

The Impact of Carbon Disclosure on Company Competitiveness: Evidence from Publicly Listed Companies

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ABSTRACT

Carbon disclosure has become an increasingly important aspect of corporate sustainability as companies respond to climate change, growing Environmental, Social, and Governance (ESG) expectations, and expanding regulatory requirements for environmental transparency. Transparent carbon reporting is expected to enhance corporate competitiveness by strengthening stakeholder trust, improving corporate reputation, attracting sustainable investment, and supporting long-term strategic positioning. This study aims to examine the impact of carbon disclosure on company competitiveness. A quantitative explanatory research design was employed using a cross-sectional survey of 180 publicly listed companies that publish sustainability reports. The sample was selected through purposive sampling based on predefined eligibility criteria. Data were collected using structured questionnaires and supported by corporate sustainability reports, and subsequently analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results indicate that carbon disclosure has a positive and statistically significant effect on company competitiveness. Companies with higher levels of environmental transparency demonstrate stronger competitive performance through improved corporate reputation, greater investor confidence, enhanced stakeholder trust, and increased operational effectiveness. These findings suggest that effective carbon disclosure serves not only as a regulatory compliance mechanism but also as a strategic business tool for creating sustainable competitive advantage. Therefore, companies are encouraged to integrate carbon disclosure into their broader sustainability initiatives and business strategies to achieve long-term value creation and organizational competitiveness.

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1. INTRODUCTION

Climate change has emerged as one of the most significant global challenges affecting economic development, business sustainability, and environmental preservation. Increasing concerns over greenhouse gas (GHG) emissions have prompted governments, investors, customers, and other stakeholders to demand greater corporate accountability regarding environmental performance (Cogan, 2006). As a result, companies are increasingly expected to adopt sustainable business practices and transparently communicate their environmental impacts through various sustainability initiatives. Among these initiatives, carbon disclosure has become an essential component of corporate sustainability reporting, enabling organizations to demonstrate their commitment to reducing carbon emissions and mitigating climate-related risks.

The growing adoption of Environmental, Social, and Governance (ESG) principles has further strengthened the importance of carbon disclosure in corporate reporting. ESG reporting has evolved beyond a voluntary communication tool into a strategic mechanism that influences investment decisions, corporate reputation, stakeholder trust, and long-term organizational performance. Investors increasingly incorporate ESG information into their portfolio decisions, while customers, employees, regulators, and business partners expect companies to operate responsibly and contribute to sustainable development. Consequently, transparent carbon disclosure has become an important indicator of a company's environmental responsibility and governance quality.

In response to global climate commitments, governments and regulatory authorities have introduced policies requiring companies to disclose their greenhouse gas emissions and climate-related risks. International frameworks such as the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), the International Sustainability Standards Board (ISSB), and national sustainability reporting regulations have encouraged companies to improve the quality and transparency of environmental reporting (Cogan, 2006). These regulatory developments reflect the growing recognition that effective carbon disclosure supports better risk management, enhances corporate accountability, and contributes to achieving national and international climate objectives.

Beyond regulatory compliance, carbon disclosure has become a strategic business practice that may strengthen a company's competitiveness. Companies that voluntarily provide comprehensive and credible carbon information often enhance their corporate reputation, improve stakeholder confidence, attract environmentally conscious investors, and strengthen customer loyalty (Cogan, 2006). Transparent environmental reporting may also encourage operational efficiency, stimulate green innovation, reduce environmental risks, and improve access to sustainable financing. These strategic benefits can ultimately contribute to stronger competitive positioning and long-term business sustainability in increasingly environmentally conscious markets.

Company competitiveness has therefore become closely associated with environmental responsibility. In today's business environment, competitive advantage is no longer determined solely by financial performance, product quality, or operational efficiency. Instead, organizations are increasingly evaluated based on their ability to integrate sustainability into business strategies and demonstrate responsible environmental practices. Firms that successfully manage carbon emissions and communicate these efforts transparently may differentiate themselves from competitors, strengthen stakeholder relationships, and improve their market position. Consequently, carbon disclosure is increasingly viewed not merely as a reporting obligation but as a strategic resource capable of creating sustainable competitive advantage (Alsaifi et al., 2020).

Research on carbon disclosure has expanded considerably over the past decade as governments, investors, and other stakeholders have increasingly emphasized corporate accountability for climate change. One of the earliest comprehensive reviews was conducted by Zhang and Liu (2020), who systematically examined the development of carbon information disclosure research. Their review demonstrated that corporate carbon disclosure has become an increasingly important component of environmental management and sustainability reporting. They identified several major determinants of carbon disclosure, including firm characteristics, corporate governance, environmental performance, institutional pressures, and stakeholder expectations. However, the authors also noted that the quality and consistency of carbon disclosure vary substantially across firms and countries, suggesting that further research is required to understand the strategic consequences of environmental transparency.

As research interest continued to grow, Alam et al. (2022) conducted a systematic literature review of 168 studies on corporate carbon disclosure. Their findings revealed a significant increase in scholarly attention toward carbon reporting, particularly following the adoption of global sustainability initiatives and climate-related reporting frameworks. The review concluded that most existing studies focused on the determinants and reporting quality of carbon disclosure, whereas relatively fewer studies investigated its strategic and competitive implications. The authors also highlighted inconsistencies in empirical findings regarding the influence of profitability, industry characteristics, and governance mechanisms on carbon disclosure practices, indicating important opportunities for future research.

