



From Emissions to Economy: Company Characteristics and Carbon Disclosure in Southeast Asia

Ari Warokka^{*1} , Manuel Monjas Barroso² , Aina Zatil Aqmar³ 

¹Centro Internacional “Carlos V” UAM, Madrid, 28049, Spain

²Universidad Autonoma de Madrid, Madrid, 28049, Spain

³Prosemora Consulting, Jakarta, 13220, Indonesia

*Corresponding Author: ari.warokka@gmail.com

ARTICLE INFO

Article history:

Received : May 15, 2024

Revised : May 27, 2024

Accepted : May 29, 2024

Available online : May 31, 2024

E-ISSN 3021-8179

How to cite:

Warokka, A., Barroso, M. M., & Aqmar, A. Z. (2024). From Emissions to Economy: Company Characteristics and Carbon Disclosure in Southeast Asia. *Journal of Sustainable Economics*, 2(1), 10-23.

<http://doi.org/10.32734/jse.v2i1.16440>



This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International.

ABSTRACT

This study investigates the relationship between company characteristics, carbon emission disclosure, and economic consequences in five ASEAN countries. By utilizing data from 2008 to 2017, the research focuses on non-financial companies, selected due to their prominence as the highest carbon-emitting nations in the ASEAN region. Results reveal that profitability positively influences carbon emission disclosure, while leverage exhibits no significant effect. Additionally, company size positively impacts carbon emission disclosure, whereas sales growth demonstrates a negative effect. Furthermore, carbon emission disclosure positively affects economic consequence variables. These findings offer practical implications for practitioners and investors, emphasizing the importance of considering carbon emission disclosure in investment decisions.

Keywords: Company Characteristics, Carbon Emission Disclosure, Economic Consequences, ASEAN

1. Introduction

The swift advancement of industrialization, exponential global population growth, and societal consumption patterns and lifestyles have significantly contributed to environmental problems (Huisingh et al., 2015; Yue & Gao, 2018). There is clear evidence that human activities can cause carbon emissions that contribute to global warming (Fang et al., 2011; Salam & Noguchi, 2005). According to the OECD (2012), global greenhouse gas emissions are estimated to rise by 50% by 2050 if no policies encourage carbon emission reductions (OECD, 2012).

Governments and companies worldwide must seriously develop emissions reduction strategies to decrease carbon emissions globally. One of these strategies is to disclose information regarding handling environmental/ecological issues by disclosing carbon emissions (Grauel & Gotthardt, 2016). These disclosures serve as a legitimacy management tool, with reporting quality and disclosure placement being crucial for understanding companies' responses to stakeholder expectations regarding carbon emissions and climate change (Pitrakkos & Maroun, 2020). Carbon emissions disclosure is a concrete measure towards promoting the advancement of the low-carbon economy, which aims to reshape economic development to achieve sustainable objectives (Xie, 2014).

Carbon emissions disclosure significantly enhances a company's credibility and consequently strengthens stakeholder trust (Khalid et al., 2023; Saha et al., 2021). Companies have various motivations for disclosing carbon emissions, including communication with the public, addressing stakeholder interests (such as those of customers, employees, and investors), enhancing transparency, gaining insights into business operations, cutting costs, fulfilling legal obligations, and comprehending environmental impacts (Blanco et al., 2017;

[Elsayih et al., 2018](#); [Palea & Drogo, 2020](#)). Several previous studies have highlighted the importance of standardized climate-related risk disclosure in reducing information asymmetry, emphasizing the necessity for carbon assurance and financial auditing to address this issue within existing regulations effectively ([Fan et al., 2021](#); [Schiemann & Sakhel, 2019](#)).

Based on the National Climate Change Secretariat ([2019](#)) report, countries in the Southeast Asian Nations (ASEAN) region are among the largest contributors to carbon emissions globally. Developing nations in the region, such as Thailand, Malaysia, Indonesia, and the Philippines, are particularly high emitters and must take steps to reduce emissions. Furthermore, the Carbon Disclosure Project ([2023](#)) report highlights that Southeast Asia, highly vulnerable to climate change impacts, faces estimated annual economic losses of US\$86.5 billion due to natural disasters, exacerbated by a global temperature rise of 1°C above pre-industrial levels. Despite these challenges, the Carbon Disclosure Project also found that the percentage of carbon emission disclosure reporting in Southeast Asia remains low, especially for Scope 3 emissions related to climate change, water security, and forests, and is lower than in other developed markets ([CDP, 2023](#)). Southeast Asian companies still lack the ambition to make environmental commitments ([CDP, 2023](#)). Therefore, understanding the factors influencing carbon emission disclosure in the ASEAN region is crucial.

Existing literature shows that company characteristics can be an essential factor influencing carbon emissions disclosure ([Kılıç & Kuzey, 2019](#); [Y.-J. Zhang & Liu, 2020](#)). The characteristics of a company play a pivotal role in determining company reports, influencing the breadth of information provided, the transparency of disclosures, and the alignment of reporting practices with stakeholder expectations and regulatory requirements ([Kamalluarifin, 2016](#); [Vurro & Perrini, 2011](#)). Organizations must understand the mechanisms of carbon accounting and disclosure and identify the company-specific characteristics influencing their approach to reporting climate change risks and opportunities ([Borghei, 2021](#)). Therefore, this research investigates how company traits affect carbon emission disclosure.

This research also analyzes how carbon emission disclosure influences decision-making behavior or economic consequences. By disclosing their carbon emissions transparently, companies fulfill their corporate responsibility and provide valuable insights to stakeholders ([Blanco et al., 2017](#); [Guenther et al., 2015](#)). Moreover, these reports can potentially impact managerial decisions and internal company operations directly ([Ott et al., 2017](#); [Y.-J. Zhang & Liu, 2020](#)). Disclosure by companies can mitigate information asymmetry, thereby potentially influencing both share prices and trading volume ([Hassan et al., 2009](#); [Kothari et al., 2009](#)). The economic consequences examined in this study include bid-ask spread, trading volume, and share price volatility. These variables reflect how disclosure signals can attract investor interest and enhance the company's reputation, potentially leading to continued growth in the company's value ([Gray et al., 1995](#)).

This research makes a substantial contribution in various aspects. First, it offers crucial perspectives on how company characteristics impact carbon emission disclosures in the ASEAN region. While previous studies have examined various company attributes' impact on carbon emission disclosure ([Bui et al., 2020](#); [Ghomi & Leung, 2013](#); [Welbeck et al., 2017](#)), research on factors like sales growth remains limited. Therefore, this research aims to address this theoretical gap by investigating the impact of sales growth on carbon emission disclosure. Furthermore, limited research investigates the correlation between carbon emission disclosure and economic consequences. Therefore, this research introduces a novel comprehensive model that encompasses both the determinants and outcomes of carbon emission disclosure, providing a holistic understanding of the phenomenon. The outcomes of this study will be essential for companies in effectively managing their carbon emission disclosures. Focusing on the four highest carbon-emitting countries in ASEAN—Thailand, Malaysia, Indonesia, and the Philippines—this research addresses the notably lower response rates to carbon disclosure in developing countries compared to developed ones, highlighting the need for tailored insights, especially in the ASEAN region.

