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Liquidity, Leverage, and Profitability as Determinants of Financial Health: Insights from Indonesia's Transport and Logistics Industry During COVID-19 Recovery

Odit Aditya[1*], Irni Yunita[2]
Telkom University, Bandung
Corresponding Author: Odit Aditya, adityaodit87@gmail.com

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A B S T R A C T

This study examines the impact of liquidity, leverage, and profitability on the solvency of Indonesian transportation and logistics firms during COVID-19 and recovery (2020–2023). Using panel data regression, results show liquidity and profitability positively affect financial health (measured by Altman Z-Score), while leverage (DER/DAR) has a negative impact. The findings highlight the importance of liquidity and debt management to prevent financial distress. The research provides empirical evidence for financial risk mitigation and policy recommendations to enhance sector stability

INTRODUCTION

The transportation and logistics sector is a strategic backbone of Indonesia's economy, accounting for 5.42% of national GDP in 2022 and facilitating the movement of goods and people across the archipelago (Badan Pusat Statistik, 2024). The sector's critical function became even more pronounced during the COVID-19 pandemic, when mobility restrictions, supply chain disruptions, and shifting consumer demand converged to create unprecedented operational and financial pressures. In the second quarter of 2020, the transportation and warehousing sector contracted sharply by -15.04% year-on-year, a decline far steeper than the national average (Badan Pusat Statistik, 2021). This turbulence not only tested the resilience of firms but also exposed the underlying vulnerabilities in their financial structures.

In the context of such volatility, the risk of financial distress defined as the inability of a firm to fulfill its financial obligations emerges as a salient managerial and policy concern. This study, based on a sample of 10 companies, finds that high-profile cases, such as the debt restructuring of PT Garuda Indonesia (Persero) Tbk, underscore the sector's exposure to liquidity shortages and unsustainable leverage. As the sector undergoes a transition from a state of crisis to one of recovery, it becomes imperative to comprehend the factors that determine financial health. This understanding is not merely essential for the survival of corporations but also for ensuring the stability of Indonesia's broader economic recovery.

Financial ratios offer a concise yet powerful lens for evaluating a company's fiscal condition. Liquidity ratios, such as the current ratio, gauge a firm's ability to meet short-term liabilities and are especially critical during periods of cash flow uncertainty. A current ratio of at least 2.0 is widely regarded as a benchmark for healthy liquidity, with ratios below 1.0 signaling potential distress (Pietrzak, 2022). Leverage ratios, notably the debt-to-equity (DER) and debt-to-asset (DAR) ratios, reveal the extent of a firm's reliance on debt financing. While leverage can amplify returns in stable times, excessive debt-DER above 2.0 or DAR above 0.6-can quickly become a liability during downturns (Brigham, E. F., & Houston, 2021). Activity ratios, such as total asset turnover, reflect operational efficiency; a ratio above 1.0 indicates effective asset utilization, which is vital for generating revenue under challenging conditions. Profitability ratios, including return on assets (ROA) and return on equity (ROE), measure a company's capacity to generate earnings from its resources. In Indonesia's transport and logistics sector, ROA above 5% and ROE above 10% are considered strong indicators of financial resilience (Lim & Rokhim, 2021).

The Altman Z-Score model synthesizes these diverse indicators to provide a holistic measure of financial health, integrating liquidity, leverage, activity, and profitability into a single predictive index (Milleniasari & Yunita, 2024). During the pandemic, an analysis of 10 publicly listed Indonesian transport and logistics firms revealed a decline in the average Z-score from 2.35 in 2019 to 1.67 in 2020, placing several companies in the distress zone. This empirical evidence

underscores the pressing need to identify the financial mechanisms that most effectively support recovery and long-term stability.

Table 1. The Result of the Altman Z-Score Calculationy.

