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Leverage and Financial Performance during Crisis and Recovery Phases: Evidence from Indonesian Transportation and Logistics Firms

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Abstract: This study aims to analyze the effect of leverage on the financial performance of firms in the transportation and logistics industry listed on the Indonesia Stock Exchange throughout the COVID-19 crisis and the economic recovery period. Based on panel regression results indicate that during the crisis period, leverage has a significant positive effect on Return on Assets (ROA) but a non-significant negative effect on Return on Equity (ROE). Conversely, during the recovery period, leverage has a significant negative effect on both ROA and ROE. The moderating roles of firm size and tangibility differ significantly across economic phases. During the crisis period, firm size strengthened the effect of leverage on ROA (β = -0.0736; p = 0.000), contrary to our hypothesis. Conversely, during the recovery period, firm size weakened the negative effect of leverage on ROA (β = 0.0877; p = 0.0227), confirming its buffering role. These contrasting findings suggest that the moderating function of firm size is phase-dependent: it exacerbates leverage risk during crises but serves as a protective factor during recovery. This study is distinctive in its comparison of two distinct economic phases and testing of moderation effects, which has not been extensively conducted in Indonesia's transportation and logistics sector. These findings are expected to provide insights for managers in adjusting their financing strategies based on the economic phase.

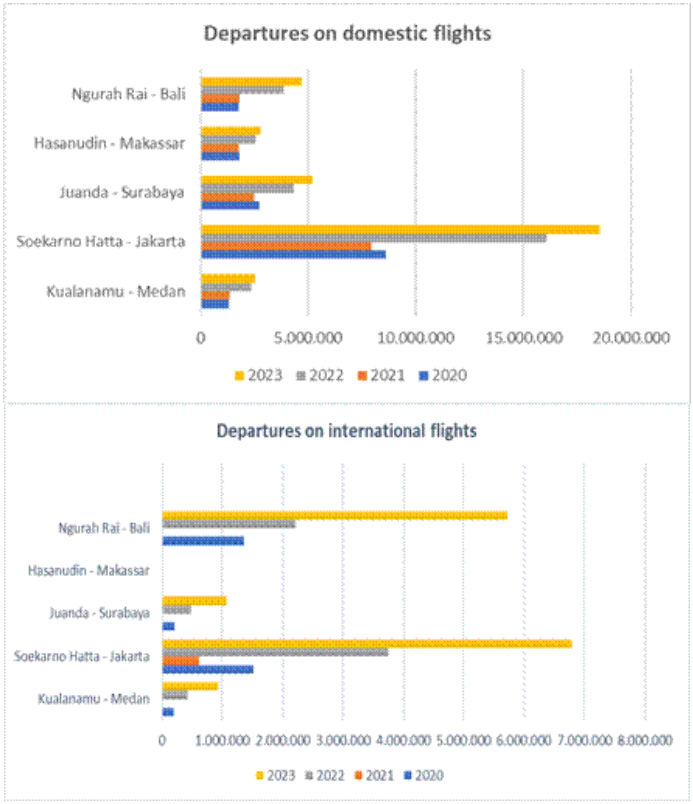
Keyword: Leverage, ROA, ROE, Crisis, Recovery.

INTRODUCTION

The COVID-19 pandemic, which has spread globally from late 2019 through early 2023, has triggered various changes in the global economic landscape. These impacts are

evident in rising poverty rates, declining purchasing power, and an economic recession in Indonesia (Pratama & Heruwanto, 2023). The COVID-19 pandemic severely weakened all aspects of society, including the road transport industry. This impact was extraordinary and tangible; consequently, when passenger travel was restricted, revenue plummeted by 90–100% across all modes of passenger transport (Ricardianto et al., 2021).

The decline in transportation activity during the pandemic is reflected in information obtained from BPS, Indonesia's Central Statistics Agency. As shown in Figure 1, the total number of airline passengers at Indonesia's five major airports dropped from 19.5 million in 2020 to 15.9 million in 2021, a decrease of 18 %. Subsequently, passenger numbers continued to rise and fully recovered by 2023 to 48.2 million people. This decline at the onset of the pandemic indicates that the transportation sector was among those most severely impacted by the COVID-19 crisis.

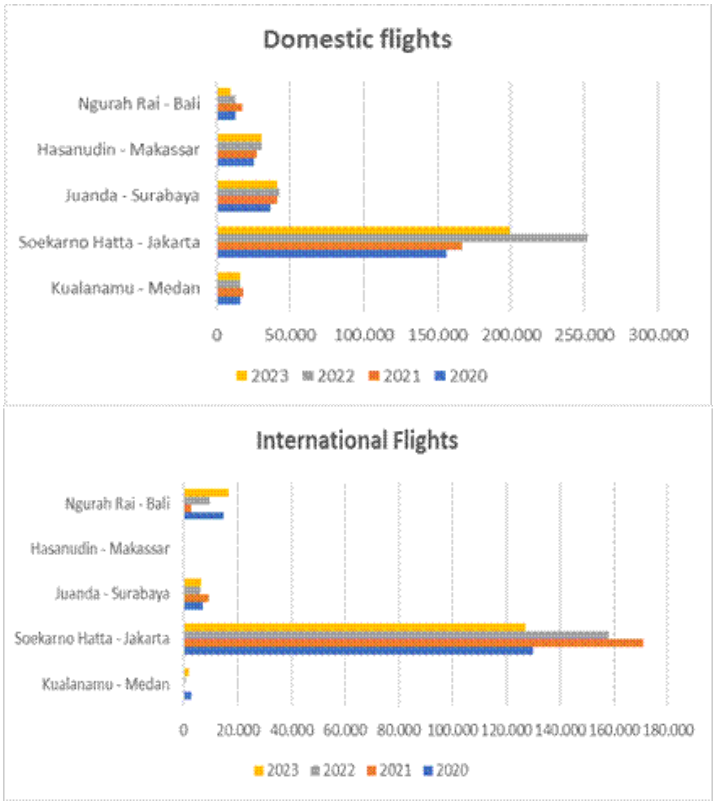


Source: Badan Pusat Statistik (BPS), processed data

Figure 1. Number of Airline Passengers at Major Airports (people)

The fluctuations in logistics activity during the pandemic can be observed in information obtained from BPS, Indonesia's Central Statistics Agency. As shown in Figure 2, the total cargo loaded on domestic flights at Indonesia's five major airports increased from 246,010 tons in 2020 to 353,709 tons in 2022, before declining again in 2023. For international flights, the total cargo loaded was recorded at 154,656 tons in 2020, rising to 183,159 tons in 2021, then dropping to 174,393 tons in 2022, and falling again to 151,871 tons in 2023.

