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MORALITY BEFORE KNOWLEDGE

Influence of GHG emissions intensity and ESG scores on the financial performance of publicly listed companies in the ASEAN Region

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ABSTRACT

Background: Sustainability and environmental responsibility have become critical concerns in corporate governance, with (Greenhouse Gases) GHG emissions intensity and (Environmental, Social, and Governance) ESG scores increasingly used as indicators of responsible business practices. However, their impact on financial performance remains a subject of debate, especially in ASEAN markets, where regulatory frameworks and investor priorities differ. This study aims to analyze the relationship between GHG semissions intensity, ESG scores, and financial performance (Return on asset (ROA) and Tobin's Q) in ASEAN public companies to assess how these sustainability metrics influence corporate success. **Methods**: The study employs fixed-effects panel regression analysis using data from Refinitiv Eikon on 220 ASEAN public companies from 2018 to 2022. The key variables include GHG emissions intensity and ESG scores as independent variables, with ROA and Tobin's Q as dependent variables. **Findings**: The findings indicate that GHG emissions intensity has a slightly significant impact on ROA but does not significantly affect Tobin's Q, suggesting that investors in ASEAN may not prioritize emissions data when evaluating corporate performance. This supports the notion that carbon emissions' financial impact varies by industry, and inconsistent regulations across ASEAN complicate emissions comparisons. In contrast, ESG scores exhibit a significant negative relationship with both ROA and Tobin's Q, implying that while investors recognize ESG engagement as a governance signal, high implementation costs and delayed returns deter investment. Additionally, risks such as greenwashing and inconsistent ESG reporting standards further undermine the credibility of ESG metrics in ASEAN markets. **Conclusion**: While GHG emissions intensity shows minimal influence on profitability, ESG engagement, despite its long-term benefits, presents short-term financial challenges. The findings underscore the importance of aligning ESG efforts with corporate strategy and standardizing ESG reporting frameworks across ASEAN to enhance investor confidence. **Novelty/Originality of this article**: This study contributes to the ongoing discourse on sustainability and corporate performance by specifically examining ASEAN markets, which have diverse regulatory environments and investor behaviors.

KEYWORDS: ASEAN; ESG score; GHG emissions intensity; return on asset; Tobin's Q.

1. Introduction

Greenhouse gasses are gasses in the Earth's atmosphere that trap heat, which influences the global climate. Between 1990 to 2017, there was a 114% increase in GHG emissions. In addition, there was more precise evidence from the 2023 IPCC report regarding the intensification and high velocity changes in global weather patterns. Over the

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last century, the drive for economic improvement has been accountable for the increase in greenhouse gasses in the atmosphere. According to Chen et al. (2022), whenever a country's GDP increases, naturally, emissions also increase. In addition, the study of Lin & Okoye (2023) identified three factors tying GHG emissions to a country's financial development: financial market advances boost production and machinery, leading to more emissions; foreign investments in these advances indirectly raise emissions; and easier loan access fuels these advances, further increasing emissions.

Rokhmawati et al. (2015) suggested that a company's performance can be affected by GHG emissions. For example, the ratification of the Kyoto Protocol may influence the whole industry, thus impacting business performance. Similarly, governments can adopt taxes on carbon and energy and carbon trading systems that are compliant with Kyoto Protocol requirements to decrease the volume of GHG emissions. In addition, Galama & Scholtens (2021) found that companies that have fewer GHG emissions also perform better financially. However, this correlation is significant only for countries that implement a strict emissions trading system regime.

With the rising awareness of corporate social responsibility, corporations globally are translating ESG performance into a scoring metric displaying ecological and social consciousness (Shakil, 2021). A transparent and excellent ESG information disclosure in companies is a crucial asset in increasing external investor and management confidence in projecting long-term growth. Recent academic research revealed that ESG has been gaining influence in global corporations in increasing market value and corporate financial performance or CFP (Li et al., 2024; Zhou et al., 2023).

Although recently concluded studies show positive results, there are several studies showing the inconsistent and negative relationship between ESG score and the overall financial performance of a company. Reber et al. (2022) emphasized that incompatibility of ESG score towards financial success. This is because markets, especially those countries that are still developing, can have a serious problem concerning shortage of resources, environmental pollution and insufficient regulatory implementation that elevates ESG risk (Engelhardt et al., 2021). To note, investing in ESG practices necessitates shouldering costs associated with technology and realignment of traditional operational methods. Thus, economies and corporations with fiscal incapacity have more pronounced GHG emissions due to the lack of access to capital and innovation (Rehman, 2023). Moreover, Aydoğmuş et al. (2022) argued that most studies employing the Shareholder Theory, showed a negative link between ESG score and financial performance. This is due to the concept that a firm's main goal is to maximize the generation of its shareholder value and profit. Putting ESG score in place as a factor, corporate managements may only use ESG practices as a guise of personal image (Bae et al., 2021) and instead, aggravate agency conflicts that damage a company's market value.