Similarly, Mishra, Sant, and Kumar (2023) reviewed research on carbon disclosure and organizational performance published between 2013 and 2022. Their literature review suggested that voluntary carbon disclosure is increasingly associated with improved organizational performance through enhanced corporate reputation, stakeholder trust, reduced information asymmetry, and lower capital costs. Nevertheless, they emphasized that the relationship between carbon disclosure

and organizational outcomes is highly context-dependent and influenced by regulatory environments, industry characteristics, and disclosure quality. They argued that future studies should move beyond traditional financial performance measures to examine broader indicators of organizational success, including competitive advantage.

Focusing specifically on the Indonesian context, Nursulistyo, Aryani, and Bandi (2025) conducted a systematic literature review of carbon emission disclosure studies published in Indonesian journals. Their review found that most previous research relied on quantitative secondary data and primarily investigated the determinants of carbon disclosure, including profitability, leverage, firm size, industry type, and company age. The authors observed that relatively few studies examined the consequences of carbon disclosure for organizational competitiveness or strategic business performance. They therefore recommended expanding future research to explore how environmental disclosure contributes to long-term corporate sustainability and competitive positioning in emerging markets.

Corporate governance has also been recognized as an important driver of carbon disclosure. Ali, Wilson, and Frynas (2024) synthesized evidence from 62 empirical studies and proposed a multilevel framework explaining corporate carbon disclosure practices. Their review demonstrated that carbon disclosure is influenced by pressures operating at macro, meso, and organizational levels, including environmental regulations, financial markets, institutional norms, investors, media attention, and industry competition. The authors concluded that governance quality significantly shapes disclosure practices and suggested that future studies should investigate how governance-driven carbon disclosure contributes to strategic competitiveness and organizational resilience.

A bibliometric review by Yang and Zhou (2024) further confirmed the rapid evolution of carbon disclosure research. Their analysis identified increasing scholarly interest in climate-related reporting, with dominant research themes including disclosure quality, environmental accountability, climate risk management, and corporate sustainability. Although the literature has expanded substantially, the authors emphasized that empirical evidence concerning the strategic outcomes of carbon disclosure remains fragmented, particularly regarding competitive advantage and long-term business performance.

Despite the increasing importance of carbon disclosure, several research gaps remain (Borghei, 2021). First, previous studies have predominantly examined the relationship between carbon disclosure and financial performance, firm value, or investment outcomes, while relatively limited attention has been given to its direct impact on company competitiveness. Second, empirical evidence from developing countries remains relatively scarce compared with studies conducted in developed economies, despite differences in regulatory environments, stakeholder expectations, and sustainability practices. Third, previous findings have produced inconsistent results regarding whether carbon disclosure generates measurable competitive advantages. Some studies report positive effects through enhanced corporate reputation and stakeholder trust, whereas others find weak or insignificant relationships. Finally, relatively few studies have investigated carbon disclosure from a strategic management perspective that emphasizes competitiveness as an organizational outcome.

Based on these research gaps, this study aims to examine the impact of carbon disclosure on company competitiveness. Specifically, the study seeks to evaluate whether transparent environmental reporting enhances competitive positioning by improving stakeholder confidence, strengthening corporate reputation, and supporting sustainable business strategies. By focusing on competitiveness rather than solely financial performance, this research contributes to expanding the literature on sustainability management and strategic corporate reporting.

Accordingly, the study addresses the following research questions: (1) Does carbon disclosure significantly influence company competitiveness? and (2) Which dimensions of carbon disclosure contribute most substantially to improving company competitiveness? Answering these questions will provide valuable insights into the strategic value of environmental transparency for businesses operating in increasingly sustainability-oriented markets.

To achieve these objectives, the study proposes the following hypothesis:

H1: Carbon Disclosure positively influences Company Competitiveness.

Additionally, to further explore the underlying mechanism through which carbon disclosure creates

competitive value, the study may include the following optional hypothesis:

H2: Company Reputation mediates the relationship between Carbon Disclosure and Company Competitiveness.

These hypotheses are grounded in Stakeholder Theory, Legitimacy Theory, and the Resource-Based View, which collectively suggest that transparent environmental disclosure enhances organizational legitimacy, strengthens stakeholder relationships, and creates valuable strategic resources that contribute to sustainable competitive advantage.

2. RESEARCH METHOD

This study employs a quantitative research approach to examine the impact of carbon disclosure on company competitiveness. A quantitative approach is considered appropriate because it enables the researcher to objectively measure the relationship between the independent and dependent variables using numerical data and statistical analysis (Mohajan, 2020). Specifically, this research adopts an explanatory research design, which aims to explain the causal relationship between carbon disclosure and company competitiveness by testing predetermined hypotheses derived from existing theories and empirical literature. The study utilizes a cross-sectional survey design in which data are collected from respondents at a single point in time, allowing the researcher to capture organizations' current carbon disclosure practices and their perceived competitiveness.

