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The Impact of Carbon Emission Disclosure and Green Innovation on Company Value: Moderating Role of Environmental Performance

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ABSTRACT

This study investigates the impact of carbon emission disclosure and green innovation on corporate value, moderated by environmental performance, among Indonesian manufacturing companies listed on the Indonesia Stock Exchange from 2018 to 2022. Drawing on data from annual and sustainability reports, as well as PROPER evaluations, the research employs a purposive sampling method to select 55 relevant companies. Findings reveal that carbon emission disclosure significantly enhances corporate value, indicating the importance of transparency in addressing environmental concerns and attracting stakeholders. Similarly, green innovation positively influences corporate value, highlighting its role in bolstering environmental stewardship and stakeholder approval. However, environmental performance, measured through PROPER ratings, does not significantly moderate these relationships, suggesting that while high environmental performance ratings may enhance credibility, they do not necessarily drive extensive carbon disclosure or green innovation efforts. These findings underscore the need for companies to prioritize transparent carbon reporting and proactive green initiatives to enhance both financial performance and environmental sustainability. Future research directions could explore additional variables like eco-efficiency and corporate social responsibility to further enrich understanding of sustainable corporate practices and their impact on valuation.

INTRODUCTION

The changing climate in Indonesia, driven by global warming, has become a critical issue worldwide (Saka & Oshika, 2014). Global warming, a significant threat to life on Earth, results from the increasing global temperatures primarily caused by greenhouse gases (GHGs). These gases, emitted in rising amounts, trap solar energy in Earth's atmosphere (Anggraeni, 2015). According to Our World in Data, there has been a significant fluctuation in GHG emissions, with a substantial rise of 28.6% from 2018 to 2019, a decrease of 14.21% from 2019 to 2020, and subsequent increases in 2021 and 2022 by 2.1% and 8.1% respectively (Jones et al., 2024). This trend underscores the continuous rise in GHG emissions, highlighting the need for companies to transparently disclose their carbon emissions due to public concern over their impact (Bae Choi et al., 2013).

In Indonesia, the manufacturing and construction industries contributed 17.75% of carbon emissions in 2018, as noted by the Ministry of Energy and Mineral Resources (Nadya, 2023). Data from the Central Bureau

Corresponding Author : Selvia Oriska

InJEBA International Journal of Economics, Business and Accounting
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Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

of Statistics revealed that the food and beverage industry grew by 4.90%, the transportation equipment industry by 10.67%, and the basic metal industry by 14.80% in 2022, indicating a positive correlation between industrial growth and GHG emissions (Gabrielle & Toly, 2019). The risks associated with climate change and carbon emissions have raised concerns among investors, regulators, standard-setters, and other stakeholders (Matsumura et al., 2014).

The Indonesian government has implemented various environmental management measures, including the PROPER program, which aims to enhance corporate environmental performance under the Ministry of Environment and Forestry. PROPER, mandated by Law No. 23 of 1997 on Environmental Management, promotes transparency, equity, accountability, and public involvement in environmental management. In 2018, PROPER achieved significant savings in energy efficiency, pollution reduction, GHG emission reduction, water efficiency, and waste management, amounting to Rp 287.334 trillion (PROPER, 2018).

Green innovation is essential for mitigating and addressing environmental impacts, helping companies minimize potential damage, reduce carbon emissions, and improve environmental performance (Ramadhan et al., 2023). This innovation ensures the optimal use of resources, emphasizing environmentally friendly materials and technologies (Xie et al., 2022). Previous studies by Gabrielle & Toly (2019) and Nur Utomo et al. (2020) found a positive impact of environmental performance on firm value. Dewi & Rahmianingsih (2020) concluded that green innovation positively affects firm value, while Xie et al. (2022) found a short-term devaluation. Studies on carbon emission disclosure by Kurnia et al. (2021) and Rahmianingsih & Malau (2022) reported a positive impact on firm value, aligning with Yuliandhari et al. (2023) but noting a significant negative effect of green innovation on firm value.

