Impact of Carbon Tax and Financial Performance on Business Sustainability Transport Firms

Abdhul Muadzin Hidayatulloh[1], Resha Dwi Ayu Pangesti Mulyono[2], Indra Lukmana Putra[3]
[1,2)]University Of Jember
[3)]Politeknik Negeri Malang
[1,2)]Jalan Kalimantan No. 37, Kampus Tegalboto, Jember, Jawa Timur, 68121
Jalan Soekarno Hatta No. 9, Jatimulyo, Kecamatan Lowokwaru, Kota Malang, Jawa Timur

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Abstract

Climate change has become a major global issue affecting environmental sustainability, economic stability, and business activities across various sectors, including transportation. The transportation sector is recognized as one of the largest contributors to carbon emissions due to its heavy reliance on fossil fuels. In response to environmental challenges, the Indonesian government implemented a carbon tax policy in 2022 as part of its sustainable fiscal reform agenda. Implementation of carbon tax is expected to encourage companies to reduce emissions and improve operational efficiency; however, it may also increase operational costs and affect corporate financial performance and sustainability.This study aims to analyze the effect of carbon tax and financial performance on the business continuity of transportation companies in Indonesia during the period 2022–2024. The background problem of this study is the limited empirical evidence regarding how environmental fiscal policies influence corporate sustainability, particularly in Indonesia's transportation sector. The novelty of this study lies in its integration of carbon tax policy, financial performance, and business continuity within a single empirical framework focusing on transportation companies in Indonesia.This study employs a quantitative research approach using secondary data obtained from annual financial reports of transportation companies listed on the Indonesia Stock Exchange (IDX) during 2022–2024. Financial performance is measured using Return on Equity (ROE), Current Ratio (CR), and Debt to Equity Ratio (DER). The collected data are analyzed using multiple regression analysis to examine the relationship between carbon tax and financial performance variables on business continuity.The findings indicate that financial performance significantly influences business continuity. Companies with strong profitability and liquidity tend to demonstrate better operational sustainability and adaptability to environmental regulations. Meanwhile, carbon tax policy creates additional operational pressures that may affect companies with weak financial conditions. The study concludes that transportation companies need to improve financial resilience and operational efficiency to maintain long-term sustainability under environmental regulatory pressures. The results of this study are expected to provide practical implications for policymakers and business practitioners in developing adaptive and sustainable business strategies.

Keywords: *Business Continuity; Carbon Tax; Financial Performance; Sustainability; Transportation Companies*

Abstrak

Perubahan iklim isu global utama memengaruhi keberlanjutan lingkungan, stabilitas ekonomi, dan aktivitas bisnis di berbagai sektor, termasuk sektor transportasi. Sektor transportasi merupakan salah satu penyumbang emisi karbon terbesar karena ketergantungannya yang tinggi terhadap bahan bakar fosil. Sebagai respons terhadap tantangan lingkungan tersebut, Pemerintah Indonesia mulai menerapkan kebijakan pajak karbon pada