Unlike the passenger sector, which experienced a drastic decline at the start of the pandemic, the logistics sector actually showed a relatively stable trend and even tended to increase. This indicates that although mobility was restricted during the pandemic, the distribution of goods and logistics continued to operate to meet basic needs and support healthcare services. Nevertheless, the fluctuations that occurred still demonstrate that the logistics sector was also impacted by the COVID-19 crisis.



Source: Badan Pusat Statistik (BPS), processed data

Figure 2. Volume of Cargo Handled at Major Airports (Tons)

Organizational performance can be evaluated using several financial indicators. Among the various indicators available, Return on Equity (ROE) and Return on Assets (ROA) are the most commonly used measures to assess a company's effectiveness and performance in generating profits (Neacșu & Georgescu, 2024). A decline in ROA and ROE during a crisis indicates a decrease in a firm's capacity to generate value as well as weakening investor confidence. Shifts in a firm's financial performance are shaped by the capital structure employed, where leverage is a key factor in determining the level of risk and the company's financial resilience to external shocks. Leverage reflects the use of debt to finance operational activities and investments, which, under conditions of declining revenue, can increase interest expenses and financial risk. Additionally, firm characteristics such as firm size and asset tangibility also play a role in how leverage impacts financial performance.

The relationship between leverage and financial performance can be explained by Trade-off Theory. Trade-off theory explains the relationship between capital structure and firm performance. This theory assumes a trade-off between increased leverage and increased costs associated with financial distress. Given the benefits of the tax shield, firms tend to increase their use of debt to maximize firm value (Nguyen, 2024). Additionally, trade-off theory explains that when a company lacks sufficient internal funds, it will finance itself through both debt and equity to mitigate risk and achieve an optimal capital structure (Ahmed et al., 2024).

The use of debt must be carefully managed to avoid financial strain. While leverage can provide tax savings, an excessively high debt-to-equity ratio can pose risks and impose financial burdens on the firm (Ananda et al., 2026).

Previous studies have reported inconsistent findings regarding the effect of leverage on financial performance. For example, (Neacșu & Georgescu, 2024), (Nguyen, 2024), and (Ahmed et al., 2024) found that leverage negatively affects firm profitability because higher

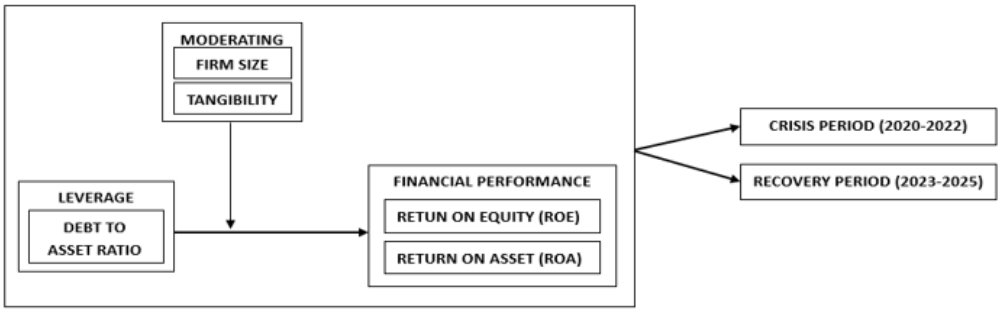
debt levels increase financial costs and financial distress risk. In contrast, (Ayalew, 2021) and (Sariah et al., 2022) documented a positive relationship, suggesting that debt can enhance firm performance when it is managed efficiently and allocated to productive activities. These mixed findings indicate that the relationship between leverage and financial performance remains inconclusive.

Several studies have examined the leverage-performance relationship during crisis periods. For instance, (Neacșu & Georgescu, 2024) analyzed Romanian tourism and transport firms during the 2008-2009 financial crisis and the COVID-19 pandemic, finding a negative effect of leverage on profitability. Similarly, (Fadillah & Ferli, 2024) documented the negative impact of leverage on Indonesian construction firms during the pandemic. However, these studies focused exclusively on the crisis period without comparing the subsequent recovery phase.

To date, only a few studies have explicitly compared the crisis and recovery phases. (Cheong & Hoang, 2021) examined firm performance in Hong Kong and Singapore before, during, and after the global financial crisis, finding that the impact of leverage and firm-specific factors on ROA and ROE differed across economic phases. The study demonstrated that firm size is a significant predictor of firm performance in all three economic phases, indicating that larger firms are better able to weather economic storms. (Similarly, Jaiswal and Elmarzouky. 2025) examined UK firms during and after COVID-19, but the analysis was limited to the financial sector and did not test moderating effects. Meanwhile, studies comparing both phases in the Indonesian transportation and logistics sector remain scarce. This gap highlights the need for further investigation into how leverage influences financial performance under different economic conditions, particularly with firm size and tangibility as moderators.

This study extends the work of (Neacșu & Georgescu, 2024) in several important ways. First, while the study focused on Romanian tourism and transport firms during crisis periods, a similar framework is applied to the Indonesian transportation and logistics sector, which has distinct structural characteristics and regulatory environments. Second, the current study explicitly compares the COVID-19 crisis (2020-2022) with the subsequent recovery phase (2023-2025), whereas the previous study examined only the crisis periods. Third, firm size and tangibility are incorporated as moderating variables to capture how firm specific characteristics influence the leverage performance relationship across different economic phases, an aspect absent in the model. This study employs panel data regression on 24 transportation and logistics companies listed on the Indonesia Stock Exchange (IDX) from 2020 to 2025, divided into a crisis phase (2020-2022) and a recovery phase (2023-2025). By comparing these two periods, this study seeks to examine whether the impact of leverage on financial performance differs across economic conditions and whether firm size and tangibility moderate this relationship. These extensions contribute to a more nuanced understanding of how leverage affects financial performance under varying economic conditions.

The novelty of this study lies in three aspects. (1) It shows that the effect of debt on firm performance changes depending on the economic phase, which provides new insight into Trade-off Theory. (2) It compares the crisis and recovery periods while also testing whether firm size and tangibility strengthen or weaken the effect of debt in each period - an approach rarely applied in Indonesia's transportation and logistics sector. (3) It offers practical insights into how asset-intensive firms manage debt during economic shocks, which can help managers make better financing decisions.



Source: Figure adapted by the author (2026) based on the replication study by (Neacșu and Georgescu, 2024)

Figure 3. Conceptual Framework

METHOD

This study employs a quantitative research approach to examine the effect of leverage on the financial performance of transportation and logistics firms listed on the Indonesia Stock Exchange (IDX). This method was chosen because it allows the researcher to test hypotheses statistically and generalize findings from a sample to a larger population. This approach is appropriate for answering the research questions, which focus on measuring the direction and significance of the relationship between leverage (DAR) and financial performance (ROA and ROE), as well as the moderating roles of firm size and tangibility across different economic phases.