Building on prior research, Damas et al. (2021) found that green innovation and carbon emissions disclosure positively affect firm value, though environmental performance does not moderate these effects. Hardiyansyah et al. (2021) observed that carbon emission disclosure positively influences firm value, strengthened by environmental performance and industry type. Contrarily, Ramadhan et al. (2023) reported that neither carbon emission disclosure nor green innovation significantly affects firm value, indicating a need for further study due to these varying findings. This study, aims to examine the influence of carbon emission disclosure and green innovation on firm value, and how environmental performance moderates these relationships. It benefits investors and academics by providing insights and serving as a reference for future research. This study builds on conflicting findings from previous research, necessitating further investigation.

LITERATURE RESEARCH

A. The theories

In developing a comprehensive theoretical foundation, Stakeholder Theory and Legitimacy Theory provide essential frameworks for understanding corporate behavior and its societal implications. Stakeholder Theory, articulated by Freeman in 1984, asserts that a company's success hinges on its ability to manage and fulfill the diverse interests of stakeholders such as government entities, employees, shareholders, and the broader community (Puspitaningrum & Indriani, 2021). This theory underscores the necessity for businesses to not only maximize economic goals but also to achieve environmental and social targets to garner stakeholder support and sustain operations (Rahmianingsih & Malau, 2022).

Conversely, Legitimacy Theory, introduced by Dowling and Pfeffer in 1975, centers on the idea that a company's legitimacy and continued existence depend on its adherence to societal norms, values, and expectations (Puspitaningrum & Indriani, 2021). Companies actively engage in voluntary social and environmental disclosures to maintain societal acceptance and justify their resource allocation decisions (Hardiyansyah et al., 2021). By aligning corporate practices with prevailing societal standards, businesses not only secure legitimacy but also cultivate trust and support from the community, enabling sustainable operational continuity (Rahelliamelinda & Handoko, 2024; Khaerun Nisa, 2023). These theories collectively underscore the importance of corporate social responsibility and environmental stewardship in contemporary business strategies.

Corresponding Author : Selvia Oriska

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Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

B. Carbon Emission Disclosure

Carbon emission disclosure involves the recording, acknowledgment, disclosure, and measurement by companies of the extent of carbon emissions they produce, stemming from the combustion of carbon-containing compounds such as CO2, fossil fuels, and other fuels (Hardianti & Dwi Mulyani, 2023). It serves as evidence of corporate responsibility fulfillment, with operational activities being a significant contributor to carbon emissions (Khaerun Nisa, 2023; Yuliandhari et al., 2023). In Indonesia, carbon emission disclosure remains voluntary due to the absence of legislation mandating such disclosures, influenced by the Kyoto Protocol categorizing Indonesia as a nation with fewer carbon-emitting companies compared to industrialized countries (Ayu Rahmanita, 2020).

C. Green Innovation

Green innovation arises from the evolution of environmental and social issues (Rahelliamelinda & Handoko, 2024), aimed at addressing and reducing environmental damage, thereby enhancing corporate value (Damas et al., 2021; Ramadhan et al., 2023). It minimizes environmental impact and enhances corporate value through innovation efforts (Rahelliamelinda & Handoko, 2024). Green innovation is categorized into two types: green process and green product innovation. Green process innovation focuses on improving resource productivity, energy efficiency, and pollution reduction during production processes (Ma et al., 2017). On the other hand, green product innovation emphasizes materials, energy usage, and pollution, significantly impacting the environment throughout a product's life cycle, from production to disposal (Maria Dangelico & Pujari, 2010).

D. Company Value

Corporate value reflects investors' perception of how well a company manages its operations (Hardiyansyah et al., 2021), influencing its sustainability and efforts to enhance corporate value, indicative of its performance (Rahelliamelinda & Handoko, 2024). Investors perceive corporate value through the relationship between company performance and stock price (Kurnia et al., 2021). It is often associated with stock prices, where higher stock prices indicate higher corporate value (Prawesti Ningrum, 2022). Corporate value benefits shareholders when stock prices rise, motivating companies to strive for high corporate value, signaling prosperity for shareholders and attracting investors seeking profitable ventures (Asnita & Wahidahwati, 2019). Corporate value is measured using Tobin's Q ratio, calculated by adding market value (derived from multiplying closing stock price by outstanding shares) and total debt, then dividing by total assets.