According to Pan (2021) ASEAN countries have taken significant strides in sustainability disclosure, initiating a host of measures starting with the Singapore Exchange's 2016 Sustainability Reporting Guide. However, the momentum for robust ESG reporting surged after 2020, especially in Indonesia and the Philippines. This dedication is supported by the study entitled Sustainability Reporting in ASEAN Countries 2018 that showed disclosure rates in the sustainability reporting protocols of Indonesia, Malaysia, Philippines, Singapore, and Thailand are at an average of 59.2%, with Malaysia having the highest disclosure rate.

In most studies, the discussion about emissions focuses on macro-levels, but researchers acknowledged the importance of examining the entities contributing to a country's emissions. Aside from that, there's also limited literature on companies in the ASEAN region, and while studies have studied the link between ESG score and financial performance, there is limited information on whether GHG emissions intensity directly impacts financial performance. Therefore, this study contributed to address the gap through the following, (1) evaluated the meso-level effects of greenhouse gas (GHG) emissions intensity, (2) explored the ESG score of publicly listed companies in the context of the ASEAN regulatory system and economic factors. Hence, this study intended to close the

identified gaps and formulated a significant body of findings on how GHG emissions intensity and ESG score influence the firm's financial performance. The findings of this study laid the groundwork for corporate managers in reexamining the mobilization of corporate resources, particularly the merits of investing in environmental initiatives to enhance their ESG score. In addition, it provided empirical evidence for policymakers to strengthen the regulatory policies governing the implementation of ESG mandates in countries belonging to the ASEAN region. However, there is limited research on the link between GHG Emissions Intensity, ESG Scores and financial performance in the region. This study evaluated the meso-level effects of GHG emissions intensity and explored ESG scores of publicly listed companies in the ASEAN regulatory context, contributing findings to support corporate managers in resource mobilization and policymakers in strengthening ESG-related regulations.

Investors are increasingly recognizing the financial risks associated with environmental issues such as extreme weather events and regulatory changes (Vikas, 2024). According to the World Business Council for Sustainable Development (2021), stakeholders are demanding greater transparency and accountability from companies regarding their social impact, including labor practices, diversity, and community engagement. The urgency for addressing climate change and resource depletion has become undeniable. In a study conducted by Zhou et al. (2023), the demand for low-carbon products increased in relation to the rising awareness of the consumers towards the worsening cases of global warming. As production and sales rely more on the manufacturer and suppliers' investment towards green technologies, government interventions on supply chain members are continuously formulated.

1.1 Literature with positive outcomes supporting the study

Li & Xu (2024) emphasized the critical role of corporations in driving green economic development, while Griffin et al. (2012) highlighted the relevance of GHG emissions disclosure to investors. Trinks et al. (2017) found a positive relationship between GHG emissions intensity and the cost of equity, and Delmas et al. (2015) confirmed a link between environmental and financial performance. Bhaskaran et al. (2020) analyzed 4,887 companies and concluded that prioritizing environmental, social, and governance (ESG) factors enhances market value. Transparent ESG disclosures significantly impact capital market transactions. Li & Xu (2024) showed that ESG ratings drive corporate innovation and financial stability. Chen et al. (2022) noted that while ESG positively influences manufacturing companies, its benefits diminish with excessive environmental investments. ESG disclosures are more effective for companies with ESG-focused investors, greater media attention, and higher agency costs (Chen & Xie, 2022).

1.2 Literature with negative outcomes supporting the study

Delmas et al. (2015) found that while improved corporate environmental performance can enhance Return on Assets (ROA), the high costs of implementing green initiatives may reduce short-term financial performance. Companies with significant carbon emissions often face unfavorable market responses, lowering profitability (Houqe, 2022). Similarly, Lee et al. (2015) and Qi et al. (2014) showed that higher carbon emissions in manufacturing harm profitability due to increased costs from inefficient resource use. In terms of ESG scores, Buallay (2018) observed that sustainability reporting in the European banking sector does not consistently improve firm value, citing ESG compliance costs. Dkhili (2023) supported this view, noting market skepticism toward ESG strategies. Aydoğmuş et al. (2022) emphasized that companies must evaluate whether ESG investments provide sufficient financial returns, as these decisions remain critical at the board level.

1.3 Literature with mixed outcomes supporting the study

In a study conducted by Van Emous (2021), the results they found regarding the relationship between a firm's corporate financial performance and carbon emissions are mixed. Using a regression analysis, they found that the reduction of carbon emissions enhances the ROE, ROS, and ROA in the short run. However, carbon emissions reduction does not affect the current ratio in terms of liquidity or Tobin's Q in terms of its market performance. Furthermore, according to Narula et al. (2024), between the period 2018 to 2020 in Indian businesses considering COVID-19 influence, studies have shown mixed results regarding the impact of individual ESG pillars in firm performance. A study conducted by various researchers (Arvidsson, 2014; Fauzi et al., 2009; Alareeni & Hamdan, 2020), suggests a negative correlation between the environmental (E) pillar score and financial performance. Conversely, Shan (2019) found a positive relationship between the governance (G) pillar score and performance. The social (S) pillar score appears to have a less clear connection, with Weston & Nnadi (2021) finding no significant relationship.