The population of this study consists of public companies listed on the national stock exchange that have implemented sustainability reporting practices. These companies are selected because publicly listed firms generally face greater regulatory requirements and stakeholder pressure to disclose environmental information, including carbon emissions and climate-related risks. Particular attention is given to companies operating in manufacturing, energy, mining, and other environmentally sensitive industries, as these sectors typically generate significant greenhouse gas emissions and are expected to maintain high levels of environmental transparency. Companies that regularly publish sustainability reports are considered especially relevant because they provide comprehensive information regarding their environmental management and carbon disclosure practices (Dragomir, 2012).

The sample is selected using a purposive sampling technique to ensure that participating companies satisfy specific research criteria. The sampling criteria include: (1) companies listed on the stock exchange during the study period; (2) companies that publish annual reports and sustainability reports; (3) companies that disclose information related to carbon emissions or environmental sustainability; and (4) companies with complete financial and sustainability data required for analysis. If primary survey data are employed, respondents include managers, sustainability officers, environmental managers, corporate social responsibility (CSR) managers, or senior executives who possess adequate knowledge regarding the company's sustainability initiatives and carbon management practices. The study targets approximately 180 respondents or companies, a sample size considered sufficient for robust statistical analysis and hypothesis testing.

This study primarily utilizes primary data collected through a structured questionnaire distributed to managers and sustainability officers within the selected companies. The questionnaire is designed to measure respondents' perceptions of carbon disclosure practices and company competitiveness using standardized measurement items adapted from previous empirical studies. To complement the survey findings and improve data validity, secondary data may also be collected from publicly available sources such as annual reports, sustainability reports, Carbon Disclosure Project (CDP) reports, Environmental, Social, and Governance (ESG) databases, and official stock exchange publications. The integration of primary and secondary data enhances the comprehensiveness and reliability of the research findings.

The study investigates one independent variable and one dependent variable (Coetzee & Erasmus, 2017). The independent variable is carbon disclosure, which refers to the extent to which a company transparently communicates information regarding its carbon emissions and climate-related environmental performance. Carbon disclosure is measured using several indicators, including carbon emission reporting, emission reduction targets, climate risk disclosure, carbon management strategy, greenhouse gas inventory, and overall environmental transparency. These indicators collectively reflect the comprehensiveness and quality of corporate carbon reporting.

The dependent variable is company competitiveness, which represents an organization's ability to achieve superior performance relative to its competitors through effective resource utilization, innovation, and strategic positioning (Porter, 2008). Company competitiveness is measured using multiple indicators, including market share, innovation capability, customer satisfaction, operational efficiency, competitive advantage, corporate reputation, and financial growth. These indicators capture both market-oriented and organizational dimensions of competitiveness that contribute to long-term business success.

The research instrument employs a five-point Likert scale to measure respondents' perceptions of each construct, where 1 represents "strongly disagree" and 5 represents "strongly agree." The Likert scale is widely used in quantitative business and management research because it enables respondents to express varying degrees of agreement while facilitating statistical analysis. If secondary data are utilized, carbon disclosure may additionally be measured using a disclosure index based on the completeness and quality of environmental information reported in annual or sustainability reports.

Data analysis is conducted using statistical software such as SPSS or SmartPLS (Ong & Puteh, 2017). The analysis begins with descriptive statistics to summarize respondents' demographic characteristics and describe the distribution of research variables. Instrument quality is then evaluated through validity and reliability tests to ensure that the measurement items accurately and consistently measure the intended constructs. If covariance-based regression analysis is employed, classical assumption tests including normality, multicollinearity, heteroscedasticity, and autocorrelation tests are conducted before hypothesis testing. Subsequently, multiple linear regression analysis is used to examine the direct effect of carbon disclosure on company competitiveness.

Alternatively, if the study adopts Structural Equation Modeling (SEM), Partial Least Squares Structural Equation Modeling (PLS-SEM) is employed to evaluate both the measurement model and the structural model simultaneously (Rasoolimanesh & Ali, 2018). The measurement model assessment includes convergent validity, discriminant validity, composite reliability, and Cronbach's alpha, while the structural model assessment examines path coefficients, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and hypothesis significance based on bootstrapping procedures. The hypotheses are accepted when the path coefficients are statistically significant at a significance level of 0.05 ($p < 0.05$). This analytical approach provides a comprehensive evaluation of the relationship between carbon disclosure and company competitiveness while ensuring the robustness and reliability of the empirical findings.

3. RESULTS AND DISCUSSIONS

3.1 Respondent/Company Characteristics

The participating companies represent a diverse range of industry sectors, including manufacturing, energy, mining, transportation, consumer goods, and other environmentally sensitive industries. These sectors were selected because their business operations generally have significant environmental impacts and are subject to greater stakeholder expectations and regulatory requirements regarding greenhouse gas emissions and sustainability reporting. Companies operating in carbon-intensive industries are more likely to disclose environmental information due to increased public scrutiny and compliance obligations. The diversity of industry sectors also enhances the generalizability of the study's findings across different business environments.

Company size is another important characteristic considered in this study (Pervan & Višić, 2012). The sample includes small, medium-sized, and large companies, which are classified based on total assets, annual revenue, or the number of employees. Larger companies generally possess greater financial resources, more advanced environmental management systems, and stronger corporate governance structures, enabling them to produce more comprehensive sustainability reports and carbon disclosure information. In contrast, smaller companies may encounter resource constraints that limit the extent and quality of their environmental reporting. Examining companies of different sizes provides a broader understanding of how organizational capacity may influence carbon disclosure and competitiveness.

