

Analysis Of The Application Of The Altman Z-Score And Zmijewski Models In Measuring The Potential For Financial Distress In State-Owned Construction Companies Listed On The IDX (Pre- And Post-Covid)

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Abstract

State-owned construction companies are capital-intensive, project-based, and rely on relatively large amounts of financing