tahun 2022 sebagai bagian dari agenda reformasi fiskal berkelanjutan. Implementasi pajak karbon diharapkan mampu mendorong perusahaan untuk mengurangi emisi karbon dan meningkatkan efisiensi operasional. Namun demikian, kebijakan ini juga berpotensi meningkatkan biaya operasional sehingga dapat memengaruhi kinerja keuangan serta keberlanjutan usaha perusahaan. Tujuan riset menganalisis pengaruh pajak karbon dan kinerja keuangan terhadap keberlangsungan usaha perusahaan transportasi di Indonesia selama periode 2022–2024. Permasalahan melatarbelakangi terbatasnya bukti empiris mengenai pengaruh kebijakan fiskal berbasis lingkungan terhadap keberlanjutan perusahaan, khususnya pada sektor transportasi di Indonesia. Kebaruan penelitian pada integrasi kebijakan pajak karbon, kinerja keuangan, dan keberlangsungan usaha dalam satu kerangka empiris yang berfokus pada perusahaan transportasi di Indonesia. Kajian kuantitatif data sekunder yang diperoleh dari laporan keuangan tahunan perusahaan transportasi yang terdaftar di Bursa Efek Indonesia (BEI) selama periode 2022–2024. Kinerja keuangan diukur menggunakan indikator *Return on Equity* (ROE), *Current Ratio* (CR), dan *Debt to Equity Ratio* (DER). Data dianalisis regresi linier berganda untuk menguji pengaruh pajak karbon dan kinerja keuangan terhadap keberlangsungan usaha. Hasil kinerja keuangan berpengaruh signifikan terhadap keberlangsungan usaha. Tingkat profitabilitas dan likuiditas yang baik cenderung memiliki keberlanjutan operasional yang lebih tinggi serta kemampuan adaptasi lebih baik terhadap regulasi lingkungan. Kebijakan pajak karbon menimbulkan tekanan biaya operasional tambahan yang berpotensi memengaruhi perusahaan dengan kondisi keuangan yang relatif lemah. Perusahaan transportasi memperkuat ketahanan keuangan, meningkatkan efisiensi operasional, serta mengembangkan strategi bisnis adaptif demi keberlanjutan usaha di tengah meningkatnya tekanan regulasi lingkungan. Temuan implikasi praktis bagi pembuat kebijakan dan pelaku usaha dalam merumuskan strategi bisnis yang berkelanjutan serta mendukung implementasi kebijakan fiskal hijau di Indonesia.

Kata Kunci: Kinerja Keuangan; Keberlangsungan Usaha; Keberlanjutan; Pajak Karbon;, Perusahaan Transportasi

INTRODUCTION

Climate change has become one of the most pressing global challenges, affecting environmental sustainability, economic stability, and business activities across various sectors. The increasing frequency of floods, droughts, rising temperatures, and extreme weather events demonstrates the accelerating impact of global climate change. One of the major contributors to this phenomenon is the continuous increase in greenhouse gas (GHG) emissions, particularly carbon dioxide (CO_2), generated from industrial production, energy consumption, and transportation activities (Putra et al, 2026). According to the International Energy Agency (IEA), ransportation sector remains one of the largest contributors to global carbon emissions because of its substantial dependence on fossil fuels for land, maritime, and air transportation. Consequently, governments worldwide have introduced various environmental fiscal policies to reduce emissions while promoting sustainable economic. This threat business sustainability is associated with organizational growth, strategic development, and the preservation of corporate existence (Mirza et al, 2024).

Carbon tax is an environmental fiscal policy designed to internalize the negative externalities arising from carbon emissions generated through fossil fuel consumption. By imposing additional costs on carbon-intensive activities, the policy provides economic incentives for companies to reduce emissions, improve energy efficiency, and accelerate investment in environmentally friendly technologies (Arifuddin & Sundari, 2022). The policy is conceptually grounded in Pigouvian Tax Theory, which argues that governments should impose taxes on activities generating negative externalities to achieve socially optimal outcomes. In Indonesia, the implementation of carbon tax officially commenced in 2022 through Law Number 7 of 2021 concerning the Harmonization of Tax Regulations (UU HPP), particularly Articles 13–17, and was further regulated under Minister of Finance Regulation (PMK) No. 21 of 2022. Initially, the policy targeted coal-fired power plants exceeding emission thresholds with a tariff of IDR 30 per kilogram of CO_2 equivalent. However, the government

has indicated that the policy will gradually expand to other sectors, including transportation, manufacturing, and other carbon-intensive industries.

Financial performance plays a critical role in determining a company's ability to respond to external economic and regulatory pressures. It reflects managerial effectiveness in utilizing corporate resources, generating profitability, maintaining liquidity, and managing financial leverage. In this study, financial performance is measured using Return on Equity (ROE), Current Ratio (CR), and Debt-to-Equity Ratio (DER). Companies exhibiting stronger profitability, liquidity, and solvency are generally more capable of financing technological innovation, improving operational efficiency, and adapting to environmental policy changes. Profitability, liquidity, and solvency significantly contribute to corporate stability and reduce the probability of business failure Lestari et al. (2024). Consequently, financial performance is expected to strengthen business resilience and support long-term sustainability. Business sustainability has likewise emerged as an essential strategic objective within modern corporate management. Rather than merely maintaining operational continuity, business sustainability reflects a company's capacity to survive uncertainty, adapt to regulatory changes, and continuously create long-term value for stakeholders. Kristiawati et al. (2024) emphasize market orientation as an important determinant of sustainable competitive advantage. Furthermore, business sustainability encompasses not only economic performance but also social and environmental responsibilities, consistent with sustainable development principles.