E. Environmental Performance

Environmental performance, as defined by the Environmental Protection and Management Law No. 32 of 2009, involves systematic and integrated efforts to preserve environmental functions and prevent damage or pollution (Khaerun Nisa, 2023). Companies can enhance environmental performance through various means such as using eco-friendly energy, efficient use of raw materials, and participating in government environmental programs like PROPER (Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan).

PROPER, overseen by the Ministry of Environment and Forestry, is mandated under the Environmental Management Law No. 23 of 1997. It aims to improve environmental management performance and ensure corporate compliance with principles of good governance such as transparency, fairness, accountability, and community involvement in environmental management. PROPER assessment criteria include compliance assessment criteria for pollution control in air and water, management of hazardous and toxic waste (B3), control of marine pollution, and potential environmental damage. Additional criteria evaluate the adoption of best environmental management practices, energy efficiency efforts, emission reduction, waste reduction, reuse, and recycling practices, water conservation, biodiversity protection, and community development programs. PROPER targets companies with significant environmental impacts, listed on the stock exchange, and involved in products oriented towards export or public use.

Corresponding Author : Selvia Oriska

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Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

METHOD

A. Population and Sampling Method

The population for this study comprises manufacturing companies listed on the Indonesia Stock Exchange (IDX) from 2018 to 2022, totaling 140 companies. Sampling is conducted using purposive sampling method with specific criteria: (1) companies listed on the IDX during the specified years, (2) companies not participating in the Program Penilaian Peringkat Kinerja (PROPER) from 2018 to 2022, and (3) companies showing inconsistent or insufficient disclosure of carbon emissions in their annual or sustainability reports for the years under study (2018-2022). This approach aims to select a sample that aligns with the study's focus on carbon emission disclosure, green innovation, and environmental performance as moderators influencing corporate value, ensuring relevance and consistency in data collection and analysis.

B. Data Source

The study utilizes secondary data sourced through intermediaries, specifically annual and sustainability reports of manufacturing companies for the years 2018 to 2022. These secondary data are obtained from official sources such as the Indonesia Stock Exchange (IDX) website (idx.co.id), company websites, and the results of the Program Penilaian Peringkat Kinerja Perusahaan dalam Pengelolaan Lingkungan (PROPER). Secondary data refers to information gathered from these established channels rather than through direct interaction or primary research methods. Annual reports provide comprehensive insights into a company's financial performance, while sustainability reports detail its environmental and social initiatives, aligning with the study's focus on carbon emission disclosure, green innovation, and environmental performance as moderators affecting corporate value. This approach ensures a robust foundation of data sourced from credible platforms, essential for conducting thorough analyses and drawing reliable conclusions regarding the interrelationships studied.

C. Data Analysis

The data analysis methodology for this study involves several key steps to ensure robustness and validity in examining the relationships between carbon emission disclosure, green innovation, environmental performance, and corporate value. Firstly, descriptive statistics will be employed to provide a comprehensive overview of the data distribution and variables under study. This includes calculating measures such as means, minimums, maximums, and standard deviations, essential for understanding the central tendencies and variability within the dataset sourced from annual reports, sustainability reports, and PROPER evaluations of manufacturing companies listed on the Indonesia Stock Exchange from 2018 to 2022.

Following descriptive analysis, classical assumption tests will be conducted to validate the regression models used in the study. These tests include checking for normality of residuals using methods like the Kolmogorov-Smirnov test, where a significance level above 0.05 indicates normal distribution. Multicollinearity will also be assessed through tolerance and Variance Inflation Factor (VIF) values, with a tolerance below 0.10 and VIF above 10 indicating multicollinearity. Autocorrelation will be tested using the Durbin-Watson statistic to ensure the absence of serial correlation in the regression residuals. Lastly, heteroskedasticity will be examined to determine if there are systematic patterns in residual variances across observations, crucial for ensuring the reliability of regression model results.

