transition toward sustainable development (Luo & Tang, 2023; United Nations ESCAP, 2023).

Conclusion

This study reveals that carbon performance significantly and positively affects carbon emissions disclosure, supporting the idea that environmental performance serves as a tool to secure legitimacy and build stakeholder trust. This finding aligns with Legitimacy Theory and Signaling Theory, suggesting that firms with strong carbon performance use disclosure to demonstrate accountability, reduce information asymmetry, and enhance market reputation. Meanwhile, financial performance does not have a significant effect, indicating that profitability alone does not motivate carbon transparency in Asia-Pacific. Instead, disclosure decisions are more strongly influenced by external pressures, such as regulatory demands, societal expectations, and institutional scrutiny.

The positive effects of firm size and independent directors further highlight the importance of organizational capacity and strong governance in encouraging transparent reporting. In the Asia-Pacific context, these results emphasize that companies in advanced economies respond more proactively to environmental demands, while firms in developing countries can leverage strong carbon performance to improve legitimacy and competitiveness even when financial resources are limited. These insights underline the critical role of environmental strategy over pure financial outcomes in driving corporate transparency and supporting long-term sustainability.

This study has three main limitations. First, it only includes Scope 1 and 2 emissions, excluding Scope 3, which limits the overall view of carbon disclosure. Future studies should incorporate Scope 3 data. Second, the focus on Asia-Pacific, with its regulatory and economic diversity, limits generalizability. Broader regional comparisons are suggested. Third, only company size and independent directors are used as controls, while factors like ownership, investor pressure, or sustainability strategies are not yet considered and should be included in future research.

Theoretically, this study supports the relevance of legitimacy and signaling theories in carbon disclosure and enriches sustainability accounting literature. Practically, it urges companies to integrate carbon disclosure into sustainability strategies and adopt global standards like GRI or CDP. Policy-wise, it highlights the need for standardized carbon reporting, including Scope 3, and suggests tax incentives to support sustainability. Governments should also promote regional cooperation to harmonize carbon reporting standards.

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