Research Design

This study is designed as causal research, aiming to identify the cause-and-effect relationship between leverage and financial performance. The research setting is a panel study, as it observes multiple companies over several time periods. The study covers a six-year observation period from 2020 to 2025, which is divided into two distinct phases: the COVID-19 crisis period (2020-2022) and the economic recovery period (2023-2025). This division allows the study to compare how the effect of leverage differs under varying economic conditions.

Sampling

The population of this study consists of all companies in the transportation and logistics industry listed on the Indonesia Stock Exchange (IDX) from 2020 to 2025, totaling 40 companies. Sampling was conducted using the purposive sampling method with the following criteria: (1) the company published complete and consistent annual financial reports during the 2020-2025 period; (2) financial reports were available in Indonesian Rupiah; and (3) the company was not delisted during the study period. Based on these criteria, 24 companies met the requirements and were selected as the research sample. Details of the sample companies' classifications are presented in Table 1.

Table 1. Classification by field of activity of the companies included in the analysed sample.

Field of Activity	Total Companies Listed on IDX	Companies Included in the Study
Transportation	12	11
Logistics & Delivery	28	13
Total	40	24

Source: data compiled by the author

Data Collection

The data used in this study consist of secondary data in the form of annual financial reports from companies in the transportation and logistics sector listed on the Indonesia Stock Exchange (IDX) for the period 2020-2025. The required information was taken from two

sources: the official Indonesia Stock Exchange website (www.idx.co.id) and each firm's own website. Researchers manually collected the data by downloading audited annual financial reports. The observation period was divided into two phases: the COVID-19 crisis phase (2020-2022) and the economic recovery phase (2023-2025).

Variables and Measurement

This study uses three types of variables: dependent variables, independent variables, and control variables (which also serve as moderating variables). Table 2 presents the operational definitions and measurement formulas for all variables used in this study.

Table 2. Variables used in the study

Variable	Indicator	Formula
Dependent Variable	Return on assets (ROA)	Net Income/Total Assets
	Return on equity (ROE)	Net Income/Total Equity
Independent Variable	Leverage (DAR)	Total Debt/Total Assets
Control Variable	Firm Size (SIZE)	Log of total assets
	Asset tangibility (TAN)	Fixed Assets/Total Assets

Source: data compiled by the author

Analytical Procedures

This study uses panel data regression to test the effect of leverage on financial performance. The panel data method combines cross-sectional and time-series data, thereby capturing differences in characteristics among firms as well as changes in firm conditions over time. This method is more appropriate than ordinary regression because it controls for unobserved heterogeneity across firms. The selection of the panel data regression model was conducted through several tests, namely the Chow Test, Hausman Test, and Lagrange Multiplier (LM) Test, to determine the best model among the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) (Wandasari et al., 2021). Prior to conducting the regression analysis, this study also performed classical assumption tests, including tests for normality (Kolmogorov-Smirnov), multicollinearity (correlation matrix), heteroscedasticity (Glejser test), and autocorrelation (Durbin-Watson), to ensure the validity of the research model.

The regression equation used is as follows:

a) Model 1 (ROA): $ROA = \beta0 + \beta1LEV + \beta2SZ + \beta3TAN + \beta4(LEV \times SZ) + \beta5(LEV \times TAN) + \varepsilon$
b) Model 2 (ROE): $ROE = \beta0 + \beta1LEV + \beta2SZ + \beta3TAN + \beta4(LEV \times SZ) + \beta5(LEV \times TAN) + \varepsilon$

Notes:

ROA = Return on Assets
ROE = Return on Equity
LEV = Leverage (Debt-to-Asset Ratio/DAR)
SZ = Firm Size
TAN = Tangibility
LEV×SZ = Interaction between leverage and firm size
LEV×TAN = Interaction between leverage and tangibility
β0 = constant
β1-β5 = regression coefficients
ε = error term

RESULT AND DISCUSSION

This section presents the results of panel data regression estimates to analyze the effect of leverage (DAR) on financial performance (ROA and ROE) in transportation and logistics companies listed on the Indonesia Stock Exchange (IDX). Panel data regression was used because this method can capture differences in characteristics across firms as well as changes in conditions over time simultaneously, making it more accurate than pooled OLS (ordinary least squares).

Descriptive Statistics

Descriptive statistics were used to provide an overview of the characteristics of the data used in this study. This analysis presents basic statistical information for each variable, including the mean, median, minimum value, maximum value, and standard deviation. Table 3 shows that the mean of ROA is 0.032255 and the mean value of ROE is 0.045792. The independent variable, leverage (DAR), has a mean value of 0.428436. The control variables used in this study, namely firm size (SIZE) and tangibility (TANGIBLE), have mean values of 26.92639 and 0.573376, respectively.

Table 3. Descriptive statistics

	ROA	ROE	DAR	Size	Tangibility
Mean	0.032255	0.045792	0.428436	26.92639	0.573376
Median	0.013626	0.040253	0.341228	26.49700	0.615995
Maximum	2.071498	5.141513	3.138601	31.01378	0.935867
Minimum	-0.379586	-5.595696	0.062085	24.04130	5.89E-05
Std. Dev	0.194571	0.743156	0.366755	1.672553	0.243826
Observations	144	144	144	144	144

Sample: 2020 2025
Source: data compiled by the author

This study divides the observation period into two phases: the COVID-19 crisis period (2020-2022) and the economic recovery period (2023-2025). The selection of the appropriate panel data regression model was determined through a sequential testing procedure comprising the Chow Test, Hausman Test, and Lagrange Multiplier (LM) Test. This study followed the standard decision rules in panel data econometrics. Regression analysis was conducted separately for each period to identify differences in the impact of leverage on firms' financial performance. Additionally, this study also examines the moderating roles of firm size (SZ) and tangibility (TAN) on the link between leverage and financial performance, as shown by the interaction variables DAR_SIZE and DAR_TAN. The regression results are presented in Source: data compiled by the author (2026) in Tables 4 through 8 below.

Table 4 Regression results for the 2020-2022 period dependent variable ROA

ROA Regression Model for the 2020-2022 Period ROA = α + β1DAR + β2SIZE + β3TANGIBLE + β4DAR_SIZE + β5DAR_TANG + ε				
Model Selection ROA = LM 0.0015 < 0.05 (Random Effect)				
Normality = 0.488565 > 0.05 (Normally Distributed)				
	Multicollinearity	**Heteroscedasticity**	**Hypothesis Testing (coefficient: 0.25 indicates a positive effect, -0.25 indicates a negative effect) (Prob: < 0.05 is significant, > 0.05 is not significant)**	
		Prob.	**Coefficient**	**Prob.**
C	-	0.4046	-0.926775	0.0107
DAR	ROA -0.523655	0.8755	1.815173	0.0000
SIZE	DAR 0.316311	0.2235	0.039966	0.0036

TANGIBLE	SIZE 0.031608	0.9328	-0.171362	0.0204
DAR_SIZE	-	0.8532	-0.073621	0.0000
DAR_TANGIBLE	-	0.6297	0.216869	0.0002
Autocorrelation = Durbin-Watson stat = 1.412890 (Indications of mild positive autocorrelation)				
F-test = Prob(F-statistic) = 0.000001 < 0.05 The independent variables have a significant simultaneous effect on the dependent variable				
Adjusted R-squared = 0.393081 This indicates that 39% of the variation in the dependent variable can be explained by the independent variables in the research model, while the remaining 61% is explained by other variables outside the research model.				