2. Method

2.1 Research Model

Company characteristics encompass a range of factors that define an organization's identity, operations, and behavior within its industry and the broader marketplace ([Blombäck & Brunninge, 2009](#); [Subramaniam et al., 2009](#)). Company characteristics shape an organization's strategic direction, operational practices, and competitive positioning within its industry and broader business environment ([Dima, 2013](#); [Menicucci, 2018](#)). Balasubramanian et al. ([2021](#)) meta-analysis study highlights extensive evidence from prior literature

underscoring the significance of company characteristics concerning environmental sustainability. This body of research indicates that these characteristics play a crucial role in elucidating variations in company attitudes and behaviors toward the environment. This research examines how company characteristics such as profitability, leverage, company size, and sales growth affect carbon emission disclosure.

The first company characteristic factor is profitability. Profitability refers to the capacity of an investment to generate returns from its utilization, reflecting the efficacy of a business entity in generating profits ([Tulsian, 2014](#)). Companies in a strong financial position tend to invest in human resources and are more inclined to disclose environmental data despite the absence of immediate benefits to the company ([Choi et al., 2013](#); [Cormier et al., 1999](#)). Highly profitable companies effectively address environmental pressures and promptly resolve issues, making them more inclined to publish social and environmental data ([Jannah & Muid, 2014](#)). Several previous researchers found that profitability was correlated with carbon emission disclosure ([Bui et al., 2020](#); [Efendy et al., 2023](#); [Ganda, 2018](#)).

The following company characteristic is leverage, which refers to the extent to which a company uses borrowed funds relative to its equity to support its operations and investments ([Ozdagli, 2012](#)). Highly leveraged companies could face challenges in absorbing the adverse financial effects of disclosing carbon information ([Luo et al., 2013](#)). Companies that rely more on borrowing from external sources tend to report their environmental data to the Carbon Disclosure Project ([Moses et al., 2018](#)). Several previous researchers found that leverage affected carbon emission disclosure ([Efendy et al., 2023](#); [Iatridis, 2013](#); [Lemma et al., 2019](#); [Moses et al., 2018](#)).

Another company characteristic considered to play an essential role in determining carbon emission disclosure is company size. Company size, a crucial determinant in organizational dynamics, often correlates with the extent and transparency of carbon emission disclosure ([Faisal et al., 2018](#)). The size of a company is characterized by its visibility and measured by the logarithm of total assets ([Choi et al., 2013](#)). Larger companies face heightened societal and stakeholder pressure and expectations regarding corporate carbon management practices, leading to increased responsiveness in their carbon disclosures ([Luo et al., 2013](#)). Prior studies found that company size affects carbon emission disclosure ([Bui et al., 2020](#); [Efendy et al., 2023](#); [Welbeck et al., 2017](#)).

Sales growth is the final company characteristic examined as a factor in carbon emission disclosure. Sales growth is the percentage increase in annual sales that aligns with the company's financial policies ([Lasisi et al., 2018](#)). The pursuit of increased sales may lead companies to expand operations, utilize more resources, and, consequently, generate higher levels of carbon emissions. Recognizing this, companies with robust sales growth may face greater pressure to publish their carbon emission data as a component of their broader sustainability initiatives ([Long et al., 2015](#)). Qian and Schaltegger ([2017](#)) found a strong association between sales growth and a change in carbon performance, indicating that sustaining a favorable sales growth rate aligns with reducing carbon emissions. Therefore, there is a likelihood that sales growth can influence carbon emission disclosure.

Carbon emission disclosure provides quantitative and qualitative information about a company's past emissions, future projections, additional relevant details, and the financial implications for navigating climate change ([Cotter & Najah, 2011](#)). Less environmentally attentive companies often extensively disclose their carbon emissions to compensate for their poor environmental performance and effectively capture investors' attention ([C. H. Cho & Patten, 2007](#); [Clarkson et al., 2011](#); [Qian & Schaltegger, 2017](#)). The disclosure of carbon emissions enhances the firm value and attracts investors, reducing capital costs and indicating superior management environments and disclosure practices ([Lee et al., 2021](#)). In this research, the carbon emission disclosure also analyzed to understand its impact on economic consequences.

Economic consequences are the impact of disclosure of company financial reports on changes in company policy ([Leuz & Wysocki, 2008](#)). Within the stock market, accessible information prompts trading activity, whereby the dissemination of information concurrently influences both price and trading volume ([Jinliang et al., 2006](#)). Several previous researchers found that carbon emission disclosure affected the bid-ask spread ([S. Y. Cho et al., 2013](#); [Michaels & Gruning, 2017](#); [Riordan & Nerlinger, 2022](#)). Corporate disclosures regarding social and environmental aspects can decrease market uncertainty, thereby potentially mitigating bid-ask spreads and minimizing losses associated with information asymmetry ([Schiemann & Sakhel, 2019](#)).

Furthermore, other studies have noted a correlation between carbon emission disclosure and trading volume (Hapsoro & Fadhilla, 2017; Hitzemann et al., 2015; Zhou & Li, 2019). Decreasing information asymmetry through extensive and high-quality voluntary environmental disclosures lessens uncertainties in financial markets, ultimately influencing the convergence of stock prices and trading volume (Borghei et al., 2018). When companies make disclosures, investors in the capital market react positively to these signals, consequently boosting stock trading volume (Hapsoro & Fadhilla, 2017).

The following economic consequence is share price volatility. Share price volatility quantifies the degree of fluctuation in stock prices over a specified period, providing insight into short-term variability rather than the absolute price levels (L. X. Zhang, 2005). According to Magnan et al. (2010), disclosures related to the environment and social issues can mitigate asymmetric information in the capital market, thereby reducing stock price volatility. Evidence from prior research indicates a link between the disclosure of carbon emissions or disclosures directly related to the environment and share price volatility (Lemma et al., 2019; Perera et al., 2023).

Based on existing literature and previous research, a possible relationship exists between company characteristics (profit, leverage, size, growth), carbon emissions disclosure, and economic consequences (bid-ask spread, trading volume, stock price volatility). Hence, Figure 1 illustrates the research model, along with the subsequent hypothesis formulation.

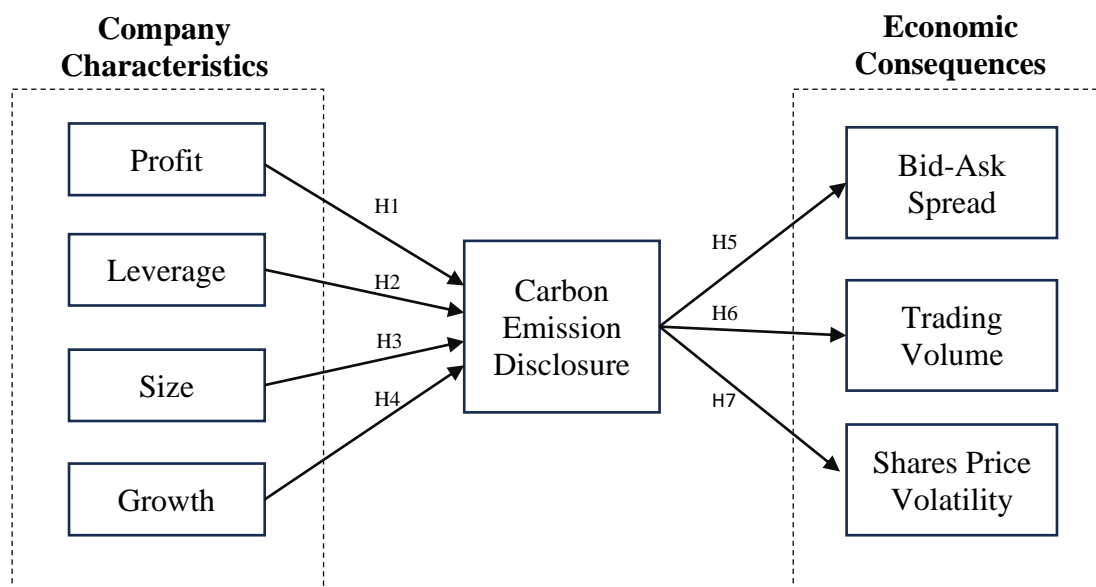


Figure 1. Research Model

H1: Profitability has a positive effect on carbon emissions disclosure

H2: Leverage has a positive impact on carbon emissions disclosure

H3: Company size has a positive effect on carbon emissions disclosure

H4: Sales growth has a positive impact on carbon emissions disclosure

H5: Disclosure of a company's carbon emissions has a negative effect on the bid-ask spread