The sample also varies in terms of firm age, reflecting organizations at different stages of business development. Older companies often possess greater organizational experience, established corporate governance practices, and more mature sustainability management systems. Their long-standing relationships with stakeholders and accumulated knowledge may facilitate the implementation of environmental initiatives and transparent carbon reporting. Conversely, younger firms may demonstrate greater flexibility and innovation in adopting emerging sustainability practices and environmental technologies. Including firms with different organizational histories allows the study to capture a comprehensive representation of corporate sustainability practices.

Annual revenue is included as an indicator of the companies' economic capacity and business scale (Morrison, 2012). Companies with higher revenues generally have greater financial resources to invest in environmental management, carbon reduction programs, green technologies, and sustainability reporting systems. Strong financial performance may also enable organizations to

respond more effectively to stakeholder expectations regarding environmental transparency while simultaneously maintaining competitive business performance. Therefore, revenue provides important contextual information for interpreting differences in carbon disclosure practices among companies.

Ownership structure represents another important organizational characteristic examined in this study. The sample consists of companies with diverse ownership structures, including state-owned enterprises, privately owned companies, foreign-owned firms, and publicly listed corporations. Ownership structure may influence strategic decision-making, corporate governance quality, and the level of accountability expected by shareholders and other stakeholders. Publicly listed companies and firms with substantial institutional or foreign ownership are generally subject to higher disclosure requirements and stronger pressure to demonstrate environmental responsibility through transparent sustainability reporting.

In addition, the study considers the companies' sustainability reporting experience (Daub, 2007). Some organizations have published sustainability reports for many years and have established comprehensive environmental reporting systems, while others have only recently begun adopting sustainability reporting practices. Companies with longer reporting experience are generally more familiar with international reporting standards and are more likely to disclose detailed information regarding carbon emissions, climate-related risks, emission reduction targets, and environmental management strategies. This accumulated reporting experience may contribute to greater stakeholder confidence, improved corporate reputation, and enhanced competitiveness.

3.2 Descriptive Statistics

The descriptive statistics indicate that the Carbon Disclosure variable has a mean score of 4.12, suggesting that the participating companies generally demonstrate a relatively high level of environmental transparency and carbon reporting practices. This finding indicates that most organizations actively disclose information related to greenhouse gas emissions, emission reduction targets, climate-related risks, carbon management strategies, greenhouse gas inventories, and other environmental initiatives. The standard deviation of 0.56 suggests relatively low variability among respondents, indicating that perceptions of carbon disclosure are fairly consistent across the sampled companies. Furthermore, the minimum value of 2.75 and the maximum value of 5.00 indicate that while some companies exhibit relatively limited carbon disclosure practices, others provide highly comprehensive environmental reporting.

Similarly, the Company Competitiveness variable records a mean score of 4.08, indicating that the sampled companies generally perceive themselves as possessing strong competitive capabilities (Bayon & Aguilera, 2021). These capabilities are reflected in factors such as market share, innovation capability, customer satisfaction, operational efficiency, competitive advantage, corporate reputation, and financial growth. The standard deviation of 0.61 indicates moderate variation among companies regarding their competitiveness, suggesting that although most organizations report relatively strong competitive performance, some differences remain across firms. The minimum and maximum values of 2.90 and 5.00, respectively, further demonstrate the existence of variability in competitive performance among the participating companies.

Overall, the relatively high mean scores for both research variables suggest that the sampled companies have adopted environmental sustainability practices while maintaining favorable levels of competitiveness. Moreover, the moderate standard deviations indicate that the responses are reasonably homogeneous and that no excessive dispersion exists within the dataset. The observed minimum and maximum values demonstrate that the variables capture sufficient variation to support subsequent statistical analyses. Consequently, the descriptive statistics provide preliminary evidence that the dataset is appropriate for further inferential analysis to examine the relationship between carbon disclosure and company competitiveness. Table 1 presents the descriptive statistics for all research variables.

Table 1. Descriptive Statistics of Research Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Carbon Disclosure	4.12	0.56	2.75	5.00
Company Competitiveness	4.08	0.61	2.90	5.00

The descriptive findings indicate that both variables exhibit relatively high average scores and acceptable levels of variability, providing a sound foundation for subsequent validity and reliability

testing, hypothesis testing, and structural model analysis. The absence of extreme dispersion suggests that the collected data are sufficiently stable and representative of the research sample, thereby enhancing the reliability of the empirical findings.

3.3 Measurement Model

The measurement model was evaluated to assess the validity and reliability of the constructs used in this study before testing the structural relationships among variables. In Partial Least Squares Structural Equation Modeling (PLS-SEM), the assessment of the measurement model includes convergent validity, discriminant validity, composite reliability, and Cronbach's alpha (Sarstedt et al., 2021). These procedures ensure that the indicators accurately measure their intended constructs and that the measurement instrument produces consistent results.

Convergent validity was examined by analyzing the outer loading values of each indicator and the Average Variance Extracted (AVE) for each construct. An outer loading value of 0.70 or higher indicates that an indicator adequately represents its construct, while an AVE value above 0.50 demonstrates that the construct explains more than half of the variance of its indicators. The results show that all indicators of the Carbon Disclosure and Company Competitiveness constructs have outer loading values exceeding the recommended threshold of 0.70. In addition, the AVE values for both constructs are greater than 0.50, indicating satisfactory convergent validity. These findings suggest that the indicators used in this study are strongly correlated with their respective latent constructs and effectively measure the intended concepts.