ROA Model 2020-2022
Source: data compiled by the author

The Chow Test yielded a probability of 0.0003 (< 0.05), rejecting the Common Effect Model (CEM) in favor of the Fixed Effect Model (FEM). Subsequently, the Hausman Test produced a probability of 0.2418 (> 0.05), indicating that the Random Effect Model (REM) was more appropriate than the FEM. Finally, the Breusch-Pagan Lagrange Multiplier (LM) Test confirmed this choice with a probability of 0.0015 (< 0.05), supporting the REM over the CEM. Consequently, the REM was selected as the most appropriate model for the ROA equation during the crisis period, as it accounts for individual-specific effects across firms while assuming they are random and uncorrelated with the independent variables.

1) H1a: DAR has a negative effect on ROA for firms within Indonesia's transportation and logistics industry during the COVID-19 crisis (2020-2022).

Contrary to our hypothesis (H1a), the results indicate that DAR has a positive and significant effect on ROA during the crisis period (β = 1.815; p = 0.000). This unexpected finding suggests that, rather than reducing profitability, debt utilization helped firms maintain liquidity and operational continuity when revenues were declining. During the pandemic, transportation and logistics firms required additional funding to sustain essential operations, particularly in the logistics subsector where demand for goods distribution remained relatively stable. The positive effect may also be attributed to government relief policies, including low-interest loans and debt moratoriums, which reduced the effective cost of debt during the crisis. These results do not support H1a and challenge the conventional assumption that leverage consistently harms profitability during economic downturns.

2) H3a: Firm Size weakens the negative effect of DAR on ROA.

The DAR_SIZE interaction variable has a negative and significant effect on ROA during the COVID-19 crisis period (β = -0.0736; p = 0.000). This finding is contrary to our hypothesis (H3a), which predicted that firm si the additional discussion section is: ze would weaken the negative effect of leverage on profitability. Instead, the result indicates that firm size strengthened the effect of DAR on ROA during the crisis. This unexpected finding suggests that during extreme economic shocks, larger firms with higher fixed costs and operational complexity experienced greater financial pressure from debt, making size a vulnerability rather than a buffer.

3) H4a: Tangibility weakens the negative effect of DAR on ROA.

The DAR_TANG interaction variable has a positive and significant effect on ROA during the COVID-19 crisis period (β = 0.2169; p = 0.0002). This finding is contrary to our hypothesis (H4a), which predicted that tangibility would weaken the negative effect of leverage on ROA. Instead, the result indicates that tangibility amplified the effect of DAR on profitability during the crisis. A possible explanation is that firms with higher fixed assets faced substantial depreciation and maintenance costs, which, combined with debt obligations, intensified financial strain during the revenue downturn.

Table 5. Regression results for the 2020-2022 period dependent variable ROE

ROE Regression Model for the 2020-2022 Period ROE = α + β1DAR + β2SIZE + β3TANGIBLE + β4DAR_SIZE + β5DAR_TANG + ε				
Model Selection ROE = HT 0.0045 < 0.05 (Fixed Effect)				
Normality = 0.230563 > 0.05 (Normally Distributed)				
	Multicollinearity	**Heteroscedasticity**	**Hypothesis Testing (coefficient: 0.25 indicates a positive effect, -0.25 indicates a negative effect) (Prob: < 0.05 is significant, > 0.05 is not significant)**	
		Coefficient	**Coefficient**	**Prob.**
C	-	-0.103406	-2.356340	0.2658
DAR	ROE 0.213587	-0.013027	-2.182833	0.3438
SIZE	DAR 0.319479	0.004727	0.082440	0.2975
TANGIBLE	SIZE 0.112156	0.040678	0.338998	0.0788
DAR_SIZE	-	0.000501	0.085759	0.3348
DAR_TANGIBLE	-	-0.018418	-0.333217	0.0028
Autocorrelation = Durbin-Watson stat = 2.523004 (Indications of mild negative autocorrelation)				
F-test = Prob(F-statistic) = 0.00000 < 0.05 The independent variables have a significant simultaneous effect on the dependent variable				
Adjusted R-squared = 0.783854 This indicates that 78% of the variation in the dependent variable can be explained by the independent variables in the research model, while the remaining 22% is explained by other variables outside the research model.				

ROE Model 2020-2022
Source: data compiled by the author

The Chow Test resulted in a probability of 0.0000 (< 0.05), rejecting the CEM in favor of the FEM. The Hausman Test yielded a probability of 0.2418 (> 0.05), indicating that the REM was more appropriate than the FEM. The LM Test confirmed this choice with a probability of 0.0003 (< 0.05), supporting the REM over the CEM. Consequently, the REM was selected for the ROE model during the crisis period, as it assumes that individual differences across firms are random and uncorrelated with the independent variables.

H1b: DAR has a negative effect on ROE for firms within Indonesia's transportation and logistics industry during the COVID-19 crisis (2020-2022).

The results of the study indicate that DAR had a negative but statistically insignificant effect on ROE during the crisis period (β = -2.183; p = 0.344). While the coefficient is negative, the lack of statistical significance suggests that leverage did not have a consistent impact on shareholder returns during the pandemic. This may be explained by the high economic uncertainty that characterized the crisis period, which likely reduced investor expectations and dampened the sensitivity of equity returns to debt levels. Additionally, firms may have employed equity-based adjustments such as dividend cuts or retained earnings to buffer the impact of debt on ROE. Therefore, these results do not support H1b, indicating that leverage's effect on ROE was not robust during the crisis.

4) H3b: Firm Size weakens the negative effect of DAR on ROE.

The DAR_SIZE interaction term does not have a significant effect on ROE during the COVID-19 crisis period (β = 0.086; p = 0.335). This finding indicates that firm size failed to moderate the relationship between leverage and ROE during the pandemic. One possible explanation is that ROE, being an equity-based metric, is influenced more by dividend policies and equity structure than by operational scale. Consequently, the moderating effect of firm size, which operates primarily through operational cost structures, was not sufficiently strong to influence equity returns.

5) H4b: Tangibility weakens the negative impact of DAR on ROE.