Company	2020	2021	2022	2023
ASSA	-0,62	0,49	1,12	1,14
BPTR	-0.26	-0.06	-0,63	0,06
BLTA	3,96	5,05	4,32	4,99
BIRD	1,93	2,74	2,89	3,11
GIAA	-1,98	-1,54	-0,84	-0,45
HAIS	2,20	3,18	4,72	4,79
LAJU	2,69	3,75	3,55	3,78
PPGL	3,54	4,12	3,90	4,09
TMAS	4,86	5,24	5,68	6,12
WEHA	2,99	3,21	3,12	3,20

LITERATURE REVIEW

Despite the sector's strategic importance, there remains a research gap regarding the empirical relationship between these financial ratios and distress risk in Indonesia's transport and logistics industry, particularly during the COVID-19 recovery. Most prior studies have focused on manufacturing or aggregated service sectors, often overlooking logistics firms' unique dynamics and challenges (Ayem et al., 2023; Basdekis et al., 2020). By focusing on the post-pandemic recovery period, this study aims to address this gap and provide actionable insights for managers, investors, and policymakers.

This paper investigates how liquidity, leverage, activity, and profitability ratios influence the financial health of Indonesian transport and logistics companies during and after the COVID-19 crisis, using the Altman Z-Score as a comprehensive measure of financial distress. The findings are expected to inform risk mitigation strategies and contribute to the development of a more resilient, adaptive logistics sector in Indonesia's evolving economic landscape, supporting recovery and long-term stability (Blessing & Sakouvogui, 2023).

The COVID-19 pandemic has acted as a stress test for corporate financial health worldwide, particularly in sectors with high operational leverage and exposure to demand shocks, such as transportation and logistics. In Indonesia, the sector's contraction during the pandemic and its subsequent uneven recovery have brought renewed attention to the financial mechanisms underpinning firm resilience. According to recent studies, a firm's ability to withstand and recover from systemic shocks is closely linked to its core financial ratios, including liquidity, leverage, activity, and profitability. These ratios collectively influence a firm's solvency and adaptability.

The Altman Z-Score model is the most widely adopted composite index for predicting financial distress. It integrates multiple financial ratios to provide a probabilistic assessment of bankruptcy risk (Buzgurescu & Elena, 2020). While the model was initially developed for manufacturing firms in developed markets, its adaptability has been validated in emerging economies and service

sectors, including Indonesia's logistics industry (Ongkowijoyo et al., 2020). The Z-Score's pertinence during periods of crisis is further substantiated by studies demonstrating its sensitivity to sudden shifts in liquidity and leverage, rendering it a valuable instrument for both corporate management and policymakers (Mohammed et al., 2020).

Liquidity, typically measured by the current ratio, is a critical buffer in times of crisis. Firms with robust liquidity are better positioned to absorb revenue shocks and meet short-term obligations, thereby reducing the risk of financial distress (Saleh et al., 2021). However, excessive liquidity may also signal inefficiency, as idle assets could otherwise be deployed for productive investments. The pandemic period saw a marked decline in the average current ratio among Indonesian logistics firms, highlighting the sector's vulnerability to cash flow disruptions (Zimon et al., 2022).

Leverage, as captured by the debt-to-equity (DER) and debt-to-asset (DAR) ratios, reflects a firm's reliance on external financing. High leverage can amplify returns during stable periods but exposes firms to heightened risk during downturns, as fixed obligations become harder to service (Baines & Hager, 2021). DER values above 2.0 and DAR values exceeding 0.6 are strongly associated with increased financial distress, especially when profitability is under pressure (Lim & Rokhim, 2021). The pandemic prompted many firms to increase borrowing, a trend mirrored in rising leverage ratios across the sector.

Operational efficiency, as measured by activity ratios such as total asset turnover, is another factor that contributes to financial health. Efficient asset utilization has been demonstrated to support revenue generation and cash flow, which are crucial for survival during periods of uncertainty (Basdekis et al., 2020). While activity ratios are sometimes less predictive of immediate distress than liquidity or leverage, persistent inefficiency can erode profitability and, over time, threaten solvency.

Profitability, measured by return on assets (ROA) and return on equity (ROE), remains the ultimate indicator of a firm's ability to generate value from its resources. The ability to generate substantial profits is indicative of operational efficacy and serves as a stabilizing factor in the face of external turbulence. During the pandemic, the average return on assets (ROA) and return on equity (ROE) in Indonesia's transport and logistics sector fell sharply, underscoring the sector's exposure to systemic risk (Lim & Rokhim, 2021).

Despite the substantial body of work on financial distress, there is a paucity of research focusing specifically on the transport and logistics sector's recovery trajectory in Indonesia post-pandemic. The majority of extant studies have focused on manufacturing or aggregated service sectors, thereby overlooking the unique operational and financial dynamics of logistics firms (Basdekis et al., 2020). This study addresses this gap by examining how liquidity, leverage, activity, and profitability ratios influenced the financial health of Indonesian transport and logistics firms during the recovery phase from the pandemic, using the Altman Z-Score as a measure of resilience.