From a theoretical perspective, this study adopts Agency Theory to explain the relationship between corporate management and shareholders. Agency Theory suggests that conflicts of interest may arise because managers (agents) do not always act in accordance with shareholders' (principals') long-term interests (Sutisna et al., 2024). Previous empirical studies have reported inconsistent findings regarding the relationship between environmental regulation, financial performance, and business sustainability. Salim et al. (2022) found that carbon tax implementation significantly influences operational efficiency and business sustainability by increasing production costs and environmental compliance expenditures. Similarly, Pandini et al. (2024) concluded that carbon taxation creates additional financial pressure, particularly within energy-intensive industries, thereby influencing firms' long-term sustainability. Conversely, companies possessing strong financial performance demonstrate greater resilience in responding to environmental regulations. Tahang et al. (2023) reported that financial performance significantly enhances a company's capability to maintain sustainable operations under external pressures.

Accordingly, this study aims to analyze the effect of carbon tax and financial performance on the business sustainability of transportation companies listed on the Indonesia Stock Exchange (IDX) during the period 2022–2024. The findings are expected to contribute to the literature on environmental taxation, financial performance, and corporate sustainability while providing practical implications for policymakers and transportation companies in designing adaptive business strategies under increasing environmental regulatory pressures.

METHOD

Quantitative research approach with a causal-comparative design to examine the influence of carbon tax and financial performance on the business sustainability of transportation companies listed on the Indonesia Stock Exchange (IDX). A quantitative approach was selected because it enables objective hypothesis testing using numerical data and statistical analysis to identify causal relationships among variables (Jauze et al., 2025). Observation period covered 2022–2024, corresponding to the initial implementation of Indonesia's carbon tax policy.

Population comprised all transportation companies listed on the IDX during the 2022–2024 period. The sample was determined using purposive sampling based on several criteria: companies consistently listed during the observation period, publishing audited annual reports and complete financial statements, and providing sufficient information to measure all research variables. The study relied entirely on secondary data collected from the official IDX website (www.idx.co.id), annual reports, audited financial statements, and sustainability or Environmental, Social, and Governance (ESG) reports. Documentation method was employed to collect secondary data from publicly available corporate reports. Financial statements were used to calculate financial performance indicators, while sustainability reports and ESG disclosures provided information regarding carbon emissions and carbon tax implementation. Carbon tax (X_1) was measured using the amount of carbon tax disclosed by

transportation companies in their annual or sustainability reports (Arifuddin & Sundari, 2022). Financial performance (X_2) was measured using Return on Equity (ROE), Current Ratio (CR), and Debt-to-Equity Ratio (DER), which represent profitability, liquidity, and solvency, respectively (Brigham & Houston, 2019).

Business sustainability (Y) was measured using the Altman Z-Score model, which evaluates a company's ability to maintain long-term operational continuity and predicts the probability of financial distress (Altman, 1968). Model is expressed as

$$Z = 6.56A + 3.26B + 6.72C + 1.05D$$

A represents Working Capital to Total Assets, B represents Retained Earnings to Total Assets, C represents Earnings Before Interest and Taxes (EBIT) to Total Assets, and D represents Book Value of Equity to Total Liabilities. Higher Z-Score values indicate stronger business sustainability. Data analysis was conducted using EViews 12. Analytical procedure began with descriptive statistics to summarize the characteristics of the research variables through measures of central tendency and dispersion. Subsequently, classical assumption tests consisting of multicollinearity and heteroscedasticity tests were performed to ensure that the regression model satisfied the assumptions required for reliable estimation (Ghozali, 2018). Panel data regression analysis was then employed because the dataset combined cross-sectional observations of transportation companies and time-series observations from 2022 to 2024. Three estimation approaches—Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM)—were considered. Appropriate model was determined using the Chow, Hausman, and Lagrange Multiplier (LM) tests. Finally, hypothesis testing was conducted using the t-test to evaluate the significance of individual independent variables, while the Adjusted R^2 coefficient was used to assess the explanatory power of the regression model (Ghozali, 2018).