1.4 Policies and sustainability regulations in the ASEAN Region

According to the ASEAN CSR Network (ACN) Organization (2018), the ASEAN region's rapid economic growth has led to prioritizing sustainability, driven by global initiatives like the UNGC, IFC, and GRI. Governments are implementing regulations, particularly in mining and minerals, to encourage or mandate sustainability reporting. Singapore and Malaysia lead with mandatory regulations, enhancing transparency and accountability, while other ASEAN countries rely on voluntary guidelines, causing disparities in ESG reporting. Investors prioritize ESG factors, rewarding strong performers with lower capital costs and increased confidence. However, challenges such as inconsistent regulatory standards, data quality issues, and capacity-building limitations hinder sustainability reporting across the region. Table 1 highlights the regulatory landscape, showing variations in sustainability reporting requirements, with mandatory frameworks in some countries and voluntary ones in others, affecting transparency regarding GHG emissions and ESG factors.

Table 1. Summary list of ASEAN countries with voluntary or mandatory sustainability reporting regulations

Country	Regulatory Status (Voluntary/Mandatory)
Indonesia	Voluntary (started in 2014)
Malaysia	Mandatory (started in 2017)
Philipphines	Voluntary (started in 2019)
Singapore	Mandatory (started in 2016)
Thailand	Voluntary (started in 2012)
Vietnam	Voluntary but lacks guidelines (started in 2015)

(ASEAN CSR Network Organization, 2018)

1.5 GHG emissions intensity and ESG score

GHG emissions, consisting of carbon dioxide, methane, and nitrous oxide, increased by 9.6% from 977 million tonnes in 2012 to 1,076 million tonnes in 2018 (International Maritime Organization, 2020). To address this, the 1995 Conference of the Parties under the United Nations Framework Convention on Climate Change implemented global mitigation actions. GHG emissions intensity, defined as emissions per economic output, varies by sector and is classified into direct (Scope 1), indirect (Scope 2), and other indirect emissions (Scope 3). Low GHG intensity (<100 tons of CO_2 per USD million revenue) is typical in sectors like technology and finance, moderate intensity (100–500 tons) in manufacturing and logistics, and high intensity (>500 tons) in industries such as oil, gas, and mining (S&P Dow Jones Indices, 2020).

An ESG score is a single metric that attempts to assess a company's performance in the three crucial pillars. Based on the LSEG Data and Analytics, scores from 0-25 indicate poor ESG performance; 26-50 indicates satisfactory ESG performance; 51-75 indicates a good ESG performance; and 76-100 indicates an excellent ESG performance (LSEG, 2023). In essence, a combined ESG score acts as a benchmark for stakeholders, enabling them to compare companies and gain insights into their overall commitment to environmental and social responsibility, ultimately benefiting not just the planet and society, but also the companies themselves.

1.6 Hypotheses and conceptual framework

Based on the statement of the problem, the researchers formulated three hypotheses to guide the study. The first hypothesis posits that greenhouse gas (GHG) emissions intensity has a significant impact on the financial performance of publicly listed companies in the ASEAN region. The second hypothesis suggests that Environmental, Social, and Governance (ESG) scores also significantly influence the financial performance of these companies. Furthermore, the third hypothesis proposes that there is a significant effect of the independent variables—namely GHG emissions intensity and ESG scores—on financial performance when control variables such as company size, debt-to-equity ratio, and current ratio are incorporated into the model.

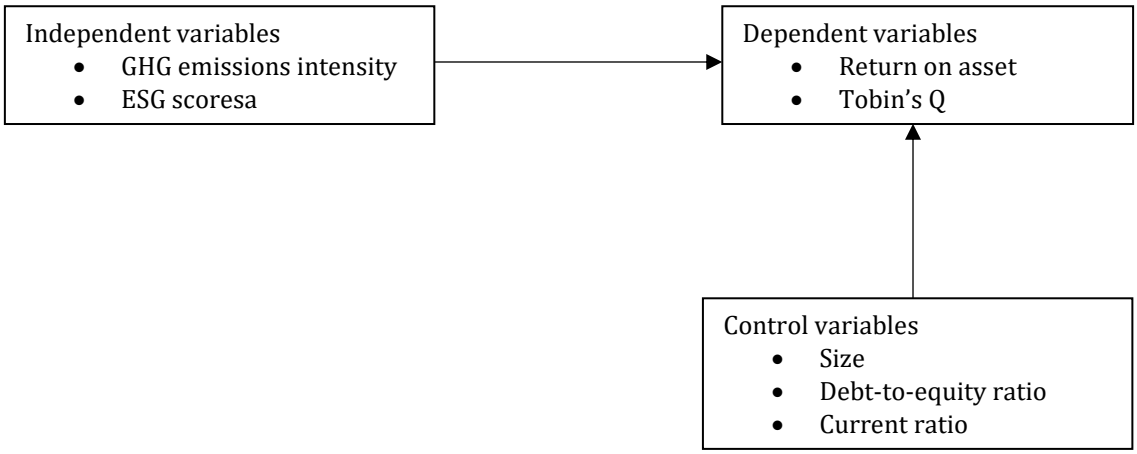

Fig. 1. Conceptual framework of the study

The Figure 1 shown above provides a clear visual presentation of the research study of the researchers, which determined the influence of GHG emissions intensity and ESG score on the financial performance of selected Publicly Listed Companies (PLCs) in the ASEAN region. As seen in the illustration, the independent variables being studied are the GHG Emissions Intensity and ESG score-under its scope are Environmental score, Social score, and Governance score. While the dependent variables consisted of the financial performances as return on asset (ROA) and Tobin's Q. These aforementioned variables are linked with the control variables - the firm's size, debt-to-equity ratio, and current ratio. This factor is significant because the researchers believed that examining a company's size was able to distinguish that they have the capability to reduce their GHG emissions through incorporating ESG practices/strategies and the level of willingness to adhere to the pressure by its stakeholders, investors, government, and competitors.