Discriminant validity was assessed using the Fornell-Larcker criterion and cross-loading analysis (Henseler et al., 2015). According to the Fornell-Larcker criterion, the square root of the AVE of each construct should be greater than its correlation with other constructs. The analysis demonstrates that the square root of the AVE for Carbon Disclosure and Company Competitiveness is higher than the inter-construct correlation values, indicating adequate discriminant validity. Furthermore, the cross-loading results reveal that each indicator loads more strongly on its associated construct than on other constructs. These results confirm that the constructs are empirically distinct from one another and measure different conceptual domains.

Composite reliability was evaluated to determine the internal consistency of the constructs. Composite reliability is considered more appropriate than Cronbach's alpha in PLS-SEM because it accounts for the actual outer loadings of the indicators. A composite reliability value of 0.70 or higher indicates acceptable reliability, while values above 0.80 reflect good reliability. The results show that the composite reliability values for Carbon Disclosure and Company Competitiveness exceed 0.80, demonstrating strong internal consistency among the indicators within each construct.

Cronbach's alpha was also calculated as an additional measure of reliability (Cho & Kim, 2015). A Cronbach's alpha value above 0.70 indicates that the indicators consistently measure the same construct. The findings reveal that both constructs have Cronbach's alpha values greater than 0.70, confirming that the measurement instrument possesses satisfactory reliability. The consistency of these results with the composite reliability analysis further strengthens the reliability of the research instrument.

Overall, the measurement model evaluation demonstrates that all constructs satisfy the recommended criteria for convergent validity, discriminant validity, composite reliability, and Cronbach's alpha. These findings indicate that the measurement instrument used in this study is both valid and reliable. Consequently, the constructs of Carbon Disclosure and Company Competitiveness are considered appropriate for further analysis in the structural model and hypothesis testing.

Table 2. Measurement Model Evaluation

Construct	AVE	Composite Reliability	Cronbach's Alpha
Carbon Disclosure	0.64	0.88	0.84
Company Competitiveness	0.67	0.90	0.86

The values presented in Table 2 indicate that all constructs meet the recommended thresholds of AVE > 0.50, Composite Reliability > 0.70, and Cronbach's Alpha > 0.70, thereby confirming the adequacy of the measurement model for subsequent structural model analysis.

3.4 Structural Model

Following the evaluation of the measurement model, the structural model was assessed to examine the hypothesized relationship between Carbon Disclosure and Company Competitiveness. The structural model evaluation aimed to determine the predictive capability of the proposed model and the statistical significance of the hypothesized path. In Partial Least Squares Structural Equation

Modeling (PLS-SEM), the structural model is evaluated using path coefficients, t-statistics, p-values, the coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2) (Wong, 2019). These measures collectively provide evidence regarding the strength, significance, and predictive power of the proposed research model.

The results indicate that the path coefficient from Carbon Disclosure to Company Competitiveness is 0.548, suggesting a positive relationship between the two constructs. This finding implies that companies with higher levels of carbon disclosure tend to exhibit stronger competitiveness. The positive coefficient indicates that improvements in environmental transparency, carbon emission reporting, climate risk disclosure, and carbon management practices are associated with enhanced competitive performance, including greater market share, stronger corporate reputation, improved innovation capability, and higher operational efficiency.

The significance of the structural relationship was evaluated using the bootstrapping procedure. The analysis produced a t-statistic of 8.436, which exceeds the recommended critical value of 1.96 for a significance level of 5% (Kirana & Wahyudi, 2021). Furthermore, the corresponding p-value was less than 0.001, indicating that the relationship between Carbon Disclosure and Company Competitiveness is statistically significant. Therefore, the proposed hypothesis that Carbon Disclosure positively influences Company Competitiveness is supported.

The explanatory power of the structural model was assessed using the coefficient of determination (R^2). The analysis shows that the R^2 value for Company Competitiveness is 0.301, indicating that Carbon Disclosure explains approximately 30.1% of the variance in Company Competitiveness. According to commonly accepted guidelines for PLS-SEM, this value represents a moderate level of explanatory power. Although Carbon Disclosure significantly contributes to company competitiveness, the remaining variance is likely explained by other organizational, managerial, and environmental factors that are beyond the scope of the present study.

The effect size (f^2) was also calculated to evaluate the substantive contribution of Carbon Disclosure to the prediction of Company Competitiveness (Ooi et al., 2019). The obtained f^2 value of 0.431 indicates a large effect size according to the criteria proposed by Cohen, where values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively. This finding suggests that Carbon Disclosure makes a substantial contribution to explaining variations in Company Competitiveness and should be regarded as an important strategic factor influencing organizational performance.

To further evaluate the model's predictive capability, predictive relevance (Q^2) was assessed using the blindfolding procedure (Akter et al., 2011). The results indicate a Q^2 value of 0.218, which is greater than zero. A positive Q^2 value demonstrates that the structural model possesses satisfactory predictive relevance and is capable of accurately predicting the endogenous construct. This finding indicates that the proposed model has acceptable out-of-sample predictive ability and is suitable for explaining the relationship between Carbon Disclosure and Company Competitiveness.

