JOURNAL OF ACCOUNTING AND AUDITING
https://ojs.azzukhrufcendikia.or.id/index.php/aaaj
VOL. 2. No. 3 ; April (2026)
E-ISSN : 3090-2401

Analysis of Financial Distress in the Infrastructure Sector through the Altman Z-Score Approach

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Article Info

Keywords:
- *Operating Cash Flow;*
- *Solvency;*
- *Financial Distress;*

Article History

Received: 05 – 01 - 2026
Revised: 07 – 02 - 2026
Accepted: 02 – 03 - 2026
Published: 02 – 04 - 2026

DOI

https://doi.org/10.65440/jaa.v2i2.188

Abstract

Purpose – *This study aims to obtain empirical evidence regarding the effect of Operating Cash Flow and Solvency on Financial Distress.*

Design/methodology/approach – *This study uses quantitative research. It utilizes secondary data. The population is 71 infrastructure sector companies listed on the Indonesia Stock Exchange between 2022 and 2024. The sample is 37 infrastructure sector companies listed on the Indonesia Stock Exchange between 2022 and 2024. The total number of observations in this study is 111. The analysis technique used to test the hypotheses is multiple regression analysis using Eviews9 software*

Findings – *The results of this study indicate that the operating cash flow variable has a negative and significant effect on financial distress. The solvency variable has a negative and significant effect on financial distress.*

Research limitations/implications – *This study contributes to financial distress literature by providing empirical evidence from the infrastructure sector and highlights the importance of cash flow management and debt control in maintaining financial stability.*

JEL : M4

INTRODUCTION

Rapid global economic growth and technological advancement have compelled companies to continuously enhance their competitiveness and ensure business sustainability. One strategy widely adopted is going public through the Indonesia Stock Exchange (IDX) to obtain long-term external funding and increase firm value (Katharina & Mentalita, 2024). In the context of the post-pandemic economic recovery era, the infrastructure sector has emerged as one of the strategic sectors that plays a crucial role in driving national economic growth while ensuring sustainable development.

The infrastructure sector, which comprises the transportation infrastructure, heavy

construction and civil engineering, telecommunications, and utilities subsectors, serves as a fundamental pillar in strengthening regional connectivity, improving the efficiency of goods and services distribution, and supporting national productivity. In line with government efforts to accelerate economic recovery, infrastructure spending in the 2024 State Budget (APBN) reached approximately IDR 422.7 trillion and was allocated to the development of toll roads, seaports, airports, energy networks, and digital infrastructure. However, limited fiscal capacity has encouraged the government to develop alternative financing schemes through Public–Private Partnerships (PPP). Kontan (2025) reported that the value of infrastructure projects financed through PPP schemes during the 2025–2029 period amounted to IDR 544.48 trillion, indicating the increasing involvement of the private sector in infrastructure project financing in Indonesia. Despite increased investment and infrastructure development offering positive growth prospects, such conditions do not automatically reduce the financial risk faced by private infrastructure companies. The capital-intensive nature of the sector, long project durations, and heavy reliance on external financing instead heighten the potential for financial distress, particularly during the economic recovery period, which remains characterized by interest rate volatility, exchange rate fluctuations, rising raw material prices, and staggered project payment schemes. These conditions directly exert pressure on corporate liquidity and cost structures.

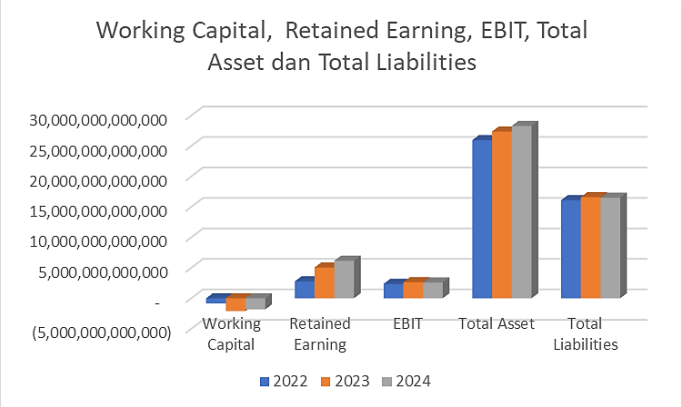

Figure 1 : Average Working Capital, Retained Earnings, EBIT, Total Assets, and Total Liabilities in the Infrastructure Sector