Moreover, the researcher's conceptual framework is grounded in the stakeholders theory wherein it firmly believes that the company should not only consider the interests of investors and shareholders that are expecting greater financial returns, but also take into account the interests/concerns of the employees, business partners, and communities – all these proponents have interest in a company's activities. The researchers defined the determining factor to financial health by correlating the financial performance to ESG score and GHG emissions intensity. The study also delved into the performance of companies with

or minimal ESG performance capability which is based on their leverage ratio (debt-to-equity ratio) and firm size, with the goal to discover potential positive correlations, where lower emissions could entail cost savings through factors in the likelihood of reduced energy consumption or access to green financing. Acknowledgment of potential negative correlations will be put into place with the consideration of upfront costs associated with the transition to cleaner technologies and adaptation to the low-carbon economy. The conceptual framework understood the interconnection between these forces and how they ultimately influence the two key financial metrics being Return on Assets and Tobin's Q.

2. Methods

2.1 Sample data

The sample of this study are 220 mid-sized to largest publicly listed companies in the multi-sector market of the ASEAN region from 2018-2022 based on secondary data from Refinitiv Eikon. Using purposive sampling, the companies were selected based on two criteria. First, the companies must have a complete set of independent, dependent, and control variables. Second, the companies must have a market capitalization of at least US$25 billion and above. Table 2 shows the summary of the sample data.

Table 2. Sample data

	Initial Sample from Refinitiy	Firms Selected Based on Criteria
Sample Period	2018-2022	2018-2022
No. of Observations	27615	1100
Total No. of Companies	5523	220
Firms by Region		
Indonesia	953	30
Malaysia	1134	49
Philippines	287	27
Singapore	685	61
Thailand	876	49
Vietnam	1588	4

2.2 Variables description

The researchers chose both GHG Emissions Intensity and ESG Score as the independent variables. The Organisation for Economic Co-operation and Development (OECD) defines GHG emissions intensity as a combination of carbon dioxide (CO_2) and hydrofluorocarbons (HFCs) that comes from fossil fuel combustion, generation of waste materials, and industrial activities. It is also an aggregate of emissions for Scope 1 (all direct emissions), Scope 2 (indirect emissions from energy or heat consumption), and Scope 3 (other forms of indirect emissions) (OECD, n.d.; Griffin et al., 2017; Trinks et al., 2017) divided by the sum of revenue to get the measure of carbon efficiency (S&P Dow Jones Indices, 2020). On the other hand, the ESG Score is a rating comprising environmental, social, governance pillars to measure firm sustainability. The Refinitiv Data Analytics calculates ESG Scores based on category where Environmental is 34%, Social is 31%, and Governance is 26% of the aggregate (Environmental, social and governance scores from LSEG (2023).

Meanwhile, the study employs two dependent variables to represent the firm's financial performance. First, the return on asset (ROA) measures the efficiency of asset utilization to generate profit (Gallo, 2017). On the other hand, Tobin's Q is a reliable parameter obtained by dividing a firm's total market value by its total assets, which expresses if a firm is overvalued or undervalued (Veeravel et al., 2024; Ghani et al., 2023). Multiple studies found that a higher Tobin's Q indicated higher firm performance (Boulhaga et al., 2023; Chininga et al., 2023; Ademi & Klungseth, 2022; Giannopoulos et al., 2022).

We also selected three control variables. The firm size is based on a firm's operational capacity and scalability. Previous studies determine this variable through a firm's total assets (Deng & Cheng, 2019; Ruan & Liu, 2021). Large companies are often pressured by stakeholders to adopt sustainability practices to improve financial performance (Naeem et al., 2022; Alessa et al., 2024). Moreover, capital structure is measured by debt-to-equity ratio. This metric determines the proportion of debt relative to a firm's shareholder capital to signify the extent to which a company is financed externally or internally. Several studies discovered that firms with lower debts have better ESG performance (Veeravel et al., 2024; Alves & Meneses, 2024; Li et al., 2024; Hasanuddin et al., 2021). Lastly, the current ratio calculates a firm's ability to cover its short-term liabilities. Typically, studies explain that a higher current ratio implies that a firm has more assets to meet its obligations (Gupta & Kashiramka, Wang et al., 2023; 2024; Luo, 2022; Kozak, 2021; Hasanuddin et al., 2021; Houque et al., 2020). Table 3 provides the list of variables.