H6: Disclosure of company carbon emissions has a positive effect on stock trading volume

H7: Disclosure of company carbon emissions has a negative effect on stock price volatility

2.2. Methodological Approach

This research focuses on non-financial companies listed on the stock exchanges of Indonesia, Malaysia, Thailand, Vietnam, and the Philippines. These countries were chosen due to their status as the highest carbon-

emitting nations in the ASEAN region. The study gathered data from financial statements, annual publications, and environmental information reports from 2008 to 2017.

The carbon emission disclosure variable is assessed using measurement by the Carbon Disclosure Project, which divides it into five large categories, namely climate change risks and opportunities (CC), greenhouse gas emissions (GHG), energy consumption (EC), greenhouse gas reduction and costs (RC), and accountability of carbon emissions (AEC). Out of these five categories, 18 items were identified. A score of 1 is assigned to each item the company discloses, with a potential score ranging from 0 to 18. If a company discloses all items, its score reaches the maximum of 18. The list of categories and each item is listed in Table 1. Measurements for other variables are summarized in Table 2.

The data was analyzed using partial least squares structural equation modeling (PLS-SEM) and processed with Warp PLS-SEM 5.0 software. This research employs the PLS-SEM method due to its numerous advantages and suitability for the studied research model. PLS-SEM facilitates testing complex relationships involving multiple constructs and indicators, is robust to non-normally distributed data, and accommodates diverse measurement scales (Hair et al., 2017). Its suitability for small sample sizes and its effectiveness in resolving research challenges are notable advantages. Moreover, PLS yields accurate results even with limited theoretical support, rendering it suitable for estimating causal predictive models often encountered in research settings.

Table 1. Checklist Carbon Emission Disclosure

| Category | Item | Indicator |
|---|------|---|
| Climate Change Risks and Opportunities (CC) | CC1 | Assessment/description of risks (both specific and general regulations) related to climate change and the actions taken to manage these risks |
| | CC2 | Current (and future) assessment/description of the financial implications, business implications and opportunities of climate change |
| Greenhouse Gas Emissions (GHG) | GHG1 | Description of the methodology used to calculate greenhouse gas emissions (e.g., GHG or ISO protocol) |
| | GHG2 | The existence of external verification of the calculation of the quantity of greenhouse gas emissions by whom and on what basis |
| | GHG3 | Total greenhouse gas emissions (metric tons of CO ₂ -e) produced |
| | GHG4 | Disclosure of scopes 1 and 2 or 3 direct greenhouse gas emissions |
| | GHG5 | Disclosure of greenhouse gas emissions based on source (e.g., coal, electricity, etc.) |
| | GHG6 | Disclosure of greenhouse gas emissions by facility or segment level |
| | GHG7 | Comparison of greenhouse gas emissions with previous years |
| Energy Consumption (EC) | EC1 | Amount of energy consumed (e.g., tera-joules or petajoules) |
| | EC2 | Calculation of energy from renewable resources |
| | EC3 | Disclosure by type, facility, or segment |
| Greenhouse Gas Reduction and Costs (RC) | RC1 | Details of plans or strategies to reduce greenhouse gas emissions |
| | RC2 | Details of current greenhouse gas emission reduction target levels and emission reduction targets |
| | RC3 | Emission reductions and costs or savings currently achieved as a result of emissions reduction plans |
| | RC4 | Future emission costs are taken into account in capital expenditure planning |
| Accountability of Emission Carbon (AEC) | AEC1 | An indication that the board committee (or other executive body) has responsibility for action related to climate change |
| | AEC2 | A description of the mechanism by which a board committee (or other executive body) reviews the company's climate change-related developments |

Table 2. Summary of Variable Measurement

| Variable | Measurement |
|-------------------------|--|
| Profitability | Return on assets (ROA), calculated as earnings before interest and tax, divided by average assets |
| Leverage | Debt Ratio, calculated as total debt divided by total assets |
| Size | Natural logarithm of total assets |
| Growth | Sales growth, calculated as current period sales minus prior period sales, divided by prior period sales |
| Bid-Ask Spread | $\frac{\{(bid_{i,t} - ask_{i,t}) / (bid_{i,t} + ask_{i,t}) / 2\} \times 100}{n}$ Denotes ask as the lowest selling price, bid is the highest buying price, and n is the number of trading days for one year |
| Trading Volume | $VPS_i = \frac{\sum_{t=1}^n VPS_{i,t}}{n}$ Denotes, VPS _{i,t} is the company's daily stock trading volume from the beginning of the year to the end of the year, and n is the number of trading days during one year |
| Shares Price Volatility | $S^2 = \frac{\sum_{i=1}^n (X_i - \bar{X})^2}{n - 1}$ Denotes, X _i is the company's daily stock price in one year, \bar{X} is the average daily stock price, and n is the number of trading days during one year |

4. Result and Discussion

4.1. Result

Descriptive analysis is an essential tool for understanding and summarizing data characteristics. In this study, descriptive analysis provides insights into the distribution and central tendencies of the variables under examination. Specifically, measures such as mean, minimum score, maximum score, and standard deviation are employed to provide a comprehensive overview of the dataset. Table 3 displays the findings of descriptive statistics.

Table 3. Descriptive Statistics

| Variable | Mean | Minimum | Maximum | Std. Deviation |
|----------------------------|----------|----------|----------|----------------|
| Profitability | 10.1026 | -48.146 | 73.0662 | 11.7662 |
| Leverage | 27.6672 | 0.14424 | 144.7120 | 19.7256 |
| Size | 5303.70 | 129.002 | 68534.76 | 8621.471 |
| Growth | 8.13943 | -98.254 | 171.271 | 25.317 |
| Bid-Ask Spread | -0.00087 | -0.0451 | 0.00019 | 0.0027 |
| Trading Volume | 17.9469 | 0.014953 | 611.7599 | 46.297 |
| Shares Price Volatility | 0.32183 | 2.87E-06 | 21.6766 | 1.66651 |
| Carbon Emission Disclosure | 7.80222 | 0 | 17 | 5.5554 |

Researchers typically examine convergent and discriminant validity values to ascertain whether a collinearity issue exists in PLS analysis. These tests typically form part of the outer model evaluation. Convergent validity evaluates the correlation among items/indicators to measure the strength of the construct. In contrast, discriminant validity examines items/indicators from distinct constructs to ensure they do not demonstrate excessive correlation. The convergent validity results, as indicated by the Average Variance Extracted (AVE) value, are presented in Table 4.