RESULT AND DISCUSSION

Descriptive statistics were employed to provide an overview of the characteristics of research variables, including carbon tax, financial performance, and business sustainability. Analysis consisted of the mean, median, maximum, minimum, and standard deviation to describe the distribution and variability of the data. Overall, the descriptive statistics indicate that transportation companies listed on the Indonesia Stock Exchange (IDX) exhibit heterogeneous financial characteristics during the 2022–2024 observation period. Such variation reflects differences in firm size, capital structure, profitability, and the level of exposure to environmental regulations, particularly carbon tax implementation.

Table 1. Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Altman Z-Score	1.3552	1.1931	3.1463	-0.6422	1.0233	-0.0056	2.3686
DER	1.2106	0.8300	5.3100	-5.0600	1.8904	-0.1376	4.9723
ROE	-0.2549	0.1200	0.9800	-22.7500	3.3633	-6.5681	44.4515
CR	1.4762	1.0100	7.6800	0.0400	1.3665	2.3497	10.4238
Carbon Tax (TP)	18.0090	17.8275	24.3780	11.7745	3.1644	-0.0024	1.9185

Table 1 shows substantial variation among transportation companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 observation period. The mean Altman Z-Score of 1.3552 indicates that, on average, the sampled companies were positioned within grey zone**,** suggesting moderate financial vulnerability rather than strong financial stability. The minimum Z-Score of −0.6422 further indicates that several firms experienced serious financial distress, whereas the maximum value of 3.1463 reflects that a number of companies maintained relatively healthy financial conditions. Standard deviation of 1.0233 demonstrates moderate variation in business sustainability across firms. Financial performance exhibits considerable heterogeneity across the sample. Average Debt-to-Equity Ratio (DER) of 1.2106 indicates that transportation companies relied more heavily on debt financing than equity, although the relatively high standard deviation **(**1.8904) suggests substantial differences in capital structure among firms. Return on Equity (ROE) of −0.2549 indicates that several companies experienced financial losses during the observation period. Highly negative skewness (−6.5681) and extremely high kurtosis **(**44.4515**)** confirm the presence of several extreme negative profitability

observations, indicating that a small number of firms recorded. Current Ratio (CR) has an average value of 1.4762, suggesting that most transportation companies possessed adequate liquidity to meet short-term obligations.

Maximum value of 7.6800 and positive skewness **(**2.3497**)** indicate that a limited number of firms maintained exceptionally high liquidity positions, while others experienced relatively constrained working capital. Kurtosis value of 10.4238 further suggests a leptokurtic distribution with several extreme observations. Regarding the carbon tax variable (TP**),** the average value of 18.0090 with a standard deviation of 3.1644 indicates relatively moderate variation across the observed companies. The skewness value close to zero (−0.0024**)** implies that carbon tax exposure is symmetrically distributed, while the kurtosis value of 1.9185**,** which is below the normal benchmark of three, suggests a relatively flat distribution without excessive outliers. Overall, these descriptive findings demonstrate that although transportation companies exhibit diverse financial characteristics, the distribution of carbon tax exposure is comparatively more stable. Such variation provides an appropriate empirical basis for examining the influence of carbon tax and financial performance on business sustainability through panel data regression analysis.

Classical Assumption Test

Prior to panel regression estimation, classical assumption tests were conducted to ensure the reliability of the regression model. The multicollinearity test indicated that all correlation coefficients among independent variables were below the recommended threshold of 0.85, suggesting that multicollinearity was not present. Similarly, the heteroscedasticity test demonstrated randomly distributed residuals, indicating homoscedastic variance across observations. Therefore, the regression model satisfies the assumptions required for panel data estimation and produces unbiased and efficient estimators (Ghozali, 2018).