Table 3. List of variables

Type	Variable	Measure
Independent	GHG-GHG Emissions Intensity	Total Greenhouse Gas Emission/Total Revenue
	ESG-ESG Score	ESG Disclosure Score
Dependent	ROA-Return on Assets	Net Income/Total Assets
	TQ-Tobin's Q	(Equity Market Value + Liabilities Market Value) / (Equity Book Value + Liabilities Book Value)
Control	SIZE	In (Total Asset)
	DTER (Debt to Equity Ratio)	Total Debt/Total Shareholders Equity
	CR (Current Ratio)	Current Assets/Current Liabilities

2.3 Methodology

To examine the impact of the chosen variables, four models were constructed. Two each for ROA and Tobin's Q. The models below were formulated by the researcher, where GHG_{it} and ESG_{it} are independent variables, ROA_{it} and TQ_{it} are dependent variables, $SIZE_{it}$, $DTER_{it}$, and CR_{it} are control variables, β_0 is the intercept, and ε_{it} is the error term.

$$ROA_{it} = \beta 0 + \beta_1 GHG_{it} + \beta 2 ESG_{it} + \varepsilon_{it} \quad \text{(Eq. 1)}$$

$$ROA_{it} = \beta 0 + \beta_1 GHG_{it} + \beta 2 ESG_{it} + \beta 3 SIZE_{it} + \beta 4 DTER_{it} + \beta 5 CR_{it} + \varepsilon_{it} \quad \text{(Eq. 2)}$$

$$TQ_{it} = \beta 0 + \beta_1 GHG_{it} + \beta 2 ESG_{it} + \varepsilon_{it} \quad \text{(Eq. 3)}$$

$$TQ_{it} = \beta 0 + \beta_1 GHG_{it} + \beta 2 ESG_{it} + \beta 3 SIZE_{it} + \beta 4 DTER_{it} + \beta 5 CR_{it} + \varepsilon_{it}\ To \quad \text{(Eq. 4)}$$

The methodology of this study follows a series of steps to ensure the data's reliability and validity. Panel data regression analysis was used to reach a definitive interpretation of the study's results. To begin, the data was examined for Skewness and Kurtosis to determine the presence of the asymmetry of distributions and the "tailedness" of the distributions. The results revealed that the majority of the skewness and kurtosis p-values stood at 0.0000 with the highest chi2 valued at 931.44 and the lowest being 24.22. These values signal the presence of moderate to major deviations from normality.

The study was also checked for diagnostic tests as Reported in Table 4. The Shapiro-Wilk Test is essential in validating the study's hypothesis tests and confidence intervals. If the residuals are found to be non-normally distributed, the statistical inferences made during the regression may be negatively affected in terms of reliability. The findings for this test suggest that ROA with 0.9382 and TQ with 0.9445 have lower W-values because it's far from 1, indicating that neither variable follows a normal distribution. Further supported by the p-values, both variables have 0.00000, thus both test results were rejected, which means they were not normally distributed. Following that, the heteroscedasticity test also concluded that there is strong evidence of heteroscedasticity in the data due to p-values of 0.0076 and 0.0030 for ROA and TQ respectively, which is lower than the alpha level of 0.05.

Heteroscedasticity occurs if the variance of residuals is not constant across the independent variables, leading to inefficiency in the estimates.

It is also important to take into account that highly correlated variables cause instability in the estimates of coefficients and make it difficult to determine the effect of each variable. Hence, a multicollinearity test was conducted through Variance Inflation Factor (VIF). The results have shown that The ESG score exhibited the lowest level of correlation which is likely due to the lack of direct relationship between the other variables. Although GHG intensity could affect the ESG scores, other factors could also counter this, such as the policy and regulations of a country and the integrity of the released data (Smith & Wentworth, 2022). The VIF showed a small amount of correlation (1.20). Thus, the study successfully passed the multicollinearity test. Lastly, the data was also screened for autocorrelation and cross-sectional dependence. The findings revealed that both ROA and TQ exhibited first-order correlation and cross-sectional dependence with p-values lower than the significance level of 0.05. Table 4 displays the results of the tests.

Table 4. Diagnostic test

Test	ROA	Tobin's Q
Shapiro-Wilk Test	0.00000	0.00000
Heteroscedasticity	0.0076	0.0030
VIF	1.20	1.20
Woolridge Test	0.0136	0.0000
Pesaran's CD Test	0.0000	0.0000

These are indications of deviations from normality. Thus, the need for transformation was enabled to mitigate this issue. Applying the natural logarithm to the variables is the most optimal approach to address the issues regarding skewness, non-normality, and heteroskedasticity. With the use of the log transformation, the scale of the data is compressed, reducing the influence of extreme outliers. As a result, this stabilized the variance of the dataset, ensuring that the data is now more reliable to be utilized for statistical inferences. One essential factor to consider is that the variables of this study are financial variables (e.g., ratios), whose behaviors are typically positively skewed. Logging them aligns with this behavior, making them more normally distributed (Marasigan, 2024). This contributes to the comparability of the dataset across firms because coefficients that are logged are directly interpreted through proportional changes or differences. Compared to other methods such as winsorization and differencing, natural logarithm is less aggressive and preserves the original structure of the panel data. Hence, it is regarded as the most optimal choice for this study.

