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Environmental Management Accounting and Green Innovation on Financial Performance: The Moderating Role of Regulatory Pressure

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ABSTRACT
This study examines the influence of Environmental Management Accounting (EMA) and Green Innovation (GI) on financial performance, with Regulatory Pressure (RP) serving as a moderating variable. Data from 150 manufacturing firms in Indonesia (2020–2025) reveal that both EMA and GI significantly enhance Return on Assets (ROA), affirming their strategic role beyond compliance. Moderation analysis further reveals that RP strengthens the positive relationship between EMA and ROA, as well as between GI and ROA, suggesting that external regulatory forces serve as institutional catalysts that enhance the effectiveness of sustainability practices. The findings contribute to Institutional Theory and Resource-Based View by demonstrating how regulatory mechanisms reinforce the strategic value of internal capabilities. Practically, this study provides insights for managers and policymakers to design regulatory frameworks that not only enforce compliance but also incentivise green transformation through digitalisation and strategic partnerships. While the study is limited to Indonesian manufacturing firms, it opens up avenues for cross-sectoral and cross-country research that incorporates qualitative dimensions and mediating variables. Overall, this research underscores the importance of aligning internal sustainability strategies with external regulatory contexts to optimise financial outcomes.

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INTRODUCTION

In recent years, the Indonesian manufacturing industry has faced significant pressure due to the environmental impact of its production activities. For example, pollution of the Citarum River by textile waste containing microplastics reaches 85% of the total river water samples (Ahmad Arif, 2022) in Bantaeng, PT. Huadi Nickel Alloy Indonesia reportedly dumps waste directly into the sea and air, causing health problems and damage to the ecosystem (Chandra, 2023). This phenomenon suggests that unsustainable operational practices can harm a company's reputation and compromise its long-term financial stability.

To address these challenges, companies have begun to adopt Environmental Management Accounting (EMA), an accounting system that integrates environmental information into the decision-making process. The EMA enables more accurate identification and management of environmental costs, supporting operational efficiency and business sustainability (Sudarminto & Harto, 2023). A study by Agustia (2020) shows that the EMA has a positive and significant influence on the financial performance of manufacturing companies in Indonesia.

In addition to EMA, Green Innovation (GI) is a crucial strategy for addressing environmental pressures. GI encompasses the development of environmentally friendly products and processes, including energy efficiency, waste reduction, and the substitution of hazardous chemicals (J. Zhang et al., 2024). Research by Rupasinghe et al. (2024) found that green product innovation can improve a company's environmental performance, although its impact on financial performance still varies depending on the type of innovation and industry sector.

Financial performance remains the primary indicator of a managerial strategy's success. However, the integration of EMA and GI does not necessarily result in an immediate increase in profitability (Hermawan, 2025). Studies show that the initial cost of implementing green technology and environmental accounting systems can lead to reduced profit margins in the short term (Duggal, 2025). Therefore, it is necessary to understand the factors that can strengthen or weaken the relationship between green strategies and financial performance (Majidah & Aryanty, 2022).

One of the important factors that can moderate these relationships is Regulatory Pressure. Pressures from environmental regulations, such as the Ministry of Environment and Forestry's PROPER, emission standards, and ESG reporting, encourage companies to take EMA and GI more seriously (Aprilina et al., 2023). Regulatory pressure can strengthen managerial commitment to sustainability and increase the effectiveness of green strategies in generating economic value (Marcus & Vogel, 2020). A study by Widyantoro & Rusmanto (2025) demonstrates that regulatory pressures enhance the relationship between green innovation and financial performance in emerging markets.

Studies have examined the relationship between EMA, GI, and FP; inconsistencies remain in the results, and limitations persist in the context of moderation. For example, research by Hermawan (2025) shows that GI has no significant effect on FP, while EMA has a positive effect. However, the study used Environmental Performance as a mediating variable, not a moderator, and did not consider regulatory pressures as external factors that could strengthen or weaken the relationship between variables (Batool & Mohsin, 2025).

A study by S. Zhang et al. (2025) examined the role of Green Intellectual Capital as a moderator between GI and FP, but did not examine regulatory pressures as a form of external and binding public policy intervention. In the context of developing countries such as Indonesia, regulatory pressures, including the Ministry of Environment and Forestry's PROPER, emission standards, and ESG reporting, have a significant impact on the company's sustainability strategy (Rahmaniati & Ekawati, 2024).