These rigorous statistical tests will culminate in hypothesis testing, where coefficients of determination (R-squared) will indicate the proportion of variance in the dependent variable explained by the independent variables. The significance of individual coefficients will be assessed using t-tests, while the overall significance of the model will be evaluated using the F-test. This structured approach ensures that the findings of the study regarding the impacts of carbon emission disclosure, green innovation, and environmental performance on corporate value are reliable and valid, providing insights for both academic research and practical implications for stakeholders.

Corresponding Author : Selvia Oriska

InJEBA International Journal of Economics, Business and Accounting
DOI:10.5281/zenodo.12948519
Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

RESULTS AND DISCUSSION

1. Descriptive Statistical Test

Table 1. Descriptive Statistical Test

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
CED	55	0,111	0,722	0,45859	0,196045
GI	55	0,250	0,750	0,50455	0,112741
EP	55	3	5	3,60	0,683
NP	55	0,644	17,678	2,94094	3,822370

Based on Table 1, the analysis reveals insights into the variables studied within the context of corporate environmental performance and value. Carbon emission disclosure (X1) across the 55 sampled companies shows an average score of 0.45859, indicating that on average, companies have disclosed approximately half of the carbon emission items measured. The highest score of 0.722 was achieved by Sido Muncul Tbk between 2018 and 2022, while Asahimas Flat Glass Tbk held the lowest at 0.111 during the same period. Green innovation (X2) received an average score of 0.50455, suggesting that companies have effectively implemented approximately half of the assessed innovation indicators, with Asahimas Flat Glass Tbk and Solusi Bangun Indonesia Tbk achieving the highest score of 0.750, and Phapros Tbk the lowest at 0.250. Environmental performance (Z), as a moderating variable, obtained an average rating of 3.60, with a majority of companies (50.9%) achieving the blue rating under the PROPER assessment, indicating good environmental management practices. The company values (Y) exhibit an average score of 2.94094, with a notable deviation between the maximum (17.678) attained by Unilever Indonesia Tbk in 2018 and the minimum (0.644) by Solusi Bangun Indonesia Tbk in 2016, reflecting significant variations in market perceptions of corporate worth. These findings underscore the importance of environmental factors and disclosure practices in influencing corporate valuation and market perceptions within the studied context.

2. Regression Test

After passing all the test for classic assumption test, the result of the regression tests are down below:

Table 2. Model regression 1

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2,409	2,725		0,884	0,381
	CED	17,944	2,706	0,920	6,632	0,000
	GI	8,874	3,805	0,262	2,332	0,024
	EP	-3,382	0,737	-0,604	-4,591	0,000

The data analysis methodology for this study involves several key steps to ensure robustness and validity in examining the relationships between carbon emission disclosure, green innovation, environmental performance, and corporate value. Firstly, descriptive statistics will be employed to provide a comprehensive

Corresponding Author : Selvia Oriska

InJEBA International Journal of Economics, Business and Accounting
DOI:10.5281/zenodo.12948519
Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

Table 3. Model regression 2

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-10,281	8,512		-1,208	0,233
	CED	34,023	12,978	1,745	2,622	0,012
	GI	15,876	6,976	0,468	2,276	0,027
	EP	-,736	2,338	-0,131	-0,315	0,754
	X1_Z	-1,938	4,610	-0,478	-0,420	0,676
	X2_Z	-5,158	4,704	-0,689	-1,097	0,278

Based on the results from regression Model 2 in Table 3, which employed multiple regression analysis (MRA) using SPSS 26 for Windows, the equation Y = -10.281 + 34.032X1 + 15.876X2 – 0.736Z – 1.938X1Z – 5.158X2Z was derived. The analysis indicates that the interaction terms involving environmental performance (Z) with carbon emission disclosure (X1) and green innovation (X2) are not statistically significant, with p-values of 0.676 and 0.278 respectively, both exceeding the 0.05 significance level. Therefore, it can be concluded that environmental performance (Z) does not moderate the effects of carbon emission disclosure (X1) or green innovation (X2) on corporate value (Y). Consequently, hypotheses H3 and H4 are rejected, suggesting that "Environmental Performance does not moderate Carbon Emission Disclosure towards Corporate Value" and "Environmental Performance does not moderate Green Innovation towards Corporate Value."