3. Results and Discussion

3.1 Characteristics of the ASEAN PLCS

This study focused on 220 ASEAN Publicly Listed Companies (PLCs) from 2018-2022, meeting criteria such as a market capitalization of over $2.25 billion and years of operation. Among ASEAN countries, Singapore led ESG compliance with 27.73% of companies engaging in sustainable practices , followed by Malaysia and Thailand with 22.27% each. Vietnam lagged behind with just 1.82%, due to limited ESG regulations (Tilleke & Gibbins, 2024). The consumer non-cyclicals sector had the highest ESG participation at 17.27%, followed by the financial sector at 15.45%. The healthcare sector had the lowest participation at 2.27%. The research found that larger companies with higher market capitalization are more likely to prioritize ESG practices, as investors favor such companies with strong ESG ratings (Statista, 2023).

In terms of year of operation, 58.64% of the ASEAN PLCs had been in operation for over 35 years, showing the prominence of established businesses. Additionally, 46.46% of the companies had low GHG emissions intensity, mainly from sectors like technology and

financial services , while 31.36% had moderate intensity, and 22.27% had high intensity, common in heavy industries (Lamb et al., 2021; Martín-Ortega & González-Sánchez, 2023). The majority (55.91%) of the companies had good ESG scores, showing moderate sustainability practices. The remaining 29.09% had poor ESG scores, reflecting weaker practices in regions with lesser regulatory pressure, while 15% excelled with excellent ESG scores, attracting ESG-focused investors.

3.2 Descriptive statistics

This study analyzed data from Refinitiv Eikon for 220 companies, yielding 1,100 observations from 2018 to 2022. Companies were selected based on data availability, market size, and operating history. ROA, measured in ratios, reflects a firm's profitability relative to total assets, with a mean of 5.81%, indicating average returns from asset investments. The standard deviation of 7.49 shows moderate variability. Tobin's Q, also in ratios, measures market value relative to asset replacement cost, with a mean of 1.34, indicating firms are generally valued above their book value. A standard deviation of 1.89 highlights variability, with a minimum of 0.05 and a maximum of 17.04, reflecting diverse market perceptions of firm value.

GHG emissions intensity, measured in metric tons per million USD of revenue, had a mean of 786.54, indicating significant emissions on average, with a high standard deviation of 3797.27 due to industry sector variability. Emissions ranged from 0.05 (low-emission sectors like healthcare and technology) to 110,492.1 (high-polluting sectors like energy and utilities). ESG scores, measured in percentages, averaged 58.73, reflecting moderate adherence to sustainability principles. Scores ranged from 6.57 (poor ESG performance) to 91.88 (excellent performance), highlighting disparities in sustainable practices across firms.

Control variables—SIZE, DTER, and CR—showed significant variation. Firm size (SIZE), measured in dollars, had a mean of USD 249 billion, ranging from USD 8.59 million to USD 689 billion, covering medium to large firms. The debt-to-equity ratio (DTER) averaged 177.58, with cases of extreme leverage suggesting its potential impact on performance. The current ratio (CR) had a mean of 1.62, reflecting adequate short-term liquidity but with considerable variability. These diverse financial characteristics highlighted the importance of accounting for size, leverage, and liquidity when analyzing financial outcomes. Descriptive statistics for raw variables can be seen in Table 5.

Table 5. Descriptive statistics for raw variables

Variable	Mean	Std. Dev.	Min	Max
ROA	5.812791	7.486013	-14.54	84.96
TQ	1.340818	1.892494	0.05	17.04
ESG	58.73386	16.35907	6.57	91.88
GHG	786.5354	3797.272	0.05	110492.1
SIZE	249e+10	6.47e+10	8597999	6.89e+11
DTER	177.5842	1351.047	0.06	23096.64
CR	1.6248	1.098275	0.04	8.84

3.3 Correlation analysis

In this analysis, transformed variables were used because natural logarithms improve the interpretability of coefficients, enabling proportional differences to be easily understood, as demonstrated in a study by Marasigan (2024). According to a few authors, it is preferred for panel regression analysis, because it stabilizes variance and exhibits normal distribution, enhancing their suitability for statistical techniques (Heiss, 2021; Shah, 2024). As outlined in Chapter 3, log transformations will also be applied in the subsequent analysis. Table 6 presented the correlation test, highlighting relationships between variables. ESG scores showed weak negative correlations with both ROA (-0.0388) and Tobin's Q (-

0.0910), suggesting minimal links between sustainability practices and financial performance or firm value.