Based on the background that has been described, the formulation of the problem in this study is as follows: 1) Does Environmental Management Accounting have a positive effect on the company's Financial Performance? 2) Does Green Innovation have a positive effect on the company's Financial Performance? 3) Does Regulatory Pressure moderate the influence of Environmental Management Accounting on Financial Performance? 4) Does Regulatory Pressure Moderate the Influence of Green Innovation on Financial Performance?

Based on this background, this study aims to investigate the impact of Environmental Management Accounting and Green Innovation on Financial Performance, with Regulatory Pressure serving as a moderating variable. The study is expected to make a theoretical contribution to the sustainable management accounting literature, as well as provide practical implications for companies in designing green strategies that are responsive to regulatory requirements. This research is also relevant for the development of public policies that support industrial transformation towards sustainability.

This research presents a novel approach by simultaneously examining the influence of Environmental Management Accounting and Green Innovation on Financial Performance, which has been studied separately in previous research. In addition, this study introduces Regulatory Pressure as an external moderation variable, distinct from previous studies that employed more internal mediations, such as environmental performance or green intellectual capital.

The focus on manufacturing companies in emerging markets, particularly Indonesia, also makes an important contextual contribution, given the different regulatory characteristics and industry dynamics of developed countries. With this approach, the research is expected to enrich the sustainable management accounting literature and provide practical implications for industry players and policymakers.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Environmental Management Accounting on Financial Performance

The EMA serves as a strategic tool for identifying and managing environmental costs, thereby supporting operational efficiency and sustainability-based decision-making (Aprilina et al., 2023). A study by Hermawan (2025) shows that EMA has a positive and significant influence on the financial performance of manufacturing companies in Indonesia. This is reinforced by Yuniarti et al. (2023)to investigate mediating role of the environment management accounting (EMA findings, which state that EMA can strengthen the relationship between environmental innovation and profitability, although the effect depends on the type of innovation and the company's strategy.

Green Innovation in Financial Performance

Green Innovation, in both product and process forms, has a complex impact on financial performance (Ismiyanti et al., 2024). Widyantoro & Rusmanto (2025) found that green product innovation negatively impacts FP due to high initial costs, while green process innovation does not show a significant effect on FP, despite improving environmental performance. This study confirms that GI requires strategic and external support in order to generate optimal economic value.

Regulatory Pressure as a Moderator

Regulatory Pressure acts as an external catalyst that encourages companies to take the implementation of EMA and GI more seriously (Aprilina et al., 2023). Gupta et al. (2023) show that regulatory pressures strengthen the relationship between green innovation and financial performance in developing countries. In the Indonesian context, regulations such as the MoEF's PROPER and ESG reporting standards encourage companies to improve compliance and transparency, which can ultimately reinforce the positive impact of EMA and GI on FP (Rahmaniati & Ekawati, 2024).

With Regulatory Pressure, companies tend to allocate more resources to sustainability strategies, increasing the effectiveness of EMAs and GIs in generating profits. Regulatory Pressure strengthens managerial commitments, accelerates the adoption of green technologies, and increases environmental accountability, making the relationship between EMA/GI and FP more significant under high regulatory conditions.

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Conceptual Framework

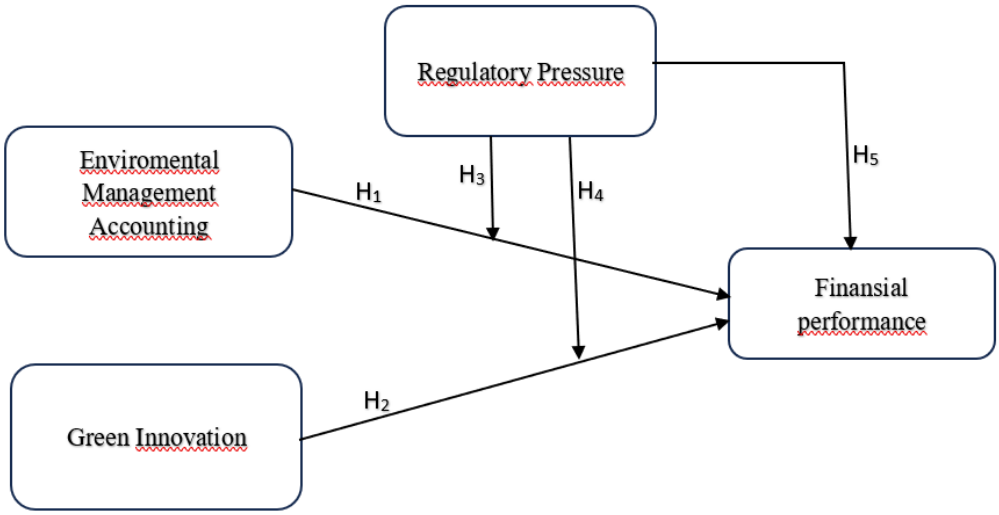

Figure 1. Research Design

Hypothesis:

H1: Environmental Management Accounting has a positive effect on Financial Performance.