Overall, the structural model evaluation demonstrates that Carbon Disclosure has a positive and statistically significant influence on Company Competitiveness. The model exhibits moderate explanatory power, a substantial effect size, and satisfactory predictive relevance. These findings provide empirical support for the proposed theoretical framework and suggest that transparent carbon disclosure represents an important strategic practice that contributes to strengthening organizational competitiveness. Consequently, the structural model confirms that companies adopting comprehensive carbon disclosure practices are more likely to achieve sustainable competitive advantages in increasingly environmentally conscious business environments.

Table 3. Structural Model Results

Relationship	Path Coefficient (β)	T-Statistic	P-Value	Result
Carbon Disclosure → Company Competitiveness	0.548	8.436	< 0.001	Supported

Table 4. Structural Model Evaluation

Indicator	Value	Interpretation
R^2 (Company Competitiveness)	0.301	Moderate explanatory power
Effect Size (f^2)	0.431	Large effect
Predictive Relevance (Q^2)	0.218	Predictive relevance established

3.5 Hypothesis Testing

Hypothesis testing was conducted to determine whether the proposed relationship between Carbon Disclosure and Company Competitiveness was statistically supported. The analysis was performed using the bootstrapping procedure in Partial Least Squares Structural Equation Modeling (PLS-SEM), which estimates the significance of the structural path based on the path coefficient, t-statistic, and p-value. The decision to accept or reject the hypothesis was based on a significance level of 5%, where a t-statistic greater than 1.96 and a p-value less than 0.05 indicate a statistically significant relationship.

The results reveal that the path coefficient for the relationship between Carbon Disclosure and Company Competitiveness is 0.548, indicating a positive relationship between the two constructs. This positive coefficient suggests that higher levels of carbon disclosure are associated with higher levels of company competitiveness. Companies that provide comprehensive and transparent information regarding carbon emissions, emission reduction targets, climate-related risks, greenhouse gas inventories, and carbon management strategies are more likely to strengthen their competitive position in the marketplace. Transparent environmental reporting enhances corporate credibility, builds stakeholder trust, supports sustainable business practices, and contributes to long-term competitive advantage.

The statistical significance of this relationship is confirmed by a t-statistic of 8.436, which exceeds the recommended threshold value of 1.96, and a p-value of less than 0.001, which is substantially lower than the significance level of 0.05 (Madsen, 2012). These findings indicate that the influence of Carbon Disclosure on Company Competitiveness is statistically significant. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted.

Based on these findings, Hypothesis 1 (H1) is supported, demonstrating that Carbon Disclosure has a positive and significant effect on Company Competitiveness. This result suggests that companies implementing higher-quality carbon disclosure practices are more likely to improve their competitiveness through enhanced corporate reputation, increased stakeholder confidence, stronger investor support, improved customer loyalty, and greater operational efficiency. The findings also indicate that transparent environmental reporting is not merely a regulatory compliance activity but a strategic management practice that creates value and contributes to sustainable business success.

The empirical evidence supports the theoretical arguments of Stakeholder Theory, Legitimacy Theory, and the Resource-Based View. Stakeholder Theory proposes that transparent disclosure of environmental information strengthens relationships with investors, customers, regulators, and other stakeholders, thereby improving organizational performance (Cordeiro & Tewari, 2015). Legitimacy Theory suggests that companies disclose carbon-related information to demonstrate their commitment to societal expectations and maintain organizational legitimacy. Meanwhile, the Resource-Based View argues that effective environmental management and transparent sustainability reporting represent valuable strategic resources that are difficult for competitors to imitate, ultimately contributing to sustainable competitive advantage.

Table 5. Hypothesis Testing Results

Hypothesis	Structural Relationship	Path Coefficient (β)	T-Statistic	P-Value	Decision
H1	Carbon Disclosure → Company Competitiveness	0.548	8.436	< 0.001	Accepted

The hypothesis testing results confirm that Carbon Disclosure positively and significantly influences Company Competitiveness. Consequently, organizations are encouraged to strengthen their carbon disclosure practices as part of their broader sustainability strategy to enhance market competitiveness, improve stakeholder relationships, and achieve long-term organizational success.

3.6 Interpret findings

One important explanation for this finding is that transparent carbon disclosure increases investor confidence. Investors are increasingly incorporating Environmental, Social, and Governance (ESG) information into their investment decisions because environmental performance is viewed as an indicator of long-term corporate sustainability and risk management. Companies that voluntarily disclose comprehensive information regarding greenhouse gas emissions, climate-related risks, and carbon reduction initiatives reduce information asymmetry between management and investors (Flammer et al., 2021). This transparency enhances investor confidence by demonstrating management's commitment to responsible corporate governance and sustainable business practices. As investor confidence increases, companies gain greater access to investment capital, experience lower financing costs, and strengthen their overall competitive position within the market.

Another factor contributing to improved competitiveness is the enhancement of corporate reputation. Carbon disclosure communicates an organization's commitment to environmental responsibility, climate action, and sustainable development. Companies recognized for transparent environmental reporting are generally perceived as more ethical, responsible, and trustworthy by customers, investors, governments, and the wider public. A positive corporate reputation serves as an intangible strategic asset that differentiates companies from competitors, strengthens brand value, and attracts environmentally conscious consumers and business partners. Consequently, organizations with stronger reputations are better positioned to maintain customer relationships, expand market opportunities, and sustain competitive advantages over the long term.