2. F test

Table 4. F test result

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	367,486	3	122,495	14,822	0,000[b]
	Residual	421,481	51	8,264		
	Total	788,968	54			
2	Regression	389,879	5	77,976	9,574	0,000[b]
	Residual	399,089	49	8,145		
	Total	788,968	54			

Based on Table 4.12, it is evident that in Model 1, the calculated F-value of 14.822 exceeds the critical F-value of 2.79, with a significance level of 0.000 < 0.05. This indicates that all independent variables—carbon emission disclosure (X1), green innovation (X2), and environmental performance (Z)—simultaneously have a significant impact on corporate value (Y). Similarly, in Model 2, the F-value of 9.574 is also greater than the critical F-value of 2.79, with a significance level of 0.000 < 0.05. This signifies that carbon emission disclosure (X1), green innovation (X2), environmental performance (Z), as well as their interactions (X1 with Z and X2 with Z), collectively exert a significant influence on corporate value (Y).

3. Coefficient Determination

Based on the results from the test, the adjusted R square values indicate the coefficient of determination for regression models assessing the influence of independent variables on corporate value (Y). The adjusted R square of 0.434 reveals that 43.4% of the variance in corporate value can be explained by carbon emission disclosure (X1), green innovation (X2), and environmental performance (Z), while the remaining 56.6% is attributed to other factors not included in the study. Moving on, the adjusted R square of 0.443 shows that in Model Regression 2, which includes interactions between X1 and Z, and X2 and Z alongside the main effects, 44.3% of the variance in corporate value is explained by these variables, with 55.7%

Corresponding Author : Selvia Oriska

InJEBA International Journal of Economics, Business and Accounting
DOI:10.5281/zenodo.12948519
Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

accounted for by other unmeasured factors. These findings underscore the significant but partial explanatory power of carbon emission disclosure, green innovation, and environmental performance in influencing corporate value, highlighting the need for further exploration of additional variables to enhance the model's explanatory capability.

3. The Effect of Carbon Emission Disclosure on Company Value

Based on the research findings, it is concluded that "Carbon Emission Disclosure positively influences Corporate Value," thus confirming hypothesis H1. This conclusion is supported by the significant impact of carbon emission disclosure (X1) with a significance level of 0.000 < 0.05 (at a 5% significance level), aligning with stakeholder theory. According to Rahmianingsih & Malau (2022), companies enhance stakeholder benefits by disclosing carbon emission information, which attracts investor interest and increases stock prices due to heightened demand and investor engagement (Kurnia et al., 2021). Additionally, companies consider societal perceptions resulting from operational activities, crucial in legitimacy theory, where community support enhances company image (Puspitaningrum & Indriani, 2021). This study's findings are consistent with prior research by Damas et al. (2021), Kurnia et al. (2021), and Rahmianingsih & Malau (2022), which similarly indicate a positive impact of carbon emission disclosure on corporate value.

4. The Effect of Green Innovation on Company Value

Based on the research findings, it is concluded that "Green Innovation positively influences Corporate Value," thus confirming hypothesis H2. This conclusion is supported by the significant impact of green innovation (X2) with a significance level of 0.024 < 0.05 (at a 5% significance level), consistent with stakeholder theory. According to Khaerun Nisa (2023), environmental performance is crucial, and companies demonstrate their commitment through environmental management and innovations to reduce environmental impacts (Ramadhan et al., 2023). This aligns with legitimacy theory, indicating that legitimacy is achieved when companies demonstrate efforts to observe environmental impacts and societal norms (Khaerun Nisa, 2023). This study's findings are corroborated by prior research by Damas et al. (2021), Dewi & Rahmianingsih (2020), and Chika Dianti & Puspitasari (2024), which similarly highlight the positive impact of green innovation on corporate value.