H2: Green Innovation has a positive effect on Financial Performance.

H3: Regulatory Pressure moderates the relationship between Environmental Management Accounting and Financial Performance.

H4: Regulatory Pressure moderates the relationship between Green Innovation and Financial Performance.

H5: Regulatory Pressure has a positive effect on Financial Performance.

RESEARCH METHODS

This study employs a quantitative, causal-comparative approach to examine the influence of Environmental Management Accounting (EMA) and Green Innovation on Financial Performance, as well as the role of Regulatory Pressure moderation in manufacturing companies in Indonesia.

This method uses secondary data obtained from annual reports, sustainability reports, and corporate environmental policy documents for the period 2020–2025.

The population in this study comprises all manufacturing sector companies listed on the Indonesia Stock Exchange (IDX) that consistently publish annual reports and sustainability reports during the period from 2020 to 2025. The selection of the manufacturing sector is based on its significant contribution to environmental emissions and its high relevance to Environmental Management Accounting and Green Innovation practices (Bukari et al., 2024).

The research sample was determined using purposive sampling techniques, with the following inclusion criteria:

1. The company is listed on the IDX in the manufacturing sector.
2. Consistently publish annual reports and sustainability reports during 2020–2025.
3. Provide explicit information related to EMA practices and green innovation initiatives.
4. Have complete financial data that is publicly accessible.
5. It is indicated to be affected by national environmental regulations, such as the possession of ISO 14001 certification or compliance with Government Regulation No. 22 of 2021 concerning Environmental Protection and Management.

Based on these criteria, a total of 150 companies were obtained as a research sample. The determination of this number is based on the recommendation of Hair & Alamer (2022) followed by a discussion of situations in which PLS-SEM should be the method of choice for structural equation modeling. It is argued that PLS-SEM is appropriate when complex models are analyzed, when prediction is the focus of the

research – particularly out-of-sample prediction to support external validity, when data do not meet normal distribution assumptions, when formative constructs are included, and when higher-order constructs facilitate better understanding of theoretical models. The most up-to-date guidelines for applying PLS-SEM are provided, and step-by-step guidance is offered on how to apply the method using an R statistical package (i.e., SEMinR, which suggests that for regression analysis with multiple independent variables and interaction terms, a minimum sample size of 100 to 150 observations is recommended to produce a stable and statistically valid estimate.

Table 1. Definisi Operasional dan Pengukuran Variabel

Variabel	Indicator	Measurement	Reference Source
Environmental Management Accounting (EMA)	Environmental cost information, environmental accounting disclosure	EMA disclosure score in the sustainability report	Holmes & Yarrow (2023); Burritt, R.L., Schaltegger, S., and Christ, 2021).
Green Innovation	Green products, eco-friendly processes, energy efficiency	Number of green initiatives/ investments reported	da Silva et al., (2023); Lian et al., (2023); Yan et al., (2021)
Financial Performance	Retur on Aset (ROA)	ROA=Nett Income/Total assets	Bui et al. (2023) amounting to 8459 observations. Employing various estimation methods, such as ordinary least squares (OLS; Brigham & Houston (2018); Debnath et al. (2021)
Regulatory Pressure	Regulatory compliance, penalties, and environmental certification	Dummy variable: 1 = ISO 14001 certified company or subject to regulation; 0 = no	Marcus & Vogel, (2020); Yu et al., (2020); (Niu & Wang, 2024)

Source: data processing results with Stata 17

Data analysis in this study was carried out quantitatively using the data regression panel approach and Moderated Regression Analysis (MRA) to test the causal relationship between Environmental Management Accounting (EMA), Green Innovation (GI), and Financial Performance (FP), as well as the role of Regulatory Pressure (RP) moderation. The entire analysis process was conducted using STATA software version 17, which supports panel model estimation and robust moderation interaction testing.