Table 4. Average Variance Extract

| Profitability | Leverage | Size | Growth | Bid-Ask Spread | Trading Volume | Shares Price Volatility | CED |
|---------------|----------|-------|--------|----------------|----------------|-------------------------|-------|
| 0.806 | 0.822 | 0.957 | 0.228 | 0.365 | 0.722 | 0.943 | 0.625 |

According to Table 4, most variables exhibit satisfactory AVE values exceeding 0.50, thereby confirming their compliance with convergent validity criteria. However, the Growth and Bid Ask variables have AVE values

below 0.50. Despite these two variables having AVE values below 0.50, the full collinearity VIF values for each variable is $3.3 \geq VIFs \leq 5$, indicating no concerns regarding multicollinearity in the model.

Table 5. Correlations among Latent Variables with sq. rts. of AVEs

| | Profit | Leverage | Size | Growth | Bid-Ask | Trading | Shares Price | CED |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Profit | 0.898 | -0.412 | -0.412 | 0.101 | 0.497 | -0.153 | 0.683 | 0.283 |
| Leverage | -0.412 | 0.907 | 0.313 | -0.021 | -0.218 | 0.177 | 0.047 | -0.090 |
| Size | -0.451 | 0.313 | 0.978 | -0.234 | 0.181 | 0.384 | -0.253 | 0.195 |
| Growth | 0.101 | -0.021 | -0.234 | 0.478 | 0.092 | -0.336 | -0.062 | -0.240 |
| Bid-Ask | 0.497 | -0.218 | 0.181 | 0.092 | 0.604 | -0.038 | 0.393 | 0.278 |
| Trading | -0.153 | 0.177 | 0.384 | -0.336 | -0.038 | 0.850 | -0.151 | 0.109 |
| Shares Price | 0.683 | 0.047 | -0.253 | -0.062 | 0.393 | -0.151 | 0.971 | 0.299 |
| CED | 0.283 | -0.085 | 0.195 | -0.242 | 0.278 | 0.109 | 0.299 | 0.791 |

The discriminant validity assessment involves comparing the AVE's square root with the correlation between constructs. Based on Table 5, constructs or variables exhibit good discriminant validity when the values on the diagonal line are higher than the correlations between constructs. Additionally, the table provides correlation figures between constructs.

The inner model analysis aims to demonstrate the robustness of estimates between constructs, evaluating the relationship between constructs in the model. Evaluation of the inner model in PLS involves several indicators, such as average R-squared (ARS), average path coefficient (APC), and average variance inflation factor (AVIF). Based on Table 6, in the validation of the main model, the APC value is 0.260 (P value $0.015 < 0.05$), indicating significance; however, ARS is 0.154 (P value $0.069 > 0.05$), and AARS is 0.122 (P value $0.099 > 0.05$), showing marginal significance. Additionally, AFVIF and AVFIF are both ≤ 3.3 , resulting in a GOF value of 0.325, indicating a medium fit category. Furthermore, SPR, RSCR, and SSR are all 1, suggesting no causality problem in the model. Moreover, NLBCDR is ≥ 0.7 , meeting the criteria for Goodness of Fit Model, which is satisfactory.

Table 6. Fit Model for 4 ASEAN Countries

| Indicator | Result | Criteria | Information |
|---------------------------|---------------|-------------------------------|------------------------|
| APC | 0.260 (0.015) | < 0.05 | Accepted |
| ARS | 0.154 (0.069) | < 0.05 | - |
| AARS | 0.122 (0.099) | < 0.05 | - |
| AVIF | 1.130 | $3.3 \geq AVIF \leq 5.5$ | Accepted |
| AFVIF | 2.161 | $3.3 \geq AFVIF \leq 5.5$ | Accepted |
| GOF | 0.325 | $0.1 \leq GOF \leq 0.36$ | Medium Fit |
| SPR | 1 | $SPR=1$ atau $SPR \geq 0,7$ | Accepted |
| RSCR | 1 | $RSCR=1$ atau $RSCR \geq 0,7$ | Accepted |
| SSR | 1 | $SSR \geq 0,7$ | Accepted |
| NLBCDR | 0,929 | $NLBCDR \geq 0,7$ | Accepted |
| R- Squares | | | Kock and Lynn (2012) |
| CED | 0.323 | $0.25 \geq Rs \leq 0.70$ | Moderate |
| Price | 0.138 | $0.25 \geq Rs \leq 0.70$ | Weak |
| Trade | 0.068 | $0.25 \geq Rs \leq 0.70$ | Weak |
| Bid Ask | 0.089 | $0.25 \geq Rs \leq 0.70$ | Weak |
| Adjusted R ² | | | Kock and Lynn (2012) |
| CED | 0.256 | $0.25 \geq Rs \leq 0.70$ | Moderate |
| Price | 0.118 | $0.25 \geq Rs \leq 0.70$ | Weak |
| Trade | 0.046 | $0.25 \geq Rs \leq 0.70$ | Weak |
| Bid Ask | 0.068 | $0.25 \geq Rs \leq 0.70$ | Weak |
| Q ² Predictive | | | Stone (1974) |
| CED | 0.342 | > 0 | Predictive Value |
| Price | 0.203 | > 0 | Predictive Value |
| Trade | 0.076 | > 0 | Predictive Value |
| Bid Ask | 0.102 | > 0 | Predictive Value |
| Full Collinearity VIFs | | | |
| Profit | 4.185 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |
| Leverage | 1.801 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |

| Indicator | Result | Criteria | Information |
|--------------|--------|------------------------|------------------------|
| Size | 2.368 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |
| Growth | 1.346 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |
| CED | 1.354 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |
| Price | 2.862 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |
| Trade | 1.369 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |
| Bid Ask | 2.002 | $3.3 \geq VIFs \leq 5$ | Multicollinearity Free |
| Effect Size | | | Cohen (1988) |
| Profit-CED | 0.068 | ≥ 0.02 | Weak Effect |
| Leverage-CED | 0.021 | ≥ 0.02 | Weak Effect |
| Size-CED | 0.084 | ≥ 0.02 | Weak Effect |
| Growth-CED | 0.150 | ≥ 0.02 | Moderate Effect |
| CED-Bid Ask | 0.089 | ≥ 0.02 | Weak Effect |
| CED-Trade | 0.068 | ≤ 0.02 | Weak Effect |
| CED-Price | 0.138 | ≥ 0.02 | Weak Effect |

Notes: \circ = Probability

The coefficient of determination test produces positive outcomes for all endogenous variables, suggesting that the independent variables effectively explain the endogenous variables. The R-squared values for CED, Price, Trade, and Bid-Ask are 0.323 (moderate), 0.138 (weak), 0.068 (weak), and 0.089 (weak), respectively. The Adjusted R-squared values for CED, Price, Trade, and Bid-Ask are 0.256 (moderate), 0.118 (weak), 0.046 (weak), and 0.068 (weak), respectively. Additionally, the research model demonstrates predictive relevance, as all endogenous variables exhibit a Q^2 value > 0 .