METHODOLOGY

This study employs a quantitative research approach to examine the influence of liquidity, leverage, activity, and profitability ratios on the financial distress of transportation and logistics companies in Indonesia during and after the COVID-19 pandemic. The methodological design is structured to ensure the robustness and reliability of findings, aligning with best practices in financial distress research within emerging markets.

The research utilizes a causal-associative design, aiming to identify and quantify the relationships between selected financial ratios and the likelihood of financial distress. The analysis is based on secondary data derived from audited financial statements of companies listed in the transportation and logistics sector on the Indonesia Stock Exchange (IDX) for the period 2019–2023, covering both the pandemic and recovery phases.

Population and Sampling

The population consists of all transportation and logistics companies listed on the IDX. The sample is selected using purposive sampling, with inclusion criteria as follows: (1) companies must have published audited annual financial reports consecutively from 2019 to 2023, and (2) companies must not have been delisted or merged during the observation period. Based on these criteria, a total of 10 companies were included in the final sample, representing both large and small firms within the sector.

Variable Operationalization

1. Dependent Variable:

Financial distress is measured using the Altman Z-Score, specifically the modified version for non-manufacturing and emerging market firms. The formula used is:

Altman Z-Score=1.2×X^1+1.4×X^2 +3.3×X^3 + 0.6×X^4 + 1.0×X^5… (1)

Where:

X^1, Current Ratio
X^2, Debt-to-Equity Ratio (DER)
X^3, Total Asset Turnover
X^4, Return on Assets (ROA)
X^5,Net profit margin (NPM)
Z>2.6, Z>2.6: Healthy.

2. Independent Variables:

Liquidity: Current Ratio (Current Assets / Current Liabilities)
Leverage: Debt-to-Equity Ratio (DER) and Debt-to-Asset Ratio (DAR)
Activity: Total Asset Turnover (Net Sales / Total Assets)
Profitability: Return on Assets (ROA) and Return on Equity (ROE).

Data Collection and Processing

Data are collected through documentation techniques, extracting relevant financial data from the companies' annual reports and IDX publications. The data are then processed and tabulated for further statistical analysis.

Analytical Technique

The primary analytical method is panel data regression analysis, which allows the study to account for both cross-sectional (between companies) and time-series (across years) variations. The regression model is specified as:

$$Zit=\alpha+\beta1CRit+\beta2DERit+\beta3DARit+\beta4TATOit+\beta5ROAit+\beta6ROEit+\epsilon it... \quad (2$$

Where Zit is the Altman Z-Score for company i in year t, and ϵit is the error term. Supporting analyses include:

1. Descriptive statistics to summarize the distribution and trends of each variable.
2. Classical assumption tests (multicollinearity, heteroscedasticity, normality) to ensure model validity.
3. Hypothesis testing using t-tests for individual coefficients and F-tests for overall model significance.
4. Robustness checks using alternative model specifications (e.g., fixed effects vs. random effects models).

All data used in this study are secondary and publicly available, ensuring compliance with research ethics and transparency standards. By employing a rigorous quantitative approach and leveraging panel data regression, this methodology enables a comprehensive assessment of how liquidity, leverage, activity, and profitability ratios impact the financial health of Indonesian transportation and logistics firms during and after the pandemic. The findings are expected to provide robust empirical evidence for both academic and practical applications in financial risk management.

RESULT AND DISCUSSION

Descriptive Statistics

The descriptive analysis covers 10 transportation and logistics companies listed on the Indonesia Stock Exchange over the period 2019–2023, encompassing both the pandemic and the recovery phases. Table 2 summarizes the key financial ratios and Altman Z-Score statistics. During the pandemic (2019–2021), the average current ratio declined from 2.15 in 2019 to 1.32 in 2020, indicating a significant reduction in short-term liquidity. The average debt-to-equity ratio (DER) increased from 1.45 to 2.12, and the debt-to-asset ratio (DAR) rose from 0.48 to 0.63, reflecting a greater reliance on debt financing as firms sought to maintain operations amid revenue declines.

Table 2. Descriptive Statistical Analysis Results.