Table 6. Pairwise correlation test

Variable	log_ro~s	log_tq	log_gh~y	log_es~e	log_size	log_dter	log_cr
log_roa_abs	1.0000						
log_tq	0.7713	1.0000					
log_ghg_in~y	0.1251	0.1419	1.0000				
log_esg_sc~e	-0.0388	-0.0910	0.0156	1.0000			
log_size	-0.5488	-0.6422	-0.1826	0.1972	1.0000		
log_dter	-0.3080	-0.2878	0.0807	-0.0285	0.2836	1.0000	
log_cr	0.2720	0.2282	0.1235	-0.0043	-0.2351	-0.4475	1.0000

This aligns with research suggesting that ESG compliance may incur high costs or delays in benefits, particularly in emerging markets with limited institutional support (Aydoğmuş et al., 2022; Buallay, 2018). GHG intensity showed weak positive correlations with ROA (0.1251) and Tobin's Q (0.1419), implying a slight positive link, potentially due to investments in future technologies or larger market shares in high-emission industries (Servaes & Tamayo, 2013). Firm size had strong negative correlations with both ROA (-0.5488) and Tobin's Q (-0.6422), indicating diminishing returns and lower market valuations as companies grow, attributed to operational inefficiencies and risk aversion (Ekele, 2024).

3.4 Regression analysis

This study utilized panel regression models to analyze data across firms over time, accounting for cross-sectional and time dimensions. Fixed effects (FE) was used in Models 1, 2, and 4. While Model 3, with only independent variable for TQ, employed random effects (RE), the selection of this model was guided by two diagnostic tests, including the Breusch-Pagan (p-value=0.0000) and Hausman test (p-value=0.0630) which suggests that RE model is appropriate for the mentioned model. Regression analysis results can be seen in Table 7.

Table 7. Regression analysis results using FE for models 1,2 and 4 and RE for model 3

Variables	1	2	3	4
	ROA (log_roa_abs)		TQ (log_tq)	
log_ghg_	-0.051	-0.0439	0.0107	-0.0144
intensity	(0.055)*	(0.097)*	-0.591	-0.534
log_esg_ score	-0.138	-0.145	-.300 (0.000)***	-0.268
	(0.052)*	(0.041)**		(0.000)***
log_size		-0.004		-0.091
		-0.91		(0.001)**
log_dter		-0.107		-0.0475
		(0.000)***		(0.022)**
log_cr		-0.023		0.0376
		-0.572		-0.297
R2	0.01	0.042	0.0142	0.31
F-statistic	3.73	5.77	-	8.44
σ_u	0.711	0.676	1.097	10.125
σ_e	0.352	0.349	0.309	0.307
ρ	0.803	0.79	0.926	0.916

Significance Levels: <0.01 '***', <0.05 '**', <0.10 '*'

Table 7 demonstrated that in Model 1, GHG Emissions Intensity and ESG Score showed a weakly significant negative effect on ROA at the 10% level, with a 1% increase in these variables leading to decreases of 0.051% and 0.138%, respectively. This inverse relationship aligns with findings by Naeem et al. (2022) and Garcia et al. (2017), attributing reduced profitability to the costs of ESG compliance. Sectors like energy and industrials are

especially affected due to regulatory and operational burdens, with stricter policies in countries like Malaysia and Singapore contributing to short-term costs.

In Model 3, GHG intensity had no significant effect on Tobin's Q, reflecting sectoral and regional variations in investor focus, with ASEAN markets prioritizing financial stability over environmental concerns. Conversely, the ESG Score showed a highly significant negative relationship with Tobin's Q, as high ESG investments were seen as dilutive to short-term profitability, especially in sectors like real estate and energy (Marasigan, 2024; Shobhwani & Lodha, 2023). These findings underline the transitional nature of ASEAN markets in adopting sustainable initiatives, with long-term benefits yet to materialize.

In Model 2, the inclusion of control variables improved the significance of ESG Score, which was statistically significant at a 5% level, while GHG Emissions Intensity became insignificant in its impact on ROA. A 1% increase in ESG Score led to a 0.145% decline in ROA, emphasizing the inverse relationship between ESG practices and short-term profitability. Firm size and current ratio were insignificant for ROA, suggesting that economies of scale and short-term liquidity had minimal influence on profitability in ASEAN firms. Leverage, measured by the Debt-to-Equity Ratio (DTER), exhibited a significant negative relationship with ROA, reflecting the financial risks associated with debt reliance, particularly in sectors like real estate and industrials (Susilawati, 2022; Nurhikmawaty et al., 2020).

Similarly, in Model 4, ESG Score retained its significant negative impact on Tobin's Q, indicating that higher ESG performance is associated with lower firm valuations in the ASEAN market, partly due to investor skepticism (Marasigan, 2024; Shobhwani & Lodha, 2023). DTER was also significant for Tobin's Q, signaling financial vulnerability linked to debt dependency (Wahid et al., 2022), while firm size showed a negative relationship, reflecting limited growth potential of larger firms compared to smaller, more agile ones. The insignificance of liquidity metrics such as current ratio highlighted the stability-oriented strategies of mid-cap firms in the region (Handoyo & Anas, 2024). Overall, these findings underscore the unique financial dynamics of ASEAN firms, shaped by regional regulatory and governance standards, sector-specific challenges, and market maturity levels, with a majority of the sampled firms being mature and resilient but constrained by evolving economic environments.