The effect size value listed in Table 6 is in the small category. This finding can be seen from the average effect size above 0.02 but smaller than 0.15. This result shows that the effect size value of the independent variable has a small influence on the endogenous variable, and only the growth variable on CED has a moderate influence. In the full VIF collinearity test, each variable is $3.3 \geq VIFs \leq 5$, meaning there is no multicollinearity problem between predictors and criteria in the model, meaning there is no lateral or vertical collinearity problem. Following the fulfillment of the Goodness of Fit Model criteria, hypothesis testing can proceed.

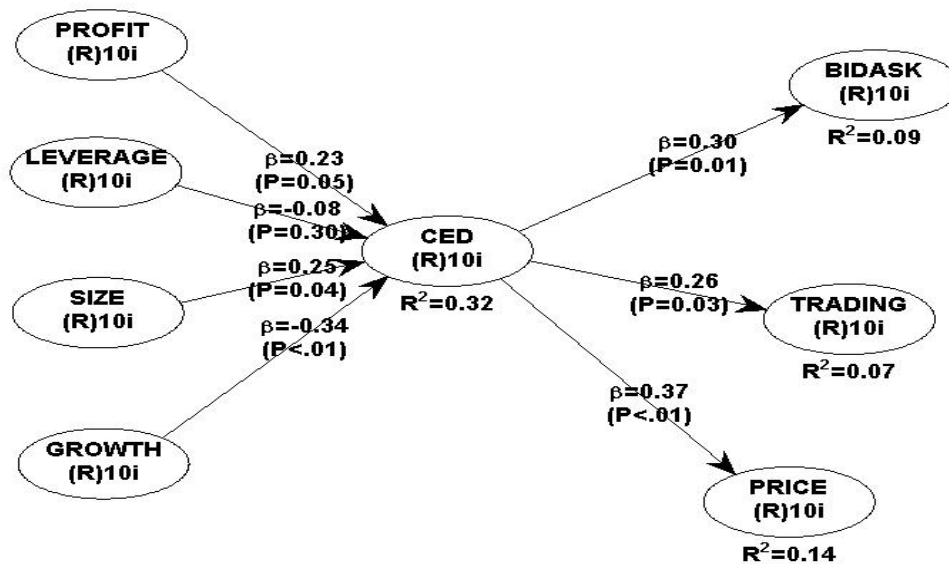


Figure 2. Analysis Model

The outcomes of hypothesis testing are illustrated in Figure 2 and summarized in Table 7. Only three of the seven proposed hypotheses are supported in this research, specifically H1, H3, and H6. However, the results of hypothesis testing show that one factor, namely leverage (H2), does not significantly influence carbon emissions disclosure. Additionally, three hypotheses, namely H4, H5, and H7, displayed coefficient signs that did not align with the hypothesized direction.

Table 7. Hypothesis Testing Results

| | Hypothesis | Path Coeff. | P-values | Decision |
|----|--|-------------|----------|---------------|
| H1 | Profitability → Carbon Emission Disclosure | 0.231 | 0.048 | Supported |
| H2 | Leverage → Carbon Emission Disclosure | -0.076 | 0.302 | Not Supported |
| H3 | Size → Carbon Emission Disclosure | 0.246 | 0.037 | Supported |
| H4 | Growth → Carbon Emission Disclosure | -0.336 | 0.007 | Not Supported |
| H5 | Carbon Emission Disclosure → Bid-Ask Spread | 0.298 | 0.014 | Not Supported |
| H6 | Carbon Emission Disclosure → Trading Volume | 0.260 | 0.030 | Supported |
| H7 | Carbon Emission Disclosure → Shares Price Volatility | 0.371 | 0.003 | Not Supported |

4.2. Discussion

This research successfully demonstrates a positive effect of profitability on carbon emission disclosure, thus confirming the first hypothesis (H1). The higher a company's profitability, the higher its tendency to disclose carbon emissions. This finding means that companies are increasingly open to providing information regarding the carbon emissions they produce. This finding supports previous researchers who found a correlation and influence of company profitability on carbon emission disclosure ([Bui et al., 2020](#); [Choi et al., 2013](#); [Ganda, 2018](#)).

According to Choi et al. (2013), firms exhibiting substantial profitability can reveal information, effectively address environmental pressures, and demonstrate a readiness to resolve associated challenges promptly. Highly profitable companies endeavor to demonstrate their superior managerial abilities and commitment to environmental protection ([Iatridis, 2013](#)). Furthermore, companies with high profitability can increasingly contribute to the environment, including initiatives such as replacing production machinery with environmentally friendly alternatives, engaging in tree planting activities, and striving to reduce emissions. Thus, it can increase their tendency to disclose carbon emissions.

The impact of leverage on carbon emission disclosure was not statistically significant, which did not support the second hypothesis (H2). These findings diverge from previous research findings that suggested a positive influence of leverage on carbon emission disclosure, thereby refuting those claims ([Efendy et al., 2023](#); [Iatridis, 2013](#); [Lemma et al., 2019](#); [Moses et al., 2018](#)). For companies to attract shareholders, they must prioritize stakeholders' interests, underscoring the necessity for synergy between managers and stakeholders. Regarding a company's environmental and social responsibility, it is noted that heightened stakeholder pressure on CSR disclosure prompts highly competitive companies to respond more to social pressures, leading to increased CSR disclosures and improved CSR strategies ([Arafat et al., 2012](#)). However, since the research findings indicate that leverage does not affect carbon emissions disclosure, stakeholders might show less interest in companies demonstrating weak financial performance and lower sensitivity to environmental concerns, preferring to avoid companies with higher levels of risk or leverage.

Company size positively influences carbon emission disclosure. These findings validate the third hypothesis, and previous researchers have found that company size positively influences carbon emission disclosure ([Bui et al., 2020](#); [Efendy et al., 2023](#); [Welbeck et al., 2017](#)). The bigger a company, the more likely it is to report carbon emissions disclosure. Larger companies face greater pressure from society and stakeholders, leading to increased demands for robust corporate carbon management strategies, rendering them more responsive to their carbon disclosures ([Luo et al., 2013](#)). These findings align with legitimacy theory, suggesting that large companies face heightened pressure to address environmental concerns, prompting them to bolster their environmental responsiveness. Given their extensive production processes and resulting industrial pollution, large companies often voluntarily provide carbon emissions data in their accounting reports to enhance their social legitimacy.

Suttipun and Stanton (2012), who researched companies listed in Thailand, stated that large companies will care more about society and make more environmental disclosures than small companies. Large companies exhibit higher levels of environmental practice implementation compared to small companies. Therefore, policymakers and industry groups can foster environmental sustainability by facilitating the transfer of ecological knowledge and skills from large to small companies ([Balasubramanian et al., 2021](#)).

This research finds that carbon emission disclosure is negatively impacted by sales growth. This result differed from what was hypothesized (H4), which was that sales growth positively affects carbon emission disclosure.

This finding contrasts with earlier studies that identified a positive effect of sales growth on carbon emission disclosure ([Long et al., 2015](#); [Qian & Schaltegger, 2017](#)). In other words, the higher the company's sales growth, the more reluctant the company will be to report information related to carbon emissions. According to Luo et al. ([2013](#)), companies in developing countries are in the growth category, focusing on financial performance rather than non-operational activities.