The results also suggest that carbon disclosure strengthens stakeholder trust. According to Stakeholder Theory, organizations must respond to the expectations of multiple stakeholder groups, including shareholders, customers, employees, suppliers, regulators, and local communities. Transparent disclosure of carbon emissions and climate-related strategies demonstrates organizational accountability and openness, thereby increasing stakeholder confidence in corporate decision-making. Strong stakeholder trust promotes long-term collaboration, reduces potential conflicts, and enhances organizational legitimacy. As stakeholder relationships improve, companies become better equipped to respond to market changes and sustain competitive performance.

Furthermore, comprehensive carbon disclosure enhances companies' access to sustainable finance. Financial institutions and institutional investors increasingly consider ESG performance when evaluating investment opportunities and lending decisions. Companies with transparent environmental reporting are more likely to qualify for sustainability-linked loans, green bonds, ESG-focused investment funds, and other sustainable financing instruments (Bradley, 2021). Improved access to financial resources enables companies to invest in cleaner technologies, innovation, operational improvements, and environmental initiatives that strengthen their long-term competitiveness. In this context, carbon disclosure contributes not only to environmental accountability but also to financial flexibility and strategic business growth.

Carbon disclosure also contributes to enhanced customer loyalty. Modern consumers are becoming increasingly aware of environmental issues and often prefer products and services provided by companies that demonstrate genuine commitments to sustainability (Ottman, 2017). Transparent reporting of carbon emissions and environmental initiatives provides customers with credible information regarding corporate environmental performance, thereby strengthening consumer confidence and purchasing intentions. Organizations that consistently communicate their sustainability achievements are more likely to build stronger customer relationships, improve brand loyalty, and increase market share. Consequently, customer loyalty becomes an important source of sustainable competitive advantage.

Another explanation for the positive relationship is the improvement of operational efficiency. The process of measuring, monitoring, and disclosing carbon emissions requires companies to evaluate their production processes, resource utilization, and energy consumption. Such evaluations often encourage organizations to identify operational inefficiencies and implement energy-saving technologies, waste reduction programs, and process innovations. These improvements reduce operational costs while simultaneously minimizing environmental impacts. As operational efficiency increases, companies become more productive and cost-effective, thereby strengthening their competitive position within their respective industries.

The findings further indicate that carbon disclosure supports better risk management. Climate change presents significant operational, financial, regulatory, and reputational risks for businesses. Companies that systematically disclose carbon-related information generally develop more comprehensive climate risk assessment and management systems. Through proactive identification and mitigation of environmental risks, organizations improve their resilience to regulatory changes, resource scarcity, market uncertainties, and stakeholder pressures. Effective risk management reduces business disruptions and enhances organizational stability, enabling companies to maintain sustainable competitive performance over time.

Additionally, transparent carbon disclosure facilitates stronger compliance with environmental regulations. Governments worldwide continue to strengthen environmental policies and climate-related reporting requirements to support carbon reduction objectives and sustainable economic development. Companies that voluntarily adopt comprehensive carbon disclosure practices are generally better prepared to comply with evolving environmental regulations and international reporting standards. Regulatory compliance reduces the likelihood of legal sanctions, financial penalties, and reputational damage while strengthening relationships with regulators and

government agencies. Organizations that proactively comply with environmental regulations can allocate more resources toward innovation and strategic growth rather than responding to compliance-related challenges (Doyle et al., 2019).

The findings of this study are consistent with several well-established theoretical perspectives. Stakeholder Theory explains that organizations improve their competitive performance by responding effectively to stakeholder expectations regarding environmental responsibility and transparency. Legitimacy Theory suggests that carbon disclosure enables companies to maintain social legitimacy by demonstrating compliance with societal values and environmental norms. Meanwhile, the Resource-Based View argues that environmental management capabilities, transparent sustainability reporting, and stakeholder trust represent valuable organizational resources that are rare, difficult to imitate, and capable of generating sustainable competitive advantage. The positive relationship identified in this study therefore supports the proposition that carbon disclosure is not merely an environmental reporting mechanism but also a strategic organizational capability that contributes to superior business performance.

3.7 Comparison of Findings with Previous Studies

The findings of this study are generally consistent with the existing body of literature, which suggests that carbon disclosure contributes positively to organizational performance and long-term business sustainability. The present study demonstrates that Carbon Disclosure has a positive and significant influence on Company Competitiveness, indicating that organizations adopting transparent environmental reporting practices are better positioned to strengthen their competitive advantage. These findings reinforce the growing consensus that carbon disclosure has evolved beyond a compliance mechanism and has become a strategic business practice that creates value for organizations and their stakeholders.

The results are consistent with the systematic literature review conducted by Zhang and Liu (2020), who concluded that carbon disclosure has become an integral component of corporate environmental management and sustainability reporting. Their review emphasized that transparent carbon disclosure enhances corporate accountability and improves relationships with stakeholders. Although their study primarily examined the determinants of carbon disclosure rather than its organizational outcomes, the present findings extend their conclusions by demonstrating that environmental transparency also contributes directly to company competitiveness.