This phenomenon is reflected in the financial conditions of infrastructure sector companies during the 2022–2024 period, where total assets and total liabilities increased in a relatively balanced manner. This trend indicates that asset expansion was largely driven by the growth of liabilities rather than equity strengthening. Meanwhile, although retained earnings and earnings before interest and taxes (EBIT) tended to increase, average working capital remained negative. Negative working capital reflects insufficient current assets to cover short-term liabilities, thereby illustrating the liquidity pressure faced by infrastructure companies. This condition suggests that improvements in profitability are not necessarily accompanied by adequate cash generation, particularly during the economic recovery period.

Financial distress refers to a condition in which a company experiences financial difficulties that may lead to an inability to meet short-term or long-term obligations and can serve as an initial stage toward bankruptcy if not managed properly. In the context of

infrastructure companies, the risk of financial distress is a critical issue, as project sustainability, investor confidence, and relationships with creditors are highly dependent on financial stability. This finding is consistent with (Giovanni & Hermi, 2023), who reported that Operating Cash Flow has a negative and significant effect on Financial Distress in energy sector companies listed on the Indonesia Stock Exchange (IDX) during 2019–2022. Similar evidence is provided by (Paryati & Retno, 2023) in the transportation and logistics subsector for the 2018–2022 period and by (Sembiring, 2022) in manufacturing sector companies for the 2017–2019 period, indicating that stronger operating cash flow reduces the likelihood of financial distress.

In contrast, (Miswaty & Novitasari, 2023) found a positive and significant effect of Operating Cash Flow on Financial Distress in transportation subsector companies during 2018–2020. Furthermore, (Sugiana & Hidayat, 2023) documented no significant relationship between Operating Cash Flow and Financial Distress in property and real estate sector companies during 2017–2021. These mixed results suggest that the impact of Operating Cash Flow on Financial Distress is contingent upon sector-specific characteristics and cash flow dynamics. These differing findings indicate that the role of Operating Cash Flow in explaining Financial Distress is not universal, but rather highly dependent on sectoral characteristics, cost structures, and industry-specific cash flow patterns.

In addition to Operating Cash Flow, Solvency is another important factor in explaining Financial Distress. (Innasril & Nur, 2022) found that Solvency had a negative and significant effect on Financial Distress. Similar results were obtained by (Jaya & Rahmanto, 2022) examined transportation sector companies listed on the IDX over the 2016–2020 period and reported that solvency negatively affects financial distress. Conversely, contrasting evidence was reported by (Azis Wijayanti et al, 2024), who found that solvency has no significant effect on financial distress. These differences suggest that high debt levels do not always reflect financial pressure, particularly in sectors characterized by relatively stable cash flows or long-term contract-based revenues. Based on the above discussion, it can be concluded that inconsistencies in prior research findings are not solely attributable to differences in research periods, but also to variations in industry characteristics. However, most previous studies have largely attributed these differences to variations in research periods and objects, without thoroughly examining the sectoral mechanisms that cause differences in the roles of Operating Cash Flow and Solvency in explaining Financial Distress. Furthermore, limited research has specifically examined the infrastructure sector in the context of the post-pandemic economic recovery era, during which increased government spending, the expansion of strategic projects, and greater private sector involvement through PPP schemes have intensified firms' dependence on external financing and extended project cash flow cycles.