Carbon emission disclosure has been proven to positively affect the bid-ask spread. These findings contradict the fifth hypothesis (H5), suggesting that carbon emission disclosure negatively affects the bid-ask spread. This research is not in line with S. Y. Cho et al. ([2013](#)), Michaels and Gruning ([2017](#)), and Riordan and Nerlinger ([2022](#)). The existence of a significant influence shows that changes in carbon emissions disclosure will influence changes in the bid-ask spread positively. In other words, the higher the carbon emission disclosure, the greater the difference in the bid-ask spread.

Furthermore, carbon emission disclosure has also positively affected trading volume. This finding supports the sixth hypothesis and previous researchers who found a positive influence of carbon emission disclosure on trading volume ([Hitzemann et al., 2015](#); [Zhou & Li, 2019](#)). In other words, the higher the carbon emission disclosure, the more stock trading there will be. High stock trading volume indicates that investors are interested in the company's shares.

This research does not support the last hypothesis (H7), which states that carbon emission disclosure negatively affects share price volatility. On the contrary, it was found that carbon emission disclosure positively affected share price volatility. In other words, increased carbon emissions disclosure leads to greater stock price volatility. These results do not support previous researchers who found a negative effect of carbon emission disclosure on share price volatility ([Lemma et al., 2019](#); [Perera et al., 2023](#)).

This research aligns with De Klerk et al. ([2015](#)) and Hapsoro and Fadhillah ([2017](#)), who found that carbon emission disclosure affects share price volatility positively. Investors commonly consider carbon emissions disclosures in annual and sustainability reports when making investment decisions ([Hapsoro & Fadhillah, 2017](#)). Transparent and thorough carbon emissions reporting helps companies improve their standing and trustworthiness among investors. This increased transparency can reduce uncertainty and risk perception, potentially lowering share price volatility. Investors may view companies with robust carbon emission disclosure practices as more stable and sustainable investments, resulting in more stable share prices over time.

5. Conclusion

This study investigated the relationship between company characteristics and carbon emission disclosure, as well as the effect of carbon emission disclosure on economic consequences in four countries in the ASEAN region. While not all hypotheses were supported, the findings revealed significant insights. Specifically, profitability positively influenced carbon emission disclosure, while leverage did not show any significant effect. Additionally, company size demonstrated a positive relationship with carbon emission disclosure, while sales growth exhibited a negative effect. Notably, carbon emission disclosure positively impacted economic consequence variables such as bid-ask spread, trading volume, and share price volatility. These findings underscore the importance of transparency and disclosure practices in shaping companies' environmental and economic outcomes. This research offers a crucial understanding of the complex interactions between company traits, carbon emission disclosure, and economic consequences, providing key implications for corporate decision-making and sustainability strategies.

The findings of this research also offer significant practical implications for practitioners and investors in their investment decisions. It is advisable for investors to carefully consider whether companies provide reports on carbon emissions and their management practices. As global developments increasingly prioritize climate management in investing, the emergence of green bonds in the ASEAN region underscores the growing importance of sustainable practices. For future research, a comparative analysis of industries within each country could provide valuable insights, considering the varying levels of carbon emissions across different sectors. Additionally, incorporating variables such as manager characteristics and mass media exposure could

further enhance the understanding of the factors influencing carbon emission disclosure and its economic consequences.

References

- Arafat, M. Y., Warokka, A., & Dewi, S. (2012). Does Environmental Performance Really Matter? A Lesson from the Debate of Environmental Disclosure and Firm Performance. *Journal of Organizational Management Studies*, 2012, 1–15. <https://doi.org/10.5171/2012.213910>
- Balasubramanian, S., Shukla, V., Mangla, S., & Chanchaichujit, J. (2021). Do firm characteristics affect environmental sustainability? A literature review-based assessment. *Business Strategy and the Environment*, 30(2), 1389–1416. <https://doi.org/10.1002/bse.2692>
- Blanco, C., Caro, F., & Corbett, C. J. (2017). An Inside Perspective on Carbon Disclosure. *Business Horizons*, 60(5), 635–646. <https://doi.org/10.1016/j.bushor.2017.05.007>
- Blombäck, A., & Brunninge, O. (2009). Corporate identity manifested through historical references. *Corporate Communications: An International Journal*, 14(4), 404–419. <https://doi.org/10.1108/13563280910998754>
- Borghei, Z. (2021). Carbon disclosure: a systematic literature review. *Accounting & Finance*, 61(4), 5255–5280. <https://doi.org/10.1111/acfi.12757>
- Borghei, Z., Leung, P., & Guthrie, J. (2018). Does voluntary greenhouse gas emissions disclosure reduce information asymmetry? Australian evidence. *Afro-Asian Journal of Finance and Accounting*, 8(2), 123–147. <https://doi.org/10.1504/AJFA.2018.091055>
- Bui, B., Moses, O., & Houqe, M. N. (2020). Carbon disclosure, emission intensity and cost of equity capital: multi-country evidence. *Accounting & Finance*, 60(1), 47–71. <https://doi.org/10.1111/acfi.12492>
- CDP. (2023). *Nature Incorporated: CDP's Southeast Asia 2022 Report*. https://cdn.cdp.net/cdp-production/cms/reports/documents/000/006/920/original/CDP_Nature_Incorporated_EN.pdf
- Cho, C. H., & Patten, D. M. (2007). The Role of Environmental Disclosures as Tools of Legitimacy: A Research Note. *Accounting, Organizations and Society*, 32(7–8), 639–647. <https://doi.org/10.1016/j.aos.2006.09.009>
- Cho, S. Y., Lee, C., & Pfeiffer, R. J. (2013). Corporate Social Responsibility Performance and Information Asymmetry. *Journal of Accounting and Public Policy*, 32(1), 71–83. <https://doi.org/10.1016/j.jaccpubpol.2012.10.005>
- Choi, B. B., Lee, D., & Psaros, J. (2013). An Analysis of Australian Company Carbon Emission Disclosures. *Pacific Accounting Review*, 25(1), 58–79. <https://doi.org/10.1108/01140581311318968>
- Clarkson, P. M., Overell, M. B., & Chapple, L. (2011). Environmental Reporting and its Relation to Corporate Environmental Performance. *Abacus*, 47(1), 27–60. <https://doi.org/10.1111/j.1467-6281.2011.00330.x>
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale NJ: Erlbaum.
- Cormier, D., & Magnan, M. (1999). Corporate Environmental Disclosure Strategies: Determinants, Costs and Benefits. *Journal of Accounting, Auditing & Finance*, 14(4), 429–451. <https://doi.org/10.1177/0148558X9901400403>
- Cotter, J., & Najah, M. M. (2011). Institutional Investor Influence on Global Climate Change Disclosure Practices. *Australian Journal of Management*.
- De Klerk, M., De Villiers, C., & Van Staden, C. (2015). The Influence of Corporate Social Responsibility Disclosure on Share Prices: Evidence from The United Kingdom. *Pacific Accounting Review*, 27(2), 208–228.
- Dima, A. M. (2013). Factorial Analysis of the Correlation Between Competitive Strategy and Company's Characteristics: The Case of Romanian Business Environment. In A. R. Thomas, N. A. Pop, & C. Bratianu (Eds.), *The Changing Business Landscape of Romania: Lessons for and from Transition Economies* (pp. 153–176). Springer New York. https://doi.org/10.1007/978-1-4614-6865-3_9
- Efendy, D. G., Ulum, I., & Widyastuti, A. (2023). The effect of company profitability, leverage, and size on carbon emission disclosure with environmental performance as a moderating variable (empirical study on manufacturing companies listed on the stock exchange in 2020). In *Environmental Issues and Social Inclusion in a Sustainable Era* (pp. 347–356). Routledge.
- Elsayih, J., Tang, Q., & Lan, Y.-C. (2018). Corporate governance and carbon transparency: Australian experience. *Accounting Research Journal*, 31(3), 405–422. <https://doi.org/10.1108/ARJ-12-2015-0153>
- Faisal, F., Andiningtyas, E. D., Achmad, T., Haryanto, H., & Meiranto, W. (2018). The content and determinants of greenhouse gas emission disclosure: Evidence from Indonesian companies. *Corporate Social Responsibility and Environmental Management*, 25(6), 1397–1406. <https://doi.org/10.1002/csr.1660>