The findings also support those reported by Alam et al. (2022), who reviewed 168 empirical studies on corporate carbon disclosure. They concluded that organizations increasingly recognize carbon disclosure as an important strategic practice that enhances corporate sustainability and stakeholder engagement. However, Alam et al. also observed that relatively few empirical studies had examined competitiveness as an outcome of carbon disclosure. The present study addresses this research gap by providing empirical evidence that transparent carbon disclosure positively influences company competitiveness, thereby extending the scope of previous sustainability research.

Furthermore, the results are consistent with the review conducted by Mishra, Sant, and Kumar (2023), who found that voluntary carbon disclosure improves organizational performance by strengthening corporate reputation, reducing information asymmetry, and increasing stakeholder confidence. The present study supports these conclusions by demonstrating that the positive relationship between carbon disclosure and competitiveness can be explained through improved investor confidence, stronger stakeholder trust, enhanced corporate reputation, and more effective strategic positioning. These findings reinforce the argument that environmental transparency generates both financial and non-financial organizational benefits.

The present findings are also aligned with the systematic review by Ali, Wilson, and Frynas (2024), which emphasized that effective carbon disclosure is influenced by corporate governance, institutional pressures, and stakeholder expectations. Their multilevel framework suggested that organizations responding proactively to environmental reporting requirements are better positioned to enhance organizational resilience and long-term sustainability. Similarly, the current study demonstrates that companies implementing comprehensive carbon disclosure practices achieve stronger competitive performance, supporting the proposition that environmental transparency represents a strategic organizational capability.

In addition, the findings support the bibliometric analysis conducted by Yang and Zhou (2024), who identified climate-related disclosure, ESG reporting, and environmental transparency as rapidly expanding research themes. They noted that while the literature has extensively investigated disclosure quality and reporting practices, empirical evidence regarding the strategic consequences

of carbon disclosure remains relatively limited. The present study contributes to addressing this limitation by providing empirical evidence that carbon disclosure enhances company competitiveness, thereby extending the literature beyond traditional measures such as financial performance and firm value.

The results are likewise consistent with the conclusions of Raghuvanshi and Milan (2025), who argued that carbon disclosure has increasingly become a strategic management practice rather than merely an environmental reporting obligation. Their bibliometric review highlighted the growing integration of carbon disclosure into corporate sustainability strategies, ESG frameworks, and stakeholder communication. The current findings reinforce this perspective by demonstrating that organizations with more transparent carbon disclosure practices gain measurable competitive advantages through improved market positioning, operational efficiency, and stakeholder relationships.

Similarly, the findings support the observations of Setiawan, Santoso, and Asrihapsari (2025), who concluded that future carbon disclosure research should shift its focus from identifying disclosure determinants toward evaluating strategic organizational outcomes, including innovation, competitiveness, and sustainable value creation. The present study responds directly to this recommendation by empirically examining company competitiveness as the primary outcome variable, thereby contributing new evidence to the evolving literature on sustainability management and strategic business performance.

Despite the broad consistency with previous studies, the present research also provides several important contributions. Most earlier studies primarily examined the relationship between carbon disclosure and financial performance, firm value, cost of capital, or corporate governance. Comparatively fewer studies investigated how carbon disclosure directly influences company competitiveness as a multidimensional construct encompassing market share, innovation capability, operational efficiency, customer satisfaction, corporate reputation, and competitive advantage. By focusing specifically on competitiveness, this study expands the understanding of the strategic value of carbon disclosure beyond conventional financial indicators.

4. CONCLUSION

This study examined the impact of Carbon Disclosure on Company Competitiveness and found that carbon disclosure has a positive and significant influence on organizational competitiveness. The findings indicate that companies implementing transparent and comprehensive carbon reporting are more likely to strengthen their competitive position by enhancing investor confidence, improving corporate reputation, increasing stakeholder trust, facilitating access to sustainable finance, fostering customer loyalty, improving operational efficiency, strengthening risk management, and ensuring compliance with environmental regulations. These results demonstrate that carbon disclosure is not merely a regulatory reporting requirement but also a strategic business practice that contributes to sustainable competitive advantage. Theoretically, this study extends the sustainability and ESG literature by providing empirical evidence of the relationship between carbon disclosure and company competitiveness, while supporting the propositions of Stakeholder Theory and Legitimacy Theory that transparent environmental disclosure enhances stakeholder relationships, organizational legitimacy, and long-term business performance. The study also enriches research on ESG reporting and competitive strategy by emphasizing the strategic value of environmental transparency in creating organizational value. From a practical perspective, the findings suggest that companies should improve the quality and comprehensiveness of carbon reporting, strengthen climate governance, integrate carbon management into overall business strategy, and enhance ESG communication with investors, customers, regulators, and other stakeholders to improve competitiveness and achieve long-term sustainability. Nevertheless, several limitations should be acknowledged. The study employed a cross-sectional research design that captures relationships at a single point in time, focused on a limited number of industries and companies within a single-country context, and relied partly on self-reported questionnaire data, which may introduce response bias and limit the generalizability of the findings. Therefore, future research is encouraged to conduct cross-country comparative studies, adopt longitudinal research designs to examine changes over time, investigate industry-specific differences in carbon disclosure practices, incorporate mediating variables such as corporate reputation, innovation capability, or stakeholder trust, and examine moderating factors including environmental regulation intensity, firm size, corporate governance, and ESG maturity to provide a more comprehensive understanding of the mechanisms through which carbon disclosure influences company competitiveness.

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