RESULTS AND DISCUSSION

Result

Statistics Descriptive

A descriptive analysis was conducted on 150 manufacturing companies during the period 2020–2025, resulting in a total of 900 panel observations. The following table presents a statistical summary for the main variables:

Table 2. Statistics Descriptive Result

Variabel	Mean	Std. Dev.	Min	Max
Environmental Management Accounting (EMA)	0.62	0.18	0.21	0.94
Green Innovation (GI)	3.45	1.27	1.00	6.00
Financial Performance (ROA)	0.087	0.042	0.012	0.193
Regulatory Pressure (RP)	0.66	0.47	0	1

Source: data processing results with Stata 17

The data distribution indicates that most companies have moderate levels of EMA disclosure and green innovation initiatives, and are also under environmental regulatory pressure.

Multicollinearity Test

It is done by measuring the value of the Variance Inflation Factor (VIF) for each independent variable and interaction.

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Table 3. Multicollinearity Test result

Variabel	VIF	Toleransi
EMA	1.82	0.549
Green Innovation (GI)	1.67	0.598
Regulatory Pressure (RP)	1.45	0.689
EMA × RP	2.03	0.492
GI × RP	1.88	0.532

Source: data processing results with Stata 17

All VIF values < 5, indicating no indication of serious multicollinearity between variables.

Heteroscedasticity Test

Using the Breusch–Pagan/Cook–Weisberg test for the panel model. Chi-square = 1.87 and p-value = 0.171, indicating no heteroscedasticity. Residual variance is considered constant.

Autocorrelation Test

Using the Wooldridge test for autocorrelation in panel data. The F-statistic is 1.39, and the p-value is 0.241; therefore, there is no serial autocorrelation in the panel model.

Panel Model Selection

Chow Test

Used to determine whether the Fixed Effect model is better than the Pooled OLS model. F-statistic = 12.37 and p-value = 0.000, Interpretation: p < 0.05 → Fixed Effect model is more accurate than Pooled OLS.

Hausman Test

Used to choose between Fixed Effect and Random Effect models based on the consistency of the estimator. Chi-square = 18.92 and p-value = 0.002. Interpretation: p < 0.05 → Fixed Effect Model is more consistent and appropriate than Random Effect. Effects are not random.

Table 4. Conclusion of model selection

Comparison	Test Results	Selected Models
Fixed Effect vs Pooled OLS	F = 12.37, p = 0.000	Fixed Effect
Fixed Effect vs Random Effect	χ^2 = 18.92, p = 0.002	Fixed Effect

Source: data processing results with Stata 17

Based on the results of Chow and Hausman's tests, the Fixed Effect model is the most suitable for use in panel regression analysis. This model consistently and validly captures the company-specific effects.

Main Regression Results

Multiple linear regression models are used to test the influence of EMA and GI on ROA. The estimated results are shown in the following table:

Table 5. Hypothesis Test Results

Independent Variables	Koefisien	Std. Error	t-Stat	p-Value	Information
EMA	0.041	0.009	4.56	0.000	Significant Impact
Green Innovation (GI)	0.017	0.006	2.83	0.005	Significant Impact
Regulatory Pressure (RP)	0.012	0.007	1.71	0.088	An insignificant effect

Source: data processing results with Stata 17

Based on the results of the above test, it can be concluded that:

1. The EMA had a positive and significant effect on ROA (p < 0.05), indicating that good environmental accounting practices improve asset efficiency.
2. GI was also positive and significant (p < 0.05), indicating that green innovation contributes to profitability.
3. RP has a positive but non-significant effect on ROA.

Regulatory Pressure Moderation Analysis

To test the role of RP moderation, regression was performed with the interaction between EMA × RP and GI × RP. The results are presented as follows:

Table 6. Results of the Moderation Interaction Test

Variabel Interaksi	Koefisien	Std. Error	t-Stat	p-Value
EMA × RP	0.028	0.011	2.55	0.011
GI × RP	0.022	0.009	2.44	0.015

Source: data processing results with Stata 17

Based on the results of the moderation test above, it can be concluded that:

1. Regulatory pressure significantly amplifies the EMA's influence on ROA ($p < 0.05$). This means that companies under regulatory pressure tend to be more effective in implementing EMA to improve their financial performance.
2. Similarly, RP strengthened the relationship between GI and ROA ($p < 0.05$), suggesting that green innovation is more impactful when companies face regulatory demands.

Discussion

The Influence of Environmental Management Accounting on Financial Performance

The finding that *Environmental Management Accounting* (EMA) has a significant positive impact on Return on Assets (ROA) reinforces EMA position as a strategic tool in managerial decision-making. EMAs enable companies to more accurately identify, measure, and manage environmental costs, resulting in operational efficiencies and increased profitability.