- Fan, H., Tang, Q., & Pan, L. (2021). An international study of carbon information asymmetry and independent carbon assurance. *The British Accounting Review*, 53(1), 100971. <https://doi.org/10.1016/j.bar.2020.100971>
- Fang, J., Zhu, J., Wang, S., Yue, C., & Shen, H. (2011). Global warming, human-induced carbon emissions, and their uncertainties. *Science China Earth Sciences*, 54(10), 1458–1468. <https://doi.org/10.1007/s11430-011-4292-0>
- Ganda, F. (2018). The influence of carbon emissions disclosure on company financial value in an emerging economy. *Environment, Development and Sustainability*, 20(4), 1723–1738. <https://doi.org/10.1007/s10668-017-9962-4>
- Ghomi, Z. B., & Leung, P. (2013). An Empirical Analysis of the Determinants of Greenhouse Gas Voluntary Disclosure in Australia. *Accounting and Finance Research*, 2(1), 110–127. <https://doi.org/10.5430/afr.v2n1p110>
- Grael, J., & Gotthardt, D. (2016). The Relevance of National Contexts for Carbon Disclosure Decisions of Stock-Listed Companies: a Multilevel Analysis. *Journal of Cleaner Production*, 133, 1204–1217. <https://doi.org/10.1016/j.jclepro.2016.05.182>
- Gray, R., Kouhy, R., & Lavers, S. (1995). Corporate Social and Environmental Reporting. *Accounting, Auditing & Accountability Journal*, 8(2), 47–77.
- Guenther, E., Guenther, T., Schiemann, F., & Weber, G. (2015). Stakeholder Relevance for Reporting: Explanatory Factors of Carbon Disclosure. *Business & Society*, 55(3), 361–397. <https://doi.org/10.1177/0007650315575119>
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Thousand Oaks, California: Sage Publications, Inc.
- Hapsoro, D., & Fadhilla, A. F. (2017). Relationship Analysis of Corporate Governance, Corporate Social Responsibility Disclosure and Economic Consequences: Empirical Study of Indonesia Capital Market. *The South East Asian Journal of Management*, 11(2), 164–182.
- Hassan, O. A. G., Romilly, P., Giorgioni, G., & Power, D. (2009). The Value Relevance of Disclosure: Evidence from The Emerging Capital Market of Egypt. *International Journal of Accounting*, 44(1), 79–102. <https://doi.org/10.1016/j.intacc.2008.12.005>
- Hitzemann, S., Uhrig-Homburg, M., & Ehrhart, K.-M. (2015). Emission permits and the announcement of realized emissions: Price impact, trading volume, and volatilities. *Energy Economics*, 51, 560–569. <https://doi.org/10.1016/j.eneco.2015.07.007>
- Huisingh, D., Zhang, Z., Moore, J. C., Qiao, Q., & Li, Q. (2015). Recent advances in carbon emissions reduction: policies, technologies, monitoring, assessment and modeling. *Journal of Cleaner Production*, 103, 1–12. <https://doi.org/10.1016/j.jclepro.2015.04.098>
- Iatridis, G. E. (2013). Environmental Disclosure Quality: Evidence on Environmental Performance, Corporate Governance and Value Relevance. *Emerging Markets Review*, 14(1), 55–75. <https://doi.org/10.1016/j.ememar.2012.11.003>
- Jannah, R., & Muid, D. (2014). Analisis Faktor-Faktor yang Mempengaruhi Carbon Emission Disclosure pada Perusahaan di Indonesia (Studi Empiris pada Perusahaan yang Terdaftar di Bursa Efek Indonesia Periode 2010-2012). *Diponegoro Journal of Accounting*, 3(2), 2337–3806. <https://doi.org/10.1016/j.jmarsys.2007.11.002>
- Jinliang, L., & Wu, C. (2006). Daily Return Volatility, Bid - Ask Spreads, and Information Flow: Analyzing the Information Content of Volume. *The Journal of Business*, 79(5), 2697–2739.
- Kamalluarifin, W. F. S. W. (2016). The Influence of Corporate Governance and Firm Characteristics on the Timeliness of Corporate Internet Reporting By Top 95 Companies in Malaysia. *Procedia Economics and Finance*, 35, 156–165. [https://doi.org/10.1016/S2212-5671\(16\)00020-4](https://doi.org/10.1016/S2212-5671(16)00020-4)
- Khalid, F., Sun, J., Guo, J., & Srivastava, M. (2023). Green corporate image: Assessing the effects of climate change management practices on corporate reputation. *Corporate Social Responsibility and Environmental Management*, n/a(n/a). <https://doi.org/10.1002/csr.2663>
- Kılıç, M., & Kuzey, C. (2019). The effect of corporate governance on carbon emission disclosures. *International Journal of Climate Change Strategies and Management*, 11(1), 35–53. <https://doi.org/10.1108/IJCCSM-07-2017-0144>
- Kock, N., & Lynn, G. (2012). Lateral collinearity and misleading results in variance-based SEM: An illustration and recommendations. *Journal of the Association for Information Systems*, 13(7), 546–580. <https://doi.org/10.17705/1jais.00302>
- Kothari, S. ., Li, X., & Short, J. E. (2009). The Effect of Disclosures by Management, Analysts, and Business Press on Cost of Capital, Return Volatility, and Analyst Forecasts: A Study Using Content Analysis. *The*