The infrastructure sector has distinct characteristics that differentiate it from other sectors, including high capital intensity, debt-based financing structures, long-term projects with delayed cash flows, and high exposure to macroeconomic risks. These conditions cause Operating Cash Flow not to always reflect strong liquidity, even when firms report improved profitability. Similarly, high Solvency levels in this sector do not merely indicate default risk but also reflect potential agency conflicts between management, shareholders, and creditors in managing large-scale projects.

Based on this research gap, this study aims to analyze the effects of Operating Cash Flow and Solvency on Financial Distress in infrastructure sector companies listed on the Indonesia Stock Exchange during the 2022–2024 period. This study contributes by positioning the

infrastructure sector as the primary analytical context in the economic recovery era and by deepening the understanding of how Operating Cash Flow and Solvency function as mechanisms of financial signaling and agency control in capital-intensive firms. Practically, the findings are expected to serve as a basis for infrastructure company management in formulating cash flow management and financing structure strategies that are more adaptive to economic volatility, as well as to assist investors and creditors in more accurately assessing the risk of Financial Distress.

LITERATUR REVIEW

Agency Theory

Agency Theory explains the relationship between principals (shareholders) and agents (management), in which agents are authorized to manage the firm on behalf of the principals (Jensen & Meckling, 1976). This delegation creates information asymmetry, as management has superior knowledge of the firm's operational performance, cash flow conditions, and financial risks. Such asymmetry is more pronounced in infrastructure companies due to their capital-intensive nature, long-term project cycles, and delayed cash inflows. From an agency perspective, weak Operating Cash Flow may reflect inefficient project execution or suboptimal cash flow management, increasing the risk of Financial Distress when short-term obligations must be met. Similarly, high leverage exacerbates agency conflicts between shareholders and creditors, constrains financial flexibility, and heightens exposure to financial risk. Therefore, Operating Cash Flow and Solvency represent key agency-related mechanisms through which managerial decisions influence the likelihood of Financial Distress in infrastructure firms.

Signaling Theory

Signaling Theory explains how firms reduce information asymmetry by conveying information to external stakeholders through financial disclosures (Spence, 1973). Financial indicators such as Operating Cash Flow and Solvency function as key signals of a firm's financial condition. Operating Cash Flow reflects the firm's ability to generate cash from core operations and maintain liquidity, while Solvency indicates its capacity to meet long-term financial obligations. Strong Operating Cash Flow provides a positive signal of financial stability and a lower likelihood of Financial Distress, as it demonstrates the firm's ability to support operational needs and debt servicing. Conversely, weak Operating Cash Flow sends a negative signal of liquidity pressure, increasing perceived financial risk. Similarly, high leverage signals reduced financial flexibility and a higher probability of Financial Distress. Therefore, within the Signaling Theory framework, Operating Cash Flow and Solvency are informative indicators for assessing Financial Distress.

Operating Cash Flow

One way to assess a company's financial performance is by examining its operating activities, which include activities related to profit generation. These activities involve cash inflows and cash outflows from operating activities, such as investments in inventory, obtaining credit from suppliers, and extending loans to customers (Putri, 2021). Operating cash flows occur based on the company's operating activities, which are used as indicators in terms of determining the company's ability to obtain cash flows as financing for capital loans,

maintenance of company operations, payment of dividends, and not using funding outside the company to invest.

Solvency

Solvency refers to a bank's capacity to meet its long-term financial liabilities and is a direct indicator of its capital structure and financial health (Laith Ahmad Mohammad Alkasasbeh & Dr. Padma C, 2025). Solvency is an indicator used to evaluate the debt management of a company. Solvency is used to measure the percentage of a company's debt against the company's total capital.

Financial Distress

Financial distress is a condition which occurs in the company's financial problems, so that means the company's financial condition is not healthy or experiencing a critical (Platt & Platt, 2002). Financial distress is a situation when a company's operational cash flow cannot fulfill its responsibilities at the due date. However, the company is still able to accomplish its operational activities.