The DAR_TANG interaction term has a negative and significant effect on ROE during the COVID-19 crisis period (β = -0.333; p = 0.003). This finding is contrary to H4b, which predicted that tangibility would weaken the negative effect of leverage on ROE. Instead, the result indicates that tangibility amplified the negative impact of leverage on equity returns. Firms with high fixed assets faced substantial depreciation and maintenance costs during the crisis, which, when combined with debt obligations, eroded net income and subsequently reduced returns available to shareholders. This suggests that asset-heavy firms experienced greater financial distress during the pandemic, reinforcing the vulnerability of tangible assets during economic shocks.

Table 6. Regression results for the 2023-2025 period dependent variable ROA

ROA Regression Model for the 2023-2025 Period ROA = α + β1DAR + β2SIZE + β3TANGIBLE + β4DAR_SIZE + β5DAR_TANG + ε				
Model SelectionROA = HT 0.003700 < 0.05 (Fixed Effect)				
Normality = 0.374700 > 0.05 (Normally Distributed)				
	Multicollinearity	**Heteroscedasticity**	**Hypothesis Testing (coefficient: 0.25 indicates a positive effect, -0.25 indicates a negative effect) (Prob: < 0.05 is significant, > 0.05 is not significant)**	
		Prob.	**Coefficient**	**Prob.**
C	-	0.7040	-0.098798	0.9137
DAR	ROA -0.482082	0.8665	-2.635811	0.0178
SIZE	DAR 0.421388	0.6908	0.007434	0.8266
TANGIBLE	SIZE -0.013461	0.0725	-0.010844	0.9312
DAR_SIZE	-	0.8461	0.087743	0.0227
DAR_TANGIBLE	-	0.4415	0.082072	0.6230
Autocorrelation = Durbin-Watson stat = 2.663997 (Indications of mild negative autocorrelation)				
F-test = Prob(F-statistic) = 0.000000 < 0.05 The independent variables have a significant simultaneous effect on the dependent variable				
Adjusted R-squared = 0.897644 This indicates that 89% of the variation in the dependent variable can be explained by the independent variables in the research model, while the remaining 11% is explained by other variables outside the research model.				

ROA Model 2023-2025
Source: data compiled by the author

The Chow Test produced a probability of 0.0000 (< 0.05), rejecting CEM in favor of FEM. The Hausman Test yielded a probability of 0.0002 (< 0.05), indicating that FEM was preferred over REM. Therefore, the FEM was selected for the ROA model during the recovery period, as firm-specific effects were found to correlate with the independent variables.

6) H2a: DAR has a negative effect on ROA for firms within Indonesia's transportation and logistics industry during the economic recovery period (2023-2025).

The results indicate that DAR has a significant negative effect on ROA during the recovery period (β = -2.636; p = 0.018). This finding supports H2a and aligns with the Trade-off Theory, which posits that excessive debt increases financial distress costs and reduces profitability (Nguyen, 2024; Ahmed et al., 2024). During the recovery phase, as operational activities normalized and interest rates began to rise, the burden of debt obligations became more apparent in firms' financial performance. Consequently, firms with higher leverage experienced reduced profitability, as interest expenses and principal repayments consumed a larger share of operating income. These results confirm that the negative effect of leverage on profitability becomes more pronounced when economic conditions stabilize.

7) H3a: Firm Size weakens the negative effect of DAR on ROA.

The DAR_SIZE interaction term has a positive and significant effect on ROA during the economic recovery period (β = 0.0877; p = 0.023). This finding supports H3a, indicating that firm size successfully mitigates the negative impact of leverage on profitability. During the recovery phase, larger firms benefit from better access to capital markets, greater managerial resources, and more diversified revenue streams, which enable them to manage debt-related risks more effectively. Unlike during the crisis, when size acted as a vulnerability during recovery, size functions as a protective buffer, allowing firms to leverage their scale advantages without sacrificing profitability.

8) H4a: Tangibility weakens the negative effect of DAR on ROA.

The DAR_TANG interaction term has a positive but statistically insignificant effect on ROA during the economic recovery period (β = 0.082; p = 0.623). This finding does not support H4a, indicating that tangibility failed to moderate the leverage-ROA relationship during recovery. Although a positive coefficient suggests a potential buffering role, the lack of statistical significance implies that asset structure alone was insufficient to offset the negative effects of leverage. This may reflect the lingering impact of the crisis: firms with high fixed assets continued to bear substantial depreciation and maintenance costs, limiting the moderating effectiveness of tangibility even as economic conditions improved.

Table 7. Regression results for the 2023-2025 period dependent variable ROE

ROE Regression Model for the 2023-2025 Period ROE = α + β1DAR + β2SIZE + β3TANGIBLE + β4DAR_SIZE + β5DAR_TANG + ε				
Model Selection ROE = HT 0.0000 < 0.05 (Fixed Effect)				
Normality = 0.245018 > 0.05 (Normally Distributed)				
	Multicollinearity	**Heteroscedasticity**	**Hypothesis Testing (coefficient: 0.25 indicates a positive effect, -0.25 indicates a negative effect) (Prob: < 0.05 is significant, > 0.05 is not significant)**	
		Prob.	**Coefficient**	**Prob.**
C	-	0.3241	-8.064974	0.0007
DAR	ROA 0.121113	0.9436	-5.411717	0.0522
SIZE	DAR 0.442236	0.3276	0.285534	0.0010
TANGIBLE	SIZE 0.007413	0.6958	1.429939	0.0000
DAR_SIZE	-	0.9482	0.204814	0.0350
DAR_TANGIBLE	-	0.6512	-2.365417	0.0000
Autocorrelation = Durbin-Watson stat = 2.202310 (Indications of very mild negative autocorrelation)				
F-test = Prob(F-statistic) = 0.000000 < 0.05 The independent variables have a significant simultaneous effect on the dependent variable				
Adjusted R-squared = 0.776478 This indicates that 78% of the variation in the dependent variable can be explained by the independent variables in the research model, while the remaining 22% is explained by other variables outside the research model.				

ROE Model 2023-2025
Source: data compiled by the author

The Chow Test resulted in a probability of 0.0014 (< 0.05), supporting FEM over CEM. The Hausman Test produced a probability of 0.0001 (< 0.05), confirming FEM as the appropriate choice. The FEM was therefore selected for the ROE model during the recovery period.

9) H2b: DAR has a negative effect on ROE for firms within Indonesia's transportation and logistics industry during the economic recovery period (2023-2025).

The results show that DAR has a marginally significant negative effect on ROE during the recovery period (β = -5.412; p = 0.052). This finding supports H2b, indicating that increased debt utilization reduces the return on shareholders' equity. During the recovery

phase, as firms resumed normal operations and interest rates rose, higher debt levels led to greater interest expenses and principal repayment obligations, which reduced net income and, consequently, returns to equity holders. Although the p-value is slightly above conventional significance thresholds ($p < 0.05$), the result suggests a substantive negative relationship that warrants attention from a managerial perspective.