5. Environmental Performance Weakens the Effect of Carbon Emission Disclosure on Company Value

Based on the research findings, it is concluded that "Environmental Performance does not moderate or weaken the relationship between Carbon Emission Disclosure and Corporate Value," thus rejecting hypothesis H3. This conclusion is supported by the non-significant interaction effect between carbon emission disclosure and environmental performance, with a significance level of 0.676 > 0.05 (at a 5% significance level) and an unstandardized beta coefficient of -1.938. This coefficient indicates that changes in environmental performance can influence a decrease in the relationship between carbon emission disclosure and corporate value. Companies with good PROPER ratings, indicating strong environmental performance, do not necessarily fully disclose their carbon emissions to achieve high scores. According to stakeholder theory, companies disclose information to gain stakeholder support, focusing on overall environmental performance rather than specific disclosures like carbon emissions, which remain voluntary (Ayu Rahmanita, 2020). PROPER ratings primarily assess criteria such as pollution control, hazardous waste management, and environmental damage potential, which may not comprehensively cover carbon emissions (PROPER, 2018). Therefore, achieving gold or green ratings in PROPER reflects efforts to gain legitimacy rather than comprehensive environmental disclosure (Anjani & Astika, 2018). This study's findings are consistent with prior research by Damas et al. (2021) and Hardianti & Dwi Mulyani (2023), which similarly conclude that environmental performance does not moderate the relationship between carbon emission disclosure and corporate value.

6. Environmental Performance Weakens the Influence of Green Innovation on Company Value

Based on the research findings, it is concluded that "Environmental Performance does not moderate or weaken the relationship between Green Innovation and Corporate Value," thus rejecting hypothesis H4. This conclusion is supported by the non-significant interaction effect between green innovation and environmental performance, with a significance level of 0.278 > 0.05 (at a 5% significance level) and an unstandardized beta

Corresponding Author : Selvia Oriska

InJEBA International Journal of Economics, Business and Accounting
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Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

coefficient of -5.158. This coefficient indicates that changes in environmental performance can influence a decrease in the relationship between green innovation and corporate value. Green innovation, aimed at reducing environmental damage and resource use, is driven by consumer preferences for eco-friendly products (Husnaini & Tjahjadi, 2021), reflecting stakeholder theory's emphasis on resource efficiency. However, PROPER ratings do not directly incentivize companies to invest in green innovation, focusing instead on natural resource conservation, environmental management systems, and CSR implementation (PROPER, 2018). Green innovation primarily involves technologies for energy reduction, eco-friendly materials, product packaging, and recyclable resources (Damas et al., 2021), functioning as a voluntary mechanism aligned with social contract fulfillment (Hardiyansyah et al., 2021). This study's findings align with prior research by Damas et al. (2021), indicating that environmental performance does not moderate the relationship between green innovation and corporate value.

CONCLUSION

Based on the findings from the study conducted on 11 manufacturing companies over the period 2018-2022, generating 55 samples, the following conclusions can be drawn regarding the influence of carbon emission disclosure and green innovation on corporate value, moderated by environmental performance. Firstly, carbon emission disclosure (X1) significantly and positively affects corporate value (Y), aligning with stakeholder theory where transparency in carbon emissions enhances investor interest and societal approval. Secondly, green innovation (X2) also shows a significant positive impact on corporate value (Y), indicating that companies' efforts in environmental innovation resonate positively with stakeholders and contribute to legitimacy theory by demonstrating environmental stewardship. However, environmental performance (Z) as a moderator does not significantly influence the relationship between carbon emission disclosure (X1) and corporate value (Y), suggesting that even with high PROPER ratings indicating good environmental performance, voluntary carbon disclosure may not be prioritized. Similarly, environmental performance (Z) does not moderate the relationship between green innovation (X2) and corporate value (Y), indicating that while high PROPER ratings may attract investors, they do not necessarily drive extensive green innovation efforts. Future research in this area should consider expanding the variables studied to include eco-efficiency, corporate social responsibility, and ESG performance to provide a more comprehensive understanding of their impact on corporate valuation and sustainability efforts.

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Corresponding Author : Selvia Oriska

InJEBA International Journal of Economics, Business and Accounting
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Vol. 2, No. 3 (Sept, 2024)
Pp. 240-249

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