Hypotheses development

The Influence of Operating Cash Flow on Financial Distress

Operating cash flow refers to all cash inflows and outflows arising from operating activities related to revenues and operating expenses in determining a firm's net income. Changes in cash flows reflect a firm's financial condition, where a decline in cash indicates that cash outflows exceed inflows, while an increase in cash suggests that inflows are greater than outflows. When a company experiences operating cash outflows that exceed its cash inflows, it may face difficulties in generating sufficient internal funds to repay debt obligations, distribute dividends, and finance new investments without relying on external financing. Prolonged reliance on external funding increases financial risk and may lead to financial distress. Therefore, operating cash flow is considered a crucial indicator of a firm's ability to sustain its operations and maintain financial stability. Empirical evidence regarding the effect of operating cash flow on financial distress, however, remains inconclusive. Several studies, such as Giovanni & Hermi (2023), Paryati & Retno (2023), and Sembiring (2022), found that operating cash flow has a negative effect on financial distress, indicating that firms with stronger operating cash flow are less likely to experience financial difficulties. These findings support the view that adequate cash generation from core business activities enhances a firm's financial resilience. In contrast, other studies report different results. Some evidence suggests that operating cash flow may not always reduce financial distress due to sectoral differences, variations in cost structures, and industry-specific cash flow volatility. Such mixed findings indicate that the relationship between operating cash flow and financial distress is not universally consistent and warrants further investigation, particularly across different industries and economic conditions.

H_1 : Operating Cash Flow has a negative effect on Financial Distress

The Influence of Solvency on Financial Distress

Solvency reflects a firm's ability to meet its long-term obligations by comparing total debt with total assets or equity (Sulastri & Zannati, 2018). According to Hery (2016), solvency ratios measure the extent to which a company relies on debt financing to support its assets. A firm's solvency level signals its long-term financial stability and capacity to fulfill both short-term and long-term obligations. Based on signaling theory (Spence, 1973), a lower solvency ratio—indicating a lower proportion of debt relative to assets or equity—serves as a positive signal to investors and creditors regarding a firm's financial health and capital structure. Firms with sound solvency positions are perceived as having a lower risk of default, thereby enhancing stakeholder confidence. Conversely, firms with high solvency ratios rely heavily on debt financing to support their operations. Excessive debt increases interest burdens and financial obligations, which may strain cash flows and elevate the risk of financial distress. In extreme cases, an unsustainable debt structure may lead to default or bankruptcy, particularly when firms are unable to generate sufficient returns to service their debt. Empirical studies on the relationship between solvency and financial distress also reveal mixed results. Innasril and Nur (2022), Jaya and Rahmanto (2022), and Maximillian and Septina (2022) found that solvency negatively affects financial distress, suggesting that firms with healthier capital structures are less likely to encounter financial difficulties. These studies emphasize that excessive reliance on debt increases vulnerability to financial instability. However, other studies have reported insignificant effects of solvency on financial distress, indicating that the impact of debt levels may vary depending on industry characteristics, debt management strategies, and firms' ability to generate stable cash flows. These inconsistencies highlight the need for further empirical examination to clarify the role of solvency in predicting financial distress.

H_2 : Solvency has a negative effect on Financial Distress.

RESEARCH METHOD

This study aims to analyze and provide empirical evidence on the influence of operating cash flow and solvency as independent variables on financial distress as the dependent variable. The research employs a quantitative approach using numerical data to test the proposed hypotheses. The sampling technique applied is non-probability sampling with a purposive sampling method. Panel data, which combine cross-sectional and time-series data, are used to observe variations across companies and time periods. Data analysis is conducted through hypothesis testing to determine the effect of operating cash flow and solvency on financial distress.