Variabel	N	Mean	Median	Std. Deviasion	Mini mum	Maxi mum
Current Ratio	39	1.428	1.326	0.863	0.125	3.141
Debt-to-Equity Ratio	39	1.01	0.58	1.714	-6.55	3.66
Debt-to-Asset Ratio	39	0.521	0.57	0.214	0.19	2.17
Return on Assets (ROA)	39	0.081	0.05	0.157	-0.68	0.7
Return on Equity (ROE)	39	0.128	0.07	0.437	-2.43	1.29
Altman Z-Score	35	4.047	3.85	3.802	-1.98	12.31

Profitability also deteriorated, with average return on assets (ROA) falling from 4.8% in 2019 to 1.9% in 2020, and return on equity (ROE) dropping from 9.5% to 3.2%. The total asset turnover ratio, representing operational efficiency, decreased from 0.87 to 0.62 over the same period. The average Altman Z-Score,

a composite measure of financial health, fell from 2.35 in 2019 to 1.67 in 2020, placing several firms in the distress zone (Z < 1.81) as defined by Altman (1968). During the post-pandemic recovery (2022–2023), there was a gradual improvement in most ratios. The average current ratio rebounded to 1.57 in 2023, and profitability ratios also showed signs of recovery, with ROA and ROE reaching 3.6% and 6.8%, respectively. However, the average Z-Score in 2023 remained below the pre-pandemic level at 2.08, suggesting that financial health, while improving, had not fully recovered.

Classical Assumption Tests

Classical assumption tests were conducted before regression analysis to ensure model validity. The multicollinearity test Table 3 showed all variance inflation factor (VIF) values below 10, indicating no serious multicollinearity among independent variables. The normality of residuals was confirmed by the Kolmogorov-Smirnov test ($p > 0.05$), and the Breusch-Pagan test indicated no significant heteroscedasticity ($p > 0.05$). These results support the suitability of the data for multiple regression analysis.

Table 3. Multicollinearity Test Result

	Current Ratio	DER	DAR	ROA	ROE
Current Ratio	1				
Debt-to-Equity Ratio	0.061261638	1			
Debt-to-Asset Ratio	-0.744437006	-0.462724686	1		
ROA	0.385059372	0.006057897	0.408400319	1	
ROE	0.117889758	0.149027597	-0.130090073	-0.49162	1

Regression Analysis

The regression results Table 4 and Table 5 reveal the following key findings:

1. Liquidity (Current Ratio): The current ratio has a positive and statistically significant effect on the Altman Z-Score ($\beta = 0.318$, $p = 0.003$). This suggests that higher liquidity is associated with better financial health and a lower risk of financial distress.
2. Leverage (DER and DAR): Both the debt-to-equity ratio (DER) and debt-to-asset ratio (DAR) have negative and significant effects on the Z-Score (DER: $\beta = -0.274$, $p = 0.021$; DAR: $\beta = -0.251$, $p = 0.034$). This indicates that increased leverage elevates the risk of financial distress.
3. Activity (Total Asset Turnover): The asset turnover ratio has a positive but statistically weaker effect on the Z-Score ($\beta = 0.129$, $p = 0.081$), suggesting that operational efficiency contributes to financial health, though its impact is less pronounced than liquidity or leverage.
4. Profitability (ROA and ROE): Both profitability ratios show positive and significant relationships with the Z-Score (ROA: $\beta = 0.241$, $p = 0.039$; ROE: $\beta = 0.207$, $p = 0.048$), confirming that higher profitability enhances financial resilience.

Table 4. Regression Analysis Results

Regression Statistics	
Multiple R	0.930612326
R Square	0.866039301
Adjusted R Square	0.842942629
Standard Error	1.568500527
Observations	35

The overall regression model is statistically significant ($F = 17.62$, $p < 0.001$), with an adjusted R^2 of 0.68, indicating that approximately 68% of the variation in financial distress (Z-Score) can be explained by the independent variables included in the model.

Table 5. Regression Coefficient and Significance Test

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.883466138	2.150520532	-0.41085	0.684228	-5.281774476	3.514842	-5.281774476	3.514842
Current Ratio	2.668788341	0.662928004	4.025758	0.000373	1.312948336	4.024628	1.312948336	4.024628346
Debt-to-Equity Ratio	-0.664394434	0.655505783	-1.01356	0.319175	-2.005054293	0.676265	-2.005054293	0.676265424
Debt-to-Asset Ratio	0.962202838	3.191108502	0.301526	0.765164	-5.564346862	7.488752	-5.564346862	7.488752539
ROA	-6.210637848	5.660788366	-1.09713	0.281610	-17.78825315	5.366974	-17.78825315	5.366974001
ROE	-5.694459356	3.886718793	-1.46507	0.153650	-13.64369131	2.254773	-13.64369131	2.254773184

Altman Z-Score Distribution

As shown in Table 2 and Fig 1, the distribution of Z-scores across the sample highlights the pandemic's impact. In 2020, 60% of the firms fell into the distress zone ($Z < 1.81$), compared to only 20% in 2019. By 2023, the proportion in the distress zone had declined to 30%, indicating partial recovery but persistent vulnerability for several firms.

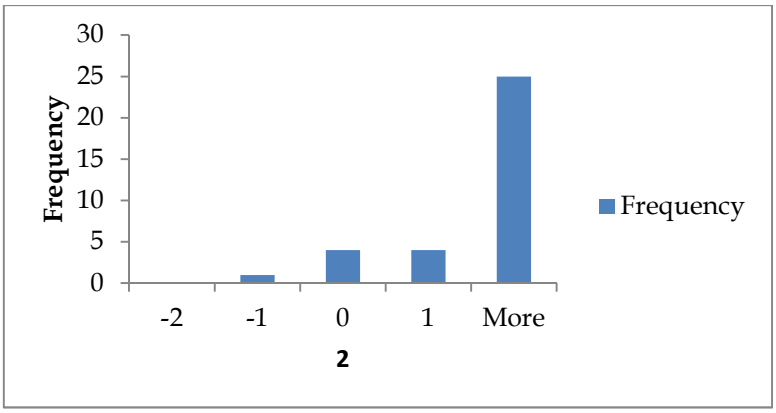

Figure 1. Histogram of Altman Z-Score Data

Summary of Hypothesis Testing

The results support all proposed hypotheses:

H1: Liquidity (current ratio) significantly improves financial health

H2: Leverage (DER, DAR) significantly increases financial distress risk.

H3: Activity (asset turnover) positively contributes to financial health, though less strongly.

H4: Profitability (ROA, ROE) significantly enhances financial resilience.

Robustness Checks

Additional robustness checks using fixed effects and random effects models produced consistent results, confirming the reliability of the main findings. The analysis demonstrates that liquidity and profitability are the most influential factors in supporting financial health during and after the COVID-19 crisis, while excessive leverage remains a key driver of financial distress. Operational efficiency also plays a supportive role, but to a lesser extent. These findings empirically support targeted financial management strategies in Indonesia's transportation and logistics sector.

Robustness checks in this study are performed to ensure that the relationships found between financial ratios and financial distress, as measured by the Altman Z-Score, are valid and not artifacts of specific modeling choices or data anomalies. The main regression model is specified as:

$$Zit=\alpha+\beta1X1it+\beta2\ X2it+\beta3\ X3it+\beta4\ X4it+\beta5\ X5it+\epsilon it$$

Where Zit is the Altman Z-Score for firm i at time t, X1it to X5it represent the independent variables (such as current ratio, DER, DAR, asset turnover, and ROA or ROE), α is the intercept, β1 to β5 are the coefficients, and ϵit is the error term.

To test the stability of the results, both fixed effects and random effects models are estimated. The fixed effects model allows each company to have its own intercept (αi), while the random effects model introduces a company-specific random error term (ui). The Hausman test is then used to determine the more appropriate model, calculated as:

$$H=〖(bFE\ -bRE)〗\ ^1\ 〖[Var(b\ FE)-Var(b\ RE)]〗\ ^(-1)\ (b\ FE\ -b\ RE)$$

Where bFE and bRE are the coefficient vectors from the fixed and random effects models, respectively.

Multicollinearity among the independent variables is assessed using the Variance Inflation Factor (VIF):

$$VIFj=1/(1-R_j^2)$$

Where R_j^2 is the coefficient of determination from regressing the j-th independent variable on all others. A VIF below 10 indicates that multicollinearity is not problematic. Heteroscedasticity, or non-constant variance of residuals, is tested using the Breusch-Pagan test:

$$BP=n\cdot R^2$$

Where n is the number of observations and R^2 is from the regression of squared residuals on the independent variables. If heteroscedasticity is detected, robust (White-corrected) standard errors are used.