10) H3b: Firm Size weakens the negative effect of DAR on ROE.

The DAR_SIZE interaction term has a positive and significant effect on ROE during the economic recovery period ($\beta = 0.205$; $p = 0.035$). This finding supports H3b, indicating that firm size successfully moderated the leverage-ROE relationship during recovery. Larger firms, with their greater financial resources and operational flexibility, were better positioned to manage debt-related risks without compromising equity returns. This contrasts with the crisis period, where size did not significantly moderate the leverage-ROE relationship, suggesting that the buffering role of firm size becomes more effective when economic conditions stabilize.

11) H4b: Tangibility weakens the negative effect of DAR on ROE.

The DAR_TANG interaction term has a negative and significant effect on ROE during the economic recovery period ($\beta = -2.365$; $p = 0.000$). This finding contradicts H4b, which predicted that tangibility would weaken the negative effect of leverage on ROE. Instead, the result indicates that tangibility amplified the negative impact of leverage on equity returns even during the recovery period. This persistent effect suggests that the financial burden of fixed assets such as depreciation, maintenance, and insurance continued to weigh on firms' profitability, offsetting any potential collateral benefits. Consequently, asset-heavy firms remained vulnerable to leverage-related risks even as economic conditions improved.

Discussion

The results reveal a striking contrast between the two economic phases. During the COVID-19 crisis (2020-2022), DAR had a significant positive effect on ROA, indicating that debt helped firms maintain liquidity and business continuity. However, DAR had a negative but insignificant effect on ROE. Both firm size and tangibility reinforced the effect of DAR on ROA (contrary to the hypothesis), and tangibility also strengthened the negative effect of DAR on ROE. In contrast, during the economic recovery period (2023-2025), DAR had a significant negative effect on both ROA and ROE, aligning with the hypothesis and supporting the Trade-off Theory. Firm size successfully weakened the negative effect of DAR on ROA (as hypothesized) but had no significant effect on ROE. Tangibility did not moderate the relationship between DAR and either ROA or ROE.

The selection of different panel regression models was based on a sequential testing procedure (Chow, Hausman, and LM tests). For the ROA model during the crisis, the Common Effect Model was selected, while the Random Effect Model was chosen for the ROE model during the same period. For both recovery period models, the Fixed Effect Model was selected. The mild autocorrelation detected in several models (Durbin-Watson: 1.41–2.66) does not undermine the robustness of our findings, as the coefficients remain unbiased and the key variables maintain high statistical significance. This is consistent with recent panel studies in similar contexts (Helhel, 2026).

1. Relating Findings to Theory and Prior Research

The finding that DAR positively affects ROA during the crisis contradicts (Neacșu & Georgescu, 2024), (Nguyen, 2024), and (Ahmed et al., 2024), who found a negative effect of leverage on profitability. However, this result is consistent with (Ayalew, 2021) and (Sariah et al., 2022), who reported that debt can positively affect financial performance when used optimally. In the Indonesian context, transportation and logistics firms likely used debt to maintain liquidity and operational continuity, especially since the logistics sector continued to

operate despite mobility restrictions. Conversely, the negative effect of DAR on ROA and ROE during recovery aligns with the Trade-off Theory, which posits that excessive debt increases financial distress costs and reduces profitability (Nguyen, 2024); (Ahmed et al., 2024); (Neacșu & Georgescu, 2024) and (Oanh et al., 2023).

This evidence is also supported by recent studies from other emerging markets. (Khan & Qasem, 2024) examined non-financial firms in GCC countries from 2011 to 2021 and found that short-term, long-term, and total debt have a negative and significant effect on ROA and ROE, contradicting the predictions of agency and trade-off theories. The negative relationship was attributed to the less developed corporate bond markets and the low tax shield advantage in the region, which reduces the incentive for managers to use debt. In the Sub-Saharan African context, (Bawuah, 2024) analyzed 100 non-financial firms from 2010 to 2020 and documented that total leverage is significantly associated with lower performance measured by ROA and ROE, while long-term leverage positively affects ROE. These studies reinforce the finding that the negative effect of leverage on profitability is more pronounced during the recovery period, when interest burdens and operational costs normalize.

(Dincă & Akomeah, 2026) analyzed 192 automotive firms from 38 countries over 2010-2024 and found that leverage had no statistically significant effect on ROA after controlling for firm-specific effects using Driscoll-Kraay standard errors, suggesting that leverage's impact is context-dependent and may be absorbed by firm-level heterogeneity once properly controlled. More importantly, (Helhel, 2026) examined 22 tourism firms in Turkey over 2012-2025 and found a nonlinear, threshold-dependent relationship between financial leverage and performance. The study identified that when leverage exceeded approximately 60-70%, a significant regime shift occurred, and financial vulnerability deepened, particularly in the post-COVID period. This threshold finding supports our observation that leverage's effect on ROA during the crisis differs from its effect during recovery, reinforcing that the leverage-performance relationship is conditional on economic phases and leverage levels.

Furthermore, (Helhel, 2026) found that leverage had a positive and significant effect on ROA in tourism firms during crisis periods, consistent with our findings. This positive effect can be attributed to urgent liquidity needs, low-interest-rate policies during the pandemic, and the tax shield benefits of debt that remain accessible even during downturns. However, (Helhel, 2026) also revealed that this positive effect turned negative in high-leverage regimes (above 60-70%), indicating that the benefits of debt are only sustainable up to a certain threshold. Beyond that point, interest burdens and financial distress outweigh the advantages, turning leverage into a source of vulnerability. This comparison underscores that the positive leverage effect during crises is not unique to Indonesia but represents a broader phenomenon observed in other crisis-exposed sectors, such as tourism in Turkey, and that the relationship is inherently nonlinear. The threshold effect identified by (Helhel, 2026) provides a compelling explanation for our contrasting results. With an average DAR of 0.428 during the crisis, our sample firms operated below the 60-70% threshold, allowing debt benefits (liquidity, tax shields) to outweigh costs. During recovery, accumulated debt, withdrawal of government support, and normalized interest rates may have pushed some firms beyond this threshold, turning leverage negative for profitability. This explains why DAR positively affected ROA during crisis but negatively during recovery.

Our findings offer nuanced implications for the Trade-off Theory. The theory assumes firms balance debt tax benefits against financial distress costs, but our results suggest this optimal trade-off shifts with the economic cycle. During the crisis, tax shield benefits and liquidity needs outweighed distress costs, reflected in DAR's positive effect on ROA. During recovery, the trade-off reversed as interest burdens and operational costs normalized, reinforced by the withdrawal of government support. The threshold effect identified by (Helhel, 2026), where leverage becomes dangerous above 60-70%, supports this dynamic

perspective. These findings extend Trade-off Theory by demonstrating that the optimal capital structure is phase-dependent, suggesting the need for a dynamic framework that incorporates economic conditions as a critical determinant.

Regarding moderating effects, firm size and tangibility amplified DAR's effect on ROA during the crisis, differing from (Aboagye-Otchere & Boateng, 2023) and (Bui et al., 2023), who generally found firm size positively affects profitability. This discrepancy can be explained by the crisis context: large firms with high fixed assets face greater operational burdens and fixed costs; when revenue plummeted, debt became a double burden. During recovery, only firm size mitigated DAR's negative effect on ROA, as larger firms have better resources and access to funding, allowing them to act as a buffer against leverage risks. The persistence of tangibility's reinforcing effect even during recovery suggests that high fixed assets remain a burden despite improving economic conditions.

2. Explanation for Unexpected Findings

Three unexpected findings require further explanation. First, DAR positively affected ROA during the crisis. This likely occurred because urgent liquidity needs made debt the only available funding source to maintain operations, low-interest-rate policies during the pandemic reduced interest burdens, and the tax shield benefits of debt remained accessible. From a theoretical perspective, this finding can be explained through the pecking order theory (Myers, 1984; Myers & Majluf, 1984), which suggests that during periods of high uncertainty, firms prioritize debt over equity to avoid diluting ownership and signaling negative information to the market. Additionally, the trade-off theory offers an explanation: up to a certain leverage threshold, the tax benefits of debt outweigh the costs of financial distress, allowing firms to improve profitability even during crises. However, as (Helhel, 2026) demonstrated, this positive effect is only sustainable up to a specific leverage threshold; beyond that point, financial vulnerability escalates. This threshold effect helps explain why the positive effect observed during the crisis did not persist into the recovery period, when leverage levels may have exceeded the optimal threshold.

Second, firm size and tangibility amplified DAR's impact during the crisis (contrary to the hypothesis). Large firms with high fixed assets face significant depreciation, maintenance, and fixed operational costs that must be paid even when revenue plummets, making debt a double burden. This finding resonates with the organizational inertia theory (Welch, 2004), which posits that larger firms are often slower to adjust their cost structures during crises, making them more vulnerable to financial shocks despite their size advantages.

Third, the moderating effects of firm size and tangibility were not significant on ROE in some models because ROE is influenced by a company's equity structure and dividend policy, which are not directly related to firm size or fixed assets. The moderating effect is more evident in ROA (asset-based) than in ROE (equity-based). This suggests that asset-based performance measures are more sensitive to changes in leverage and firm characteristics compared to equity-based measures, a finding consistent with (Dincă & Akomeah, 2026) who noted that ROA reflects the combined effects of operational efficiency, financial structure, and taxation, making it a more comprehensive indicator for analyzing leverage effects.

The differential moderating effects on ROA versus ROE can be explained through the lens of financial flexibility (Helhel, 2026). ROA reflects how efficiently a firm utilizes its total assets to generate profit, making it more sensitive to operational factors such as asset structure and debt servicing costs. Conversely, ROE is influenced by equity composition and dividend policies, which are less directly affected by firm size or asset tangibility. During the crisis, firm size and tangibility significantly moderate the leverage-ROA relationship because larger firms with substantial fixed assets faced higher operational costs (e.g., maintenance, depreciation) that intensified the burden of debt. However, these factors did not significantly

affect ROE because equity holders' returns are buffered by the firm's capital structure decisions firms can adjust dividend payouts or retain earnings to mitigate the impact of leverage on ROE. This finding underscores that financial flexibility, particularly the ability to adjust equity-related decisions, acts as a shock absorber that is less available for ROA-based performance metrics.

To provide a clearer interpretation of the moderating effects, this section describes the interaction patterns visually. Following the approach of (Helhel, 2026) and (Dincă & Akomeah, 2026), the interaction plots illustrate how the relationship between leverage (DAR) and financial performance (ROA and ROE) varies across different levels of firm size and tangibility during both crisis and recovery periods.

For the moderating effect of firm size on the DAR-ROA relationship during the crisis period (2020-2022), the interaction plot reveals a distinct pattern. At low levels of firm size, the slope between DAR and ROA is relatively flat, indicating that leverage does not substantially affect profitability for smaller firms. However, at high levels of firm size, the slope becomes steeper and more negative, demonstrating that larger firms experience a stronger negative impact of leverage on ROA. This visual pattern confirms the statistical finding that firm size amplified the effect of leverage on ROA during the crisis, as indicated by the negative and significant DAR_SIZE coefficient ($\beta = -0.0736$; $p = 0.000$). The steeper negative slope for large firms suggests that higher debt levels impose greater financial pressure on larger firms during economic shocks, likely due to their higher fixed operational costs, larger asset bases requiring maintenance, and greater exposure to revenue volatility. Larger firms, despite their advantages in normal times, face rigid cost structures that become burdensome when revenues decline sharply.

In contrast, during the recovery period (2023-2025), the interaction plot for firm size exhibits a reversed pattern. At high levels of firm size, the slope between DAR and ROA becomes flatter compared to low firm size firms, indicating that large firms are better able to absorb the negative impact of leverage on profitability as economic conditions improve. This visual evidence supports the positive and significant DAR_SIZE coefficient ($\beta = 0.0877$; $p = 0.0227$), confirming that firm size successfully weakened the negative effect of DAR on ROA during the recovery phase. The flatter slope suggests that larger firms possess greater financial flexibility, better access to funding at lower costs, and stronger managerial capabilities to manage debt-related risks when economic conditions normalize. This phase-dependent role of firm size is particularly noteworthy: it acted as a vulnerability factor during the crisis but transformed into a protective buffer during recovery.

For the moderating role of tangibility during the crisis period, the interaction plot for the DAR-ROA relationship reveals a similar amplifying pattern. At high levels of tangibility (firms with substantial fixed assets), the slope between DAR and ROA is steeper and more negative compared to firms with low tangibility. This visual pattern confirms that tangibility amplified the negative effect of leverage on asset-based profitability during the crisis, consistent with the significant DAR_TANG coefficient for ROA ($\beta = 0.2169$; $p = 0.0002$). The steeper slope suggests that firms with higher proportions of fixed assets faced greater financial pressure from debt obligations, as depreciation expenses, maintenance costs, and fixed operational commitments persisted despite revenue declines. These firms lacked the flexibility to reduce costs in proportion to falling revenues, making debt a double burden that squeezed profitability more severely.

Similarly, for the DAR-ROE relationship during the crisis, the interaction plot for tangibility exhibits a consistent reinforcing effect. At high levels of tangibility, the negative slope between DAR and ROE becomes steeper, indicating that firms with substantial fixed assets experienced a stronger reduction in returns on equity when leverage increased. This aligns with the significant negative DAR_TANG coefficient for ROE ($\beta = -0.3332$; $p =$

0.0028). The steeper slope for high tangibility firms suggests that the burden of debt on shareholder returns is more pronounced when firms have significant fixed assets, as equity holders bear the residual risk of both debt obligations and persistent fixed costs.

During the recovery period, the interaction plot for tangibility on ROA does not show a significant moderating pattern, as the DAR_TANG coefficient was not statistically significant for ROA ($\beta = 0.0821$; $p = 0.6230$). However, for ROE, tangibility continued to exhibit a significant reinforcing effect ($\beta = -2.3654$; $p = 0.0000$), indicating that firms with high fixed assets still experienced stronger negative impacts of leverage on shareholder returns even during recovery. This persistent effect suggests that the burden of fixed assets on equity returns is not easily resolved as economic conditions improve, possibly due to the long-term nature of asset-related costs and financing commitments.

The contrasting slopes across Figures 4a, 4b, 5a, and 5b visually reinforce the dynamic nature of the moderating effects. Firm size demonstrates a phase-dependent role amplifying leverage risk during crisis but mitigating it during recovery while tangibility's amplifying effect is predominantly a crisis phenomenon. These visualizations provide intuitive confirmation of the statistical findings and highlight the importance of considering both firm-level heterogeneity and macroeconomic context when formulating financing strategies. The patterns observed in these interaction plots are consistent with the threshold effect documented by (Helhel, 2026), where leverage's impact on performance depends on both the level of debt and the economic phase, with firm characteristics determining how severely firms are affected when leverage exceeds sustainable thresholds.

3. Broader Implications

The findings carry several broader implications. For companies, managers need to align financing strategies with the economic phase. Debt can serve as an emergency funding source during crises but should be reduced during recovery periods. Large firms with high fixed assets must be especially cautious during crises. For regulators, policies should distinguish between crisis and recovery phases, such as providing debt repayment relief during crises and encouraging debt restructuring during recovery. A one-size-fits-all approach is ineffective, as large firms and those with high fixed assets respond differently to debt across economic phases. For investors, the economic phase matters when evaluating investment opportunities. During crises, higher debt levels may signal better ROA performance, while during recovery, high debt tends to suppress profitability. Investors should also consider firm size and fixed asset structure in their decisions.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

This study analyzes the effect of leverage on the financial performance of transportation and logistics firms listed on the Indonesia Stock Exchange during the COVID-19 crisis (2020-2022) and the economic recovery period (2023-2025). The findings reveal that the relationship between leverage and financial performance varies across economic phases. During the crisis period, leverage had a positive and significant effect on ROA, indicating that debt helped firms maintain operations and profitability. However, leverage had a negative but insignificant effect on ROE. During the recovery period, leverage had a negative and significant effect on both ROA and ROE, indicating that high debt usage increased financial costs and reduced profitability. Regarding moderating effects, during the crisis, firm size and tangibility strengthened the effect of DAR on ROA (contrary to the hypothesis). During the recovery, only firm size weakened the negative effect of DAR on ROA, while tangibility did not moderate the relationship.

These findings contribute to existing knowledge by demonstrating that the impact of leverage on financial performance is dynamic and depends on economic conditions. This

study extends prior research (Neacșu & Georgescu, 2024) by comparing two distinct economic phases and testing moderating roles, while also confirming that the leverage-performance relationship is nonlinear and context-dependent (Helhel, 2026). The results challenge the conventional assumption that leverages consistently harms profitability, as debt proved beneficial during the crisis but detrimental during recovery. For professional practice, managers should adjust financing strategies according to the economic phase: debt can serve as an emergency tool during crises but should be reduced during recovery to maintain financial stability.

Limitations of the Study

Several limitations of this study should be acknowledged to provide context for the findings and guide future research. These limitations primarily relate to the sample characteristics, research scope, and methodological choices, which may influence the interpretation and generalizability of the results.

a. Sample Size: The sample comprises only 24 companies due to the purposive sampling criteria requiring complete financial data from 2020 to 2025. This relatively small sample may limit the generalizability of the findings to the broader transportation and logistics sector, particularly for smaller or unlisted firms.
b. Study Period: The observation period covers only 2020-2025, focusing exclusively on the crisis and recovery phases without a pre-pandemic baseline (e.g., 2015-2019). This prevents us from distinguishing between pandemic-specific effects and broader temporal trends in the leverage-performance relationship.
c. Leverage Proxy: Only one leverage proxy, the Debt-to-Asset Ratio (DAR), was used in this study. Alternative measures such as Debt-to-Equity Ratio (DER) or Long-Term Debt-to-Total Assets (LTDTA) might yield different results and provide a more comprehensive understanding of capital structure effects.
d. External Factors: This study did not control external variables such as government relief policies (e.g., loan moratoriums, fiscal stimuli), macroeconomic conditions (e.g., inflation, interest rates), or industry-specific regulations that may have influenced firm behavior during the pandemic and recovery periods.
e. Single-Country Context: The findings are specific to the Indonesian transportation and logistics sector, limiting cross-country generalizability. Institutional and regulatory differences across countries may moderate the leverage-performance relationship differently.

Recommendations for Future Research

Based on the limitations and findings of this study, several directions for future research are recommended to further validate and extend these findings.

a. Threshold Regression Analysis: Future research should employ threshold regression models, as applied by (Helhel, 2026), to identify the optimal leverage level before its effects become negative. This approach would provide more precise guidance for managers in determining safe debt thresholds and help firms avoid the financial vulnerability that emerges when leverage exceeds critical levels.
b. Pre-Pandemic Baseline: Future research should include the pre-pandemic period (e.g., 2015-2019) as a baseline to more accurately measure the impact of the crisis. This would allow researchers to distinguish between temporary crisis effects and structural changes in the leverage-performance relationship, providing a clearer understanding of how external shocks alter capital structure dynamics.
c. Multiple Leverage Proxies: Researchers should use a wider range of leverage proxies, such as the Debt-to-Equity Ratio (DER) and Long-Term Debt-to-Total Assets (LTDTA),

to compare results across different leverage measures and assess the robustness of the findings. This would provide a more comprehensive understanding of how different aspects of capital structure affect financial performance.

d. Qualitative and Mixed-Methods Research: Qualitative or mixed-methods research could be conducted to gain a deeper understanding of why companies made specific financing decisions during the crisis, as well as how managerial processes handle debt risk. Such approaches would complement the quantitative findings by providing contextual insights into managerial decision-making during periods of economic uncertainty.
e. Cross-Sectoral and Cross-Country Comparisons. Future research should expand the sample to other sectors such as tourism, hospitality, or retail to enable cross-sector comparisons, and consider cross-country studies to determine whether the observed patterns are context-specific or universally applicable.

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