Panel Data Model Selection

Model selection was conducted using the Chow Test, Hausman Test, and Lagrange Multiplier Test to determine the most appropriate panel regression model. The Chow Test compared the Common Effect Model (CEM) and Fixed Effect Model (FEM), while the Hausman Test determined whether the Fixed Effect Model or Random Effect Model (REM) was more appropriate. Finally, the Lagrange Multiplier Test evaluated the superiority of REM over CEM. Based on these specification tests, the selected model was considered the most suitable for explaining the relationship between carbon tax, financial performance, and business sustainability.

Table 2. Panel Model Selection

Effects Test	Statistic	d.f.	Prob.
Cross-section F	5.407297	(16,26)	0.0001
Cross-section Chi-square	68.855259	16	0.0000

Panel Regression Results

Panel regression analysis was conducted to examine the influence of carbon tax and financial performance on business sustainability. The regression model estimates the simultaneous relationship between environmental fiscal policy and corporate financial conditions in determining long-term business continuity.

Table 3. Panel Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Probability	Decision
Constant	1.565	0.674	2.322	0.145	Not Significant
Carbon Tax (TP)	0.006	0.021	0.154	0.891	Not Significant
Return on Equity (ROE)	0.098	0.041	4.698	0.042	Significant (+)
Debt-to-Equity Ratio (DER)	-0.298	0.022	-13.363	0.005	Significant (−)
Current Ratio (CR)	0.276	0.170	1.627	0.242	Not Significant

Carbon tax has a positive but statistically insignificant effect on business sustainability (β = 0.006; p = 0.891). This finding suggests that the implementation of carbon tax has not yet become a determining factor affecting the financial sustainability of transportation companies during the 2022–2024 observation period. The relatively small coefficient indicates that variations in carbon tax exposure are insufficient to influence the Altman Z-Score significantly. Differs from the findings of Salim et al. (2022) and Pandini et al. (2024), who reported that environmental taxation can influence corporate sustainability by increasing compliance costs and encouraging operational efficiency. A possible explanation is that Indonesia's carbon tax policy remains in its early implementation stage and has not yet been broadly imposed on transportation companies, resulting in a relatively limited financial impact.

Return on Equity (ROE) exhibits a positive and statistically significant relationship with business sustainability (β = 0.098; p = 0.042). Higher profitability enables firms to finance operational improvements, technological innovation, and environmental adaptation while maintaining business continuity. These findings support Brigham and Houston (2019), who emphasized profitability as a key indicator of corporate financial strength, and are consistent with Tahang et al. (2023) and Lestari et al. (2024), who concluded that profitable firms are generally more capable of sustaining long-term operations under changing business environments. Debt-to-Equity Ratio (DER) has a negative and statistically significant effect on business sustainability (β = −0.298; p = 0.005). Higher financial leverage significantly reduces the Altman Z-Score, implying greater financial distress risk and weaker business sustainabilit. Fndings consistently with Brigham and Houston (2019), who argued that excessive leverage increases financial risk, and support Agency Theory, which suggests that high debt levels intensify agency conflicts between managers and creditors by increasing financial pressure and monitoring requirements (Sutisna et al., 2024).

Current Ratio (CR) demonstrates a positive but statistically insignificant effect on business sustainability (β = 0.276; p = 0.242). Although companies with stronger liquidity generally possess greater capability to fulfill short-term obligations, liquidity alone does not necessarily guarantee long-term business continuity. Transportation companies often require substantial long-term investments and strategic financial management beyond maintaining current assets. Therefore, short-term liquidity appears insufficient to explain variations in business sustainability during the observation period. This finding partially differs from Lestari et al. (2024), who identified liquidity as an important determinant of corporate sustainability, suggesting that profitability and capital structure may play more dominant roles within Indonesia's transportation industry. Overall, the regression results demonstrate that financial performance is a more important determinant of business sustainability than carbon tax during the study period. Among the financial indicators, profitability (ROE) strengthens business sustainability, whereas excessive leverage (DER) significantly weakens corporate resilience. Corporate financial resilience remains the primary driver of sustainable business performance, while the effectiveness of environmental fiscal policy depends on broader policy implementation and sectoral coverage.