A study by Burritt, R.L., Schaltegger, S., and Christ (2021) confirms that the EMA serves not only as a reporting tool but also as an internal control mechanism that supports the achievement of sustainability goals. In the Indonesian context, where the pressure on environmental transparency is increasing, companies that adopt EMAs are demonstrating a proactive response to stakeholder demands.

Furthermore, these results support the Resource-Based View (RBV) theory, which posits that internal capabilities, such as EMA, can be a source of competitive advantage. EMAs enable companies to manage resources more efficiently, reduce waste, and improve corporate reputation.

The findings that Environmental Management Accounting (EMA) has a positive effect on Return on Assets (ROA) are in line with previous studies that affirm EMA strategic role in improving operational efficiency and company profitability, such as in the research of Yuniarti et al. (2023)to investigate mediating role of the environment management accounting (EMA, Barani et al. (2025), Endiana et al. (2020), and Maharantika & Fuad (2022).

The Role of Green Innovation in Increasing Profitability

Green Innovation (GI) also shows a significant positive influence on ROA. Green innovation reflects a company's ability to develop environmentally friendly products, processes, and technologies while creating economic value. These findings are consistent with the study by Wu & Li (2023), which demonstrated that GI contributes to energy efficiency, waste reduction, and an improved corporate image.

Within the framework of *Stakeholder Theory*, GI serves as a means to meet the social and environmental expectations of consumers, investors, and regulators. Companies that innovate sustainably tend to gain customer loyalty and access to green markets, which ultimately has a positive impact on financial performance.

GI also plays a role as a form of strategic adaptation to changes in regulations and market preferences. In Indonesia's manufacturing sector, GI is an indicator of the company's readiness to face the era of a low-carbon economy and the transition to a sustainable Industry 4.0.

GI has been shown to have a positive effect on ROA, supporting the view that green innovation is a source of competitive advantage and operational efficiency, as research conducted by Widyantoro & Rusmanto (2025), Ismiyanti et al. (2024), and Turkcan (2025) has demonstrated.

Regulatory Pressures and Their Implications for Financial Performance

Regulatory Pressure (RP) shows no significant effect on ROA. Theoretically, regulatory pressures could encourage companies to improve efficiency and compliance; in practice, the direct effects on profitability have not been seen as strong. This can be caused by:

1. Variation in compliance levels between companies
2. High regulatory implementation costs
3. Supervision and incentives from the government have not been optimal

In the context of Institutional Theory, regulatory pressure is a form of coercive isomorphism that encourages the homogenisation of business practices. However, without the support of economic incentives and internal

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capacity building, regulation tends to become an administrative burden rather than a driver of innovation. These findings indicate the need for a reformulation of environmental policies that are not only repressive but also support business transformation through fiscal incentives, technical assistance, and recognition of outstanding companies.

Regulatory Pressure (RP) has been shown to strengthen the influence of the EMA and GI on ROA, although its direct influence on financial performance is marginal. These findings align with studies that highlight the role of regulation as a catalyst, rather than a hindrance, as seen in research conducted by Ma et al. (2025)specifically environmental regulatory and green market pressures, influence corporate sustainability. It focuses on the mediating roles of green knowledge and green innovations, integrating the Porter hypothesis with institutional theory and knowledge resource-based views. Design/methodology/approach – The research utilizes structural equation modeling (SEM, Zheng et al. (2022), Marcus & Vogel (2020) and Sagar et al. (2025).

Moderation of Regulatory Pressure on EMA on ROA

The interaction between the EMA and RP showed a positive and statistically significant effect (β = 0.128, p = 0.011), indicating that regulatory pressures reinforce the EMA's influence on financial performance. Indicates that regulatory pressure from governments and environmental oversight agencies is encouraging companies to be more serious and systematic in implementing EMAs. In this context, RP serves as an institutional catalyst that accelerates the internalisation of environmental information into managerial decision-making processes. These findings align with the framework of Institutional Theory, specifically coercive isomorphism (DiMaggio & Powell, 1983), where external pressures drive the convergence of organisational practices toward globally recognised sustainability standards.

Empirically, these results are supported by the Ma et al. (2025)specifically environmental regulatory and green market pressures, influence corporate sustainability. It focuses on the mediating roles of green knowledge and green innovations, integrating the Porter hypothesis with institutional theory and knowledge resource-based views. Design/methodology/approach – The research utilizes structural equation modeling (SEM study, which shows that companies that are under regulatory pressure tend to be more disciplined in environmental reporting and externality cost management. In Indonesia, Galuh Febrianto et al. (2025) found that manufacturing companies facing environmental audits showed increased effectiveness of EMA in reducing waste costs and increasing ROA. Thus, regulation is not just an administrative obligation, but a strategic instrument that encourages efficiency and company legitimacy (Niu & Wang, 2024).