3.5 Country-level analysis

The researchers utilized a random effects (RE) model to retain both time-varying and time-invariant variables, crucial for country-level analysis (Wooldridge, 2010). Unlike the fixed effects (FE) model, the RE model allowed the inclusion of country-specific identifiers with coefficients and p-values. Countries were assigned ID numbers, with Singapore (ID 1) as the benchmark due to its strict sustainability reporting laws (Singapore Exchange, 2024), serving as a reference point for comparative analysis.

For Malaysia, the addition of control variables (SIZE, DTER, CR) significantly weakened the statistical significance of ROA and TQ, indicating no notable financial performance difference from Singapore. In the Philippines, the negative relationship with ROA and TQ showed no statistical significance, partly due to the recent implementation of ESG reporting guidelines in 2019 (Pan, 2021). Indonesia also lacked statistical significance in both financial metrics, aligning with findings that its growth is hindered by political instability and infrastructure limitations, despite recent economic growth (World Bank, 2023). In Thailand, positive but insignificant coefficients for ROA and TQ were observed, attributed to a flexible regulatory environment and lower institutional quality, limiting the effectiveness of ESG practices. Conversely, Vietnam's firms showed highly significant positive coefficients for both ROA and TQ, outperforming others due to strong operational efficiency, favorable economic conditions, and global capital attraction. The limited number of Vietnamese firms analyzed, particularly in manufacturing, textiles, and energy sectors, contributed to their superior performance compared to Singapore.

3.6 Discussion of the results

In this result, the impact of GHG emissions intensity is assessed with the influence of the control group. The findings indicate that GHG has a marginal statistical significant influence on ROA and but not on TQ, this implies that Hypothesis 1 is partially supported. This relationship reflects the nuanced trade-offs between environmental costs and operational efficiency. The findings reveal that ESG score significantly influences both ROA and TQ, therefore, Hypothesis 2 is supported. Investors favor firms with high ESG scores, viewing them as lower-risk investments with transparent governance, as suggested by Aydoğmuş et al. (2022). Consequently, these firms enjoy improved access to equity and debt markets by fostering investor trust and capital readiness.

The findings reveal that GHG emissions intensity does not significantly influence ROA or TQ, whereas the ESG score shows a significant impact on both financial performance, partially supporting Hypothesis 3. Despite additional model factors, the significance of GHG intensity weakened, reinforcing ESG as the primary factor. High leverage ratios (DTER) reduce profitability due to debt servicing costs, while operational inefficiencies and a focus on liquidity over asset returns weaken market valuation, hindering ESG-related investments. Summary of hypothesis testing can be seen in Table 8.

Table 8. Summary of hypothesis testing

Research Hypothesis	ROA Significance Level	TQ	Results
Hypothesis 1	(0.055)*	-0.591	Partially Supported
Hypothesis 2	(0.052)*	(0.000)***	Supported
Hypothesis 3	(0.097)*	(0.534)	Partially Supported
	GHG	GHG	
	(0.041)**	(0.000)***	
	ESG	ESG	

4. Conclusions

The purpose of this study is to examine the influence of GHG emissions intensity and ESG scores on financial performance in ASEAN public companies, focusing on ROA and Tobin's Q. Using data from Refinitiv Eikon on 220 companies from 2018 to 2022, a fixed-effects panel regression analysis identified key findings. The study yields several important findings that demand further investigation. For one, it was indicated that while GHG emissions intensity has a slightly significant impact on return on assets (ROA), it does not significantly affect Tobin's Q. This relationship indicates underlying mechanisms in operation, which may point to future research and intervention.

In addition, the demographic analysis showed different inequalities in groups, which led to the conclusion that there must be group-specific interventions targeting these disparities. The qualitative data, rich in narration, served as a complementary piece that filled the gap of quantification, showing the detailed experience and understanding of the participants. Furthermore, the study documents a significant negative relationship between the ESG scores and both the ROA and Tobin's Q. This means while investors are aware of ESG engagement as a corporate governance signal, the price of ESG engagement may discourage investment. The threat of greenwashing and inconsistency in the ASEAN countries' reporting of ESG standards across countries in this diverse regulatory environment further makes it less reliable to use the ESG metrics.

The implications of these findings reach beyond the immediate context of the study. These open up potential pathways for policy development and practical applications in relevant fields. By synthesizing these insights, stakeholders can better address the challenges identified and lead to better outcomes for the populations involved. The study brings out the need for companies to strategically align their ESG efforts with long-term corporate goals toward sustainability and financial performance. Firms are urged to truly

embrace sustainable practices aligned with stakeholder expectations rather than mere compliance with shallow ESG requirements. This can lead to increased investor confidence and, potentially, to improved market value in the long run.

Policymakers also have a critical role in this dynamic. They can make the ASEAN region a more facilitative place for sustainable business practices by harmonizing ESG standards across the region. Clear regulatory frameworks and fiscal incentives to encourage companies to make actual efforts toward sustainability may persuade more firms to invest in ESG initiatives, which will subsequently benefit the environment and economy. Therefore there is a need to carry out further research for this study so that longer periods and including other variables could be utilized. A good direction of future research avenues is suggested which will ensure researchers do long-term investigations on GHG emissions intensity and ESG scores toward financial performance for proper explanations on how they influence the success of any corporation.

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