Operational Definition and Measurement of Variables

Operating Cash Flow is measured by the ratio of operating cash flow to current liabilities. This ratio reflects a firm's ability to generate cash from core operations to meet short-term obligations. Solvency is proxied by the Debt to Asset Ratio (DAR), which measures the proportion of assets financed by debt. DAR is used to capture the firm's overall dependence on debt and long-term financial risk (Widarjo & Setiawan, 2018). Although the Altman Z-Score includes a leverage component, DAR is analyzed separately to explicitly assess the impact of

capital structure decisions on financial distress. Financial distress is measured using the Altman Z-Score model, which integrates liquidity, profitability, leverage, and cumulative performance indicators into a single index (Altman, 1995). Compared to the Springate and Zmijewski models, the Altman Z-Score is more suitable for the Indonesian infrastructure sector due to its emphasis on asset-based and leverage-related ratios, which are critical in capital-intensive industries with high debt exposure.

Based on the criteria, 37 companies from 71 companies in infrastructure sector were qualified in this study for 3 years and the number of observations was obtained as many as 111 data observations. This study employs a non-probability sampling technique using the purposive sampling method, in which samples are selected based on specific criteria relevant to the research objectives. The data used in this study are secondary data obtained from the audited annual financial statements of infrastructure sector companies published on the official website of the Indonesia Stock Exchange for the period 2020 –2024 (www.idx.co.id). Data collection is conducted through documentation and literature review, including the examination of financial reports, previous studies, books, and relevant online sources. Panel data analysis is applied by combining cross-sectional and time-series data to examine the effect of operating cash flow and solvency on financial distress.

RESULTS

Table 2. Descriptive Test Results

	Financial Distress	Operating Cash Flow	Solvency
Mean	4.003512	0.127089	0.584835
Median	2.768600	0.289200	0.486200
Maximum	69.82480	2.761000	3.600200
Minimum	-37.05610	-17.14680	0.016500
Std. Dev.	11.75865	1.904630	0.562238
Observations	111	111	111

Source : Output Eviews9 (2025)

Selection of the Best Panel Data Model

Chow Test
Decision-making criteria and based on the value of F calculated:

- If the probability (Prob) on the cross-sectionF<0.05 and if F calculates > F table then a better model is Fixed Effect.
- If the probability (Prob) on the Cross Section F is >0.05 and If F is calculated < F table then a better model is Common Effect

Table 3. Chow Test

Effects Test	Statistic	d.f.	Prob.
Cross-section F	9.027849	(36,72)	0.0000
Cross-section Chi-square	189.507708	36	0.0000

Source : Output Eviews9 (2025)

Based on the results of the Chow Test using Eviews9, it is stated that the probability value of Cross Section F is 0.00 which is less than the significance level value (α= 0.05). This means that the best model used is the Fixed Effect Model (FEM). Therefore, a Hausman Test is needed in order to choose the best model between the Fixed Effect Model and the Random Effect Model.

Hausman Test
Decision-making criteria and based on the value of F calculated:
- If the probability on the Cross Section Random > 0.05, then the better model is the Random Effect Model (REM).
- If the probability on Cross Section Random < 0.05, then the better model is the Fixed Effect Model (FEM).

Table 4. Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	12.330786	2	0.0021

Source : Output Eviews9 (2025)

Based on the results of the Hausman test, the probability value is 0.002 where this result is lower than the significant level value (α= 0.05). Therefore, the Fixed Effect Model is considered more appropriate than the Random Effect Model and is used for further analysis.

Hypothesis Test

Table 5. Partial Test (Fixed Effect Model)

Variable	Prediction	Coefficient	t- Statistics	Prob	Explanation
C		11.4070	5.1844	0.0000*	
OCF	-	-2.1972	-9.1196	0.0000*	Operating Cash Flow has an effect on Financial Distress and shows the same direction, meaning that it supports the theory

Variable	Prediction	Coefficient	t- Statistics	Prob	Explanation
SOL	-	-12.1816	-3.2574	0.0017*	Solvency has an effect on Financial Distress and shows the same direction, meaning that it supports the theory
R-Square					0.9724
Adjusted R-Square					0.9579
F-Statistic					66.8646
Prob (F-Statistic)					0.0000

Source : Output Eviews9 (2025)

Coefficient Determination Test

Table 6. Determination Coefficient Test Table

R-squared	0.972444	Mean dependent var	4.003512
Adjusted R-squared	0.957900	S.D. dependent var	11.75865
S.E. of regression	2.412659	Akaike info criterion	4.869175
Sum squared resid	419.1065	Schwarz criterion	5.821172
Log likelihood	-231.2392	Hannan-Quinn criter.	5.255372
F-statistic	66.86467	Durbin-Watson stat	2.468036
Prob(F-statistic)	0.000000		

Based on table 6, R-Square shows a value of 0.9724 which means that 97,24% of the variation in financial distress can be explained by operating cash flow and solvency.