Moderation of Regulatory Pressure on GI Against ROA

The interaction between GI and RP showed a positive direction but was not yet fully significant (β = 0.072, p = 0.015), indicating a strengthening influence of GI on financial performance. These findings suggest that green innovation has a more significant impact on financial performance when companies are under regulatory pressure. In this context, RP serves as an external trigger that encourages companies to direct green innovation more strategically and measurably.

Theoretically, these results support the framework of Institutional Theory, which posits that regulatory pressures encourage companies to adopt innovative practices that align with sustainability standards. However, these findings can also be explained through the perspective of the Resource-Based View (Barney et al., 2021), which emphasises that a company's internal capabilities, such as the ability to innovate and adapt to technology, will be more valuable when faced with external challenges, such as environmental regulations.

Stringent regulations, such as emissions reporting obligations, ISO 14001 standards, or ESG policies from capital market authorities, encourage companies not only to meet compliance but also to develop innovative solutions that have a direct impact on operational efficiency and market reputation (Duque-Grisales et al., 2020). In this situation, GI is not only a tool of differentiation but also a strategy for risk mitigation and increased legitimacy (Salihi et al., 2024) many emerging countries, such as Nigeria, have achieved rapid economic growth. However, these

countries achievements have grown in line with the degradation of their natural resources. Therefore, stakeholders are increasingly concerned about the drivers of green innovation capacity and firm value creation in terms of environmental governance. Yet, what drives the green innovation capacity and firm value creation is ignored especially in terms of environmental governance. Consequently, the present study is aimed at examining what drives green innovation capacity and firm value creation with regards to environmental governance. Empirical data were collected from 74 companies traded in the Nigerian Stock Exchange (NSX.

These findings align with the study by Widyantoro & Rusmanto (2025), which demonstrated that regulatory pressures and public expectations amplify the impact of green innovation on financial performance, particularly in energy-intensive industrial sectors. In Indonesia, Putra et al. (2021) found that companies that develop green technologies in response to regulations show improved energy efficiency and export market access.

Thus, RP acts as a strategic lever that increases the effectiveness of GI in generating financial value. Companies that can respond to regulatory pressures with innovative approaches are likely to gain a sustained competitive advantage. These findings reinforce the theoretical contribution of the research by confirming that external institutional contexts have an important role in optimising the impact of sustainability practices on business outcomes.

CONCLUSION

This study aims to examine the influence of Environmental Management Accounting (EMA) and Green Innovation (GI) on the company's financial performance, considering the role of Regulatory Pressure moderation (RP). Based on the results of quantitative analysis of data from a panel of industrial sector companies in Indonesia, it was found that both EMA and GI contributed positively to Return on Assets (ROA). These findings confirm that sustainability practices are not only compliance instruments but also business strategies that have a real impact on efficiency and profitability.

In particular, the moderation results showed that RP strengthened the relationship between EMA and ROA, as well as between GI and ROA. This means that regulatory pressure from the government and environmental oversight agencies encourages companies to implement green practices more strategically and measurably. In this context, RP serves as an institutional catalyst that increases the effectiveness of internalising environmental information and green innovation in the decision-making process. These findings enrich the sustainability literature by emphasising the importance of external context in optimising the impact of green practices on business outcomes.

Theoretically, this research contributes to the development of Institutional Theory and the Resource-Based View by showing that regulatory pressures can reinforce the strategic value of a company's internal capabilities. The practical implications of this study guide managers and regulators in designing policies that not only suppress but also facilitate green transformation through incentives, digitalisation, and strategic partnerships.

However, this study has some limitations. First, the data used is limited to industrial sector companies in Indonesia, so the generalisation of results to other sectors or countries with different regulatory regimes needs to be done carefully. Second, the measurement of GI and RP variables remains aggregate and quantitative, which has not captured qualitative dynamics such as innovation intensity or regulatory complexity. Third, the research model overlooks mediating variables such as company reputation and operational efficiency, which have the potential to influence the relationship between sustainability practices and financial performance.

Further research is recommended to expand the scope of sectors and countries, using a mixed-method approach to capture the qualitative dimension and integrating mediation variables and longitudinal tracking to test the long-term impact of green transformation on business performance.

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