Discussion

Environmental fiscal policy represented by carbon taxation is closely associated with corporate business sustainability. Carbon tax functions not only as a regulatory instrument for reducing greenhouse gas emissions but also as an economic mechanism encouraging firms to improve operational efficiency and resource utilization. Environmental taxation proposed by Arifuddin and Sundari (2022), who argued that carbon taxation encourages firms to adopt cleaner technologies while improving long-term competitiveness. Consistent with Salim et al. (2022), who reported that environmental taxation influences corporate operational decisions through increased compliance costs and efficiency improvements. Financial performance also plays an essential role in strengthening business sustainability (Lukmana Putra et al, 2025). These findings are consistent with Brigham and Houston (2019), who emphasized that financial ratios reflect managerial effectiveness in maintaining corporate value and financial stability. Similarly, Tahang et al. (2023) found that firms with stronger financial performance exhibit greater resilience under uncertain economic conditions, while Lestari et al. (2024) demonstrated that profitability and liquidity significantly enhance long-term corporate sustainability.

Managers are required to maintain profitability while ensuring compliance with carbon tax regulations and sustainability objectives. This finding supports Sutisna et al. (2024), who suggested that environmental regulations strengthen managerial accountability and reduce agency conflicts by promoting transparent financial and environmental reporting.Carbon tax encourages transportation companies to improve operational efficiency, optimize energy consumption, and strengthen risk

management. Consistent with Z. Mirza et al. (2024), who argued that sustainable business depends on organizational adaptability and strategic development, as well as Kristiawati et al. (2024), who emphasized that market orientation and adaptive capability constitute important determinants of long-term sustainability.

Overall, this study contributes to the literature by integrating environmental fiscal policy and corporate financial performance within a business sustainability framework. Unlike previous studies that primarily examined carbon taxation or financial performance independently, this research demonstrates that business sustainability results from the interaction between environmental regulation and financial resilience. These findings complement previous empirical evidence reported by Pandini et al. (2024), highlighting that firms with stronger financial conditions are better positioned to respond to environmental policies while maintaining sustainable competitive performance.

CONCLUSION AND RECOMMENDATION

Carbon tax and financial performance on the business sustainability of transportation companies listed on the Indonesia Stock Exchange (IDX) during the 2022–2024 period. The findings indicate that carbon tax has a positive but statistically insignificant effect on business sustainability, suggesting that the current implementation of Indonesia's carbon tax policy has not yet generated sufficient financial pressure to influence the long-term sustainability of transportation companies. This result reflects the gradual implementation of carbon taxation, which remains limited in sectoral coverage and regulatory enforcement. In contrast, financial performance is a significant determinant of business sustainability. Return on Equity (ROE) has a positive and significant effect, indicating that profitable companies possess greater financial resilience and stronger capacity to sustain long-term operations. Conversely, the Debt-to-Equity Ratio (DER) exhibits a significant negative effect, implying that excessive financial leverage increases financial risk and weakens business sustainability. Meanwhile, the Current Ratio (CR) has a positive but insignificant effect, indicating that short-term liquidity alone is insufficient to ensure long-term corporate sustainability. Overall, the findings demonstrate that profitability and capital structure play more substantial roles than environmental taxation in explaining business sustainability within Indonesia's transportation sector.

Study has several limitations. First, the implementation of carbon tax in Indonesia during 2022–2024 was still in its initial phase and had not been fully applied across all economic sectors, limiting the observable impact of the policy on transportation companies. Second, the observation period covered only three years, which may not adequately capture the long-term effects of environmental fiscal policy on business sustainability. Third, the analysis focused primarily on financial indicators, including profitability, leverage, and liquidity, without incorporating broader non-financial determinants that may also influence corporate sustainability. Future research is recommended to extend the observation period to evaluate the long-term impact of carbon tax implementation as environmental regulations become more comprehensive. Researchers should also utilize actual carbon tax payment data or verified corporate carbon emission disclosures to improve the measurement of environmental policy exposure. Furthermore, future studies are encouraged to incorporate non-financial variables, such as Environmental, Social, and Governance (ESG) performance, corporate reputation, innovation capability, carbon disclosure quality, and investor sentiment, to develop a more comprehensive understanding of the determinants of business sustainability under environmental regulatory frameworks.

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