- Accounting Review*, 84(5), 1639–1670. <https://doi.org/10.2308/accr.2009.84.5.1639>
- Lasisi, I. O., Candidate, M. S. A., Okpanachi, J., & Mustapha, L. O. (2018). Firm Growth and Profitability : An Empirical Study of Listed Agricultural and Agro Allied Companies in Nigeria. *Saudi Journal of Business and Management Studies*, 3(3), 299–310. <https://doi.org/10.21276/sjbms.2018.3.3.13>
- Lee, J., Kim, S., & Kim, E. (2021). Voluntary Disclosure of Carbon Emissions and Sustainable Existence of Firms: With a Focus on Human Resources of Internal Control System. In *Sustainability* (Vol. 13, Issue 17). <https://doi.org/10.3390/su13179955>
- Lemma, T. T., Feedman, M., Mlilo, M., & Park, J. D. (2019). Corporate carbon risk, voluntary disclosure, and cost of capital: South African evidence. *Business Strategy and the Environment*, 28(1), 111–126. <https://doi.org/10.1002/bse.2242>
- Leuz, C., & Wysocki, P. (2008). Economic Consequences of Financial Reporting and Disclosure Regulation: A Review and Suggestions for Future Research. *SSRN*. <https://doi.org/10.2139/ssrn.1105398>
- Long, X., Naminse, E. Y., Du, J., & Zhuang, J. (2015). Nonrenewable Energy, Renewable Energy, Carbon dioxide Emissions and Economic Growth in China from 1952 to 2012. *Renewable and Sustainable Energy Reviews*, 52, 680–688. <https://doi.org/10.1016/j.rser.2015.07.176>
- Luo, L., Tang, Q., & Lan, Y.-C. (2013). Comparison of Propensity for Carbon Disclosure between Developing and Developed Countries: A Resource Constraint Perspective. *Accounting Research Journal*, 26(1), 6–34. <https://dx.doi.org/10.1108/MRR-09-2015-0216>
- Magnan, M., Aerts, W., Cormier, D., & Ledoux, M. J. (2010). Corporate Governance and Information Asymmetry between Managers and Investors. *Emerald Group Publishing Limited*, 10(5), 574–589. <https://doi.org/10.1108/14720701011085553>
- Menicucci, E. (2018). The influence of firm characteristics on profitability. *International Journal of Contemporary Hospitality Management*, 30(8), 2845–2868. <https://doi.org/10.1108/IJCHM-04-2017-0219>
- Michaels, A., & Gruning, M. (2017). Relationship of Corporate Social Responsibility Disclosure on Information Asymmetry and The Cost of Capital. *Journal of Management Control*, 28(3), 251–274. <https://doi.org/10.1007/s00187-017-0251-z>
- Moses, O., Houqe, M. N., & van Zijl, T. (2018). What is the economic value of the Extractive Industries Transparency Initiative (EITI) information disclosure? *Journal of Contemporary Accounting & Economics*, 14(2), 216–233. <https://doi.org/10.1016/j.jcae.2018.05.003>
- NCCS. (2019). *Climate change and singapore national circumstances 2019*. National Climate Change Secretariat. <https://www.nccs.gov.sg/climate-change-and-singapore/national-circumstances/singapore%27s-emissions-profile>
- OECD. (2012). *OECD Environmental Outlook to 2050*. <https://doi.org/10.1787/9789264122246-en>
- Ott, C., Schiemann, F., & Günther, T. (2017). Disentangling the determinants of the response and the publication decisions: The case of the Carbon Disclosure Project. *Journal of Accounting and Public Policy*, 36(1), 14–33. <https://doi.org/10.1016/j.jaccpubpol.2016.11.003>
- Ozdogli, A. K. (2012). Financial Leverage, Corporate Investment, and Stock Returns. *The Review of Financial Studies*, 25(4), 1033–1069. <https://doi.org/10.1093/rfs/hhr145>
- Palea, V., & Drogo, F. (2020). Carbon emissions and the cost of debt in the eurozone: The role of public policies, climate-related disclosure and corporate governance. *Business Strategy and the Environment*, 29(8), 2953–2972. <https://doi.org/10.1002/bse.2550>
- Perera, K., Kurupparachchi, D., Kumarasinghe, S., & Suleman, M. T. (2023). The impact of carbon disclosure and carbon emissions intensity on firms' idiosyncratic volatility. *Energy Economics*, 128, 107053. <https://doi.org/10.1016/j.eneco.2023.107053>
- Pittrakkos, P., & Maroun, W. (2020). Evaluating the quality of carbon disclosures. *Sustainability Accounting, Management and Policy Journal*, 11(3), 553–589. <https://doi.org/10.1108/SAMPJ-03-2018-0081>
- Qian, W., & Schaltegger, S. (2017). Revisiting carbon disclosure and performance: Legitimacy and management views. *British Accounting Review*, 49(4), 365–379. <https://doi.org/10.1016/j.bar.2017.05.005>
- Riordan, R., & Nerlinger, M. (2022). Carbon Liquidity. In *S&P Global Market Intelligence*. <https://doi.org/10.2139/ssrn.3938563>
- Saha, A. K., Dunne, T., & Dixon, R. (2021). Carbon disclosure, performance and the green reputation of higher educational institutions in the UK. *Journal of Accounting & Organizational Change*, 17(5), 604–632. <https://doi.org/10.1108/JAOC-09-2020-0138>
- Salam, M. A., & Noguchi, T. (2005). Impact of Human Activities on Carbon Dioxide (CO₂) Emissions: A Statistical Analysis. *Environmentalist*, 25(1), 19–30. <https://doi.org/10.1007/s10669-005-3093-4>

- Schiemann, F., & Sakhel, A. (2019). Carbon Disclosure, Contextual Factors, and Information Asymmetry: The Case of Physical Risk Reporting. *European Accounting Review*, 28(4), 791–818. <https://doi.org/10.1080/09638180.2018.1534600>
- Stone, M. (1974). Cross-Validatory Choice and Assessment of Statistical Predictions. *Journal of the Royal Statistical Society: Series B (Methodological)*, 36(2), 111–133. <https://doi.org/10.1111/j.2517-6161.1974.tb00994.x>
- Subramaniam, N., McManus, L., & Zhang, J. (2009). Corporate governance, firm characteristics and risk management committee formation in Australian companies. *Managerial Auditing Journal*, 24(4), 316–339. <https://doi.org/10.1108/02686900910948170>
- Suttiapun, M., & Stanton, P. (2012). Determinants of Environmental Disclosure in Thai Corporate Annual Reports. *International Journal Of Accounting and Financial Reporting*, 2(1). <https://doi.org/10.5296/ijaf.v2i1.1458>
- Tulsian, M. (2014). Profitability Analysis (A comparative study of SAIL & TATA Stell). *IOSR Journal of Economics and Finance*, 3(2), 19–22.
- Vurro, C., & Perrini, F. (2011). Making the most of corporate social responsibility reporting: disclosure structure and its impact on performance. *Corporate Governance: The International Journal of Business in Society*, 11(4), 459–474. <https://doi.org/10.1108/14720701111159280>
- Welbeck, E. E., Owusu, G. M. Y., Bekoe, R. A., & Kusi, J. A. (2017). Determinants of Environmental Disclosures of Listed Firms in Ghana. *International Journal of Corporate Social Responsibility*, 2(1), 11. <https://doi.org/10.1186/s40991-017-0023-y>
- Xie, H. (2014). Legal Regulation of Low-Carbon Economy. *IERI Procedia*, 8, 170–175. <https://doi.org/10.1016/j.ieri.2014.09.028>
- Yue, X.-L., & Gao, Q.-X. (2018). Contributions of natural systems and human activity to greenhouse gas emissions. *Advances in Climate Change Research*, 9(4), 243–252. <https://doi.org/10.1016/j.accre.2018.12.003>
- Zhang, I. X. (2005). Economic Consequences of The Sarbanes-Oxley Act of 2002. *Disertation in William E. Simon Graduate School of Business Administration, February*.
- Zhang, Y.-J., & Liu, J.-Y. (2020). Overview of research on carbon information disclosure. *Frontiers of Engineering Management*, 7(1), 47–62. <https://doi.org/10.1007/s42524-019-0089-1>
- Zhou, K., & Li, Y. (2019). Influencing factors and fluctuation characteristics of China's carbon emission trading price. *Physica A: Statistical Mechanics and Its Applications*, 524, 459–474. <https://doi.org/10.1016/j.physa.2019.04.249>