Partial Test (T-Test)

The results of the test using *the Fixed Effect Model* (FEM) can be concluded as follows:

1. Operating Cash Flow has a negative effect on Financial Distress
   The estimation results show that Operating Cash Flow (OCF) has a regression coefficient of –2.1972, indicating a negative relationship between operating cash flow and financial distress. This result implies that an increase in operating cash flow is associated with a decrease in the level of financial distress, suggesting that stronger internal cash-generating ability improves a firm's financial condition. Using a two-tailed significance test, which is commonly applied in accounting and financial research to ensure objectivity, the probability value of 0.0000 is lower than the significance level of α = 0.05. Therefore, operating cash flow has a statistically significant negative effect on financial distress. This finding is consistent with financial theory, which posits that sufficient operating cash flows enhance a firm's ability to meet its financial obligations and reduce distress risk.
2. Solvency has a negative effect on Financial Distress
   The solvency variable shows a regression coefficient of –12.1816, indicating a negative

and statistically significant effect on financial distress. Based on the two-tailed probability value of 0.0017, which is below the 5% significance level, solvency is confirmed to have a significant influence on financial distress.

Notably, the magnitude of the solvency coefficient is substantially larger than that of operating cash flow. This suggests that changes in solvency have a stronger economic impact on financial distress than changes in operating cash flow, implying that a firm's long-term debt structure and ability to meet long-term obligations play a more dominant role in explaining financial distress conditions. However, this relatively large coefficient should be interpreted with caution. Descriptive statistics indicate an extreme minimum value of financial distress (–37.0561), which may reflect the presence of outliers. Such extreme observations can inflate coefficient estimates and contribute to a very high R-square value. Therefore, while the negative effect of solvency is statistically robust, further examination of outliers is necessary to ensure that the estimated relationship is not overly driven by extreme data points.

DISCUSSIONS

Operating Cash Flow has a negative effect on Financial Distress

The results indicate that operating cash flow has a negative and significant effect on financial distress, suggesting that firms with higher operating cash flow tend to experience lower levels of financial distress. This finding reflects not merely a statistical relationship, but a structural condition within the Indonesian infrastructure sector, particularly in the post-pandemic period. Infrastructure companies operate in a capital-intensive environment and rely heavily on the continuity of project execution and cash inflows from ongoing operations. In such conditions, cash flow from operations becomes a more reliable indicator of financial health than accrual-based accounting profit, which may not reflect actual liquidity. The negative effect of operating cash flow can be explained by the fact that infrastructure firms increasingly depend on internal efficiency and cash discipline rather than additional debt financing after the pandemic. Heightened uncertainty, tighter credit conditions, and increased financing costs have encouraged firms to prioritize liquidity preservation and operational cash generation. Companies with strong operating cash flows are better positioned to finance daily operations, service debt, and absorb payment delays without immediately falling into financial distress.