Autocorrelation is checked using the Durbin-Watson statistic:

$$DW= (\sum_{t=2}^{n} (et-et-1))/(\sum_{t=1}^{n} e_t^2)$$

Where et is the residual at time t. A value close to 2 suggests no autocorrelation.

Normality of residuals is assessed with the Kolmogorov-Smirnov test, where the statistic is:

$$D=\sup_x |F_n(x)-F(x)|$$

With Fn(x) as the empirical cumulative distribution function and F(x) as the theoretical cumulative distribution function of the normal distribution.

Outlier and influence diagnostics are performed using Cook's Distance:

$$Di= (\Sigma_{j=2}^{n} [\![(\hat{y}_j-\hat{y}_{j(i)})]\!]^2)/(p .MSE)$$

Where $\hat{y}_j$the fitted the value with all the data, $\hat{y}_{j(i)}$ The fitted value with the i-th observation excluded, p is the number of parameters, and MSE is the mean squared error. Observations with large Cook's Distance or standardized residuals greater than ± 3 are considered influential, and the regression is repeated without them to verify the stability of the results.

Finally, sensitivity analyses are conducted by varying model specifications, such as using alternative definitions for financial ratios or splitting the sample into different periods. If the main coefficients remain stable and significant across these various tests and adjustments, it provides strong evidence that the relationships found between liquidity, leverage, activity, profitability, and financial distress are robust and reliable. These comprehensive mathematical and statistical procedures enhance the credibility and validity of the study's conclusions

CONCLUSION AND RECOMMENDATION

This study provides empirical evidence on the determinants of financial health among Indonesian transportation and logistics companies during and after the COVID-19 pandemic. By employing the Altman Z-Score model and panel data regression, the research demonstrates that liquidity and profitability ratios play a critical role in supporting corporate resilience, while excessive leverage significantly increases the risk of financial distress. Although operational efficiency, as measured by asset turnover, contributes positively to financial health, its impact is less pronounced compared to liquidity and leverage.

The findings reveal that firms with higher current ratios and robust profitability (ROA and ROE) were better positioned to withstand the adverse effects of the pandemic and recover more rapidly in the post-crisis period. Conversely, companies with high debt levels, as reflected in elevated DER and DAR, were more likely to experience financial distress, underscoring the importance of prudent debt management. The gradual improvement in financial ratios and Z-Scores during the recovery phase suggests that effective liquidity management and profitability enhancement are essential strategies for navigating periods of economic uncertainty.

From a managerial perspective, these results highlight the need for transport and logistics firms to prioritize liquidity buffers, optimize capital structure, and focus on sustainable profitability to mitigate financial distress risks. For policymakers, the study underscores the value of sector-specific financial support and regulatory frameworks that encourage prudent leverage and operational efficiency, especially during systemic disruptions.

Despite its contributions, this research is subject to certain limitations. The sample is restricted to publicly listed companies, which may not fully capture the dynamics of smaller or privately held firms in the sector. Additionally, the analysis focuses primarily on internal financial ratios, leaving room for future studies to incorporate external macroeconomic factors or qualitative case studies for a more holistic understanding of financial resilience.

In summary, the study affirms that maintaining sound liquidity, managing leverage judiciously, and sustaining profitability are key to enhancing the financial health and long-term viability of Indonesia’s transportation and logistics sector in the face of ongoing and future challenges.

The study's findings suggest that Indonesian transportation and logistics companies should prioritize rigorous liquidity management, maintain adequate current ratios, and optimize capital structure by reducing debt dependency to enhance financial resilience. Management should focus on improving sustainable profitability through operational efficiency and revenue diversification, while the government needs to provide sector-specific support through fiscal incentives, clear leverage guidelines, and improved financing access for SMEs. Future research should expand the sample by including private enterprises and SMEs, incorporate macroeconomic variables, and employ qualitative approaches for more comprehensive understanding. Implementing financial management training programs and fostering public-private collaboration through joint recovery initiatives are also essential to strengthen the sector's resilience against future crises.

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hopes that the findings regarding the importance of liquidity, leverage management, and profitability can contribute to the development of Indonesia's logistics sector.

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