This condition is closely related to the role of the government as the dominant project owner in the infrastructure sector. As highlighted in the introduction through fiscal budget data, infrastructure firms are highly dependent on the smooth disbursement of government project installments. Delays in payment realization can directly disrupt operating cash flow, regardless of accounting profitability. Therefore, operating cash flow captures the actual operational reality faced by infrastructure firms more accurately than net income, reinforcing its role as a key determinant of financial distress. From a theoretical perspective, this result supports signaling theory, where strong operating cash flow sends a positive signal regarding a firm's operational strength and financial resilience. Firms that are able to consistently generate cash from core activities signal lower default risk to creditors and investors, thereby reducing the likelihood of financial distress. This explains why operating cash flow emerges as a dominant factor in explaining distress in infrastructure firms compared to accrual-based

measures. Although prior studies report mixed findings across sectors, the negative relationship identified in this study underscores the sector-specific nature of financial distress determinants. In infrastructure companies, cash realization from long-term projects is critical, making operating cash flow a more relevant and reliable indicator of financial stability.

Solvency has a negative effect on Financial Distress

The results also show that solvency has a negative and significant effect on financial distress. In this study, financial distress is measured using the Altman Z-Score, where a higher Z-score indicates a healthier firm condition. The negative coefficient of solvency (measured as debt to assets) implies that an increase in debt relative to assets reduces the Z-score, thereby increasing the risk of financial distress. This interpretation confirms that higher leverage weakens the firm's financial condition and moves it closer to distress. It is crucial to clarify this directional relationship to avoid misinterpretation. A higher solvency ratio in the form of increased debt burden does not reflect financial strength; instead, it increases financial pressure by raising fixed obligations in the form of interest and principal repayments. As debt increases, the Z-score declines, signaling a deterioration in financial health and a higher probability of distress. This finding is particularly relevant for infrastructure projects, which are characterized by long project completion periods, delayed revenue realization, and heavy upfront financing requirements. When debt levels are excessive, firms become vulnerable to liquidity shocks arising from project delays, cost overruns, or postponed payments from project owners. In such circumstances, high leverage amplifies financial risk and accelerates the transition toward distress. From an agency theory perspective, excessive leverage may also constrain managerial flexibility and increase pressure to prioritize short-term financial commitments over long-term project efficiency. While moderate debt can discipline management, excessive reliance on debt financing in long-term infrastructure projects increases exposure to refinancing risk and interest rate fluctuations, thereby elevating financial distress risk. Unlike operating cash flow, which reflects real-time operational capability, solvency captures the structural financing risk embedded in long-term capital decisions. The negative effect of solvency on financial distress therefore highlights that in infrastructure firms, financial sustainability depends not only on project profitability but also on prudent debt management aligned with long project horizons.

CONCLUSIONS

This study investigates the effect of operating cash flow and solvency on financial distress among Indonesian infrastructure firms listed on the Indonesia Stock Exchange during the 2022–2024 period. The results indicate that the financial health of infrastructure companies is strongly influenced by liquidity conditions and capital structure management. Operating cash flow plays a critical role in reducing financial distress, as it reflects a firm's ability to sustain operations and meet obligations amid long project cycles and delayed cash inflows. In contrast, high leverage increases distress risk, highlighting the vulnerability of infrastructure firms to rigid debt commitments that are not always aligned with cash realization. These findings emphasize the sector-specific nature of financial distress in infrastructure companies and suggest that effective cash flow management and prudent debt policies are essential for strengthening financial resilience, particularly in the context of government-led infrastructure development.

For financial managers in infrastructure companies, the findings suggest the need to maintain conservative leverage and strong operating cash flow to remain within the safe zone of the Altman Z-Score. Given the sector's long project cycles and delayed cash inflows, firms should avoid excessive reliance on debt financing and align debt maturities with project completion timelines. Maintaining moderate debt-to-asset ratios and stable operating cash flow sufficient to cover debt servicing obligations is essential to reducing the risk of financial distress. For regulators such as OJK and BEI, the results imply the importance of strengthening early warning systems by integrating Altman Z-Score indicators, operating cash flow metrics, and solvency thresholds into routine monitoring of infrastructure firms. Enhanced disclosure related to debt structure, cash flow sustainability, and project payment schedules would further improve market transparency. Future research should focus on incorporating macroeconomic variables, including interest rates, inflation, and government infrastructure spending, to better capture external risks affecting financial distress in the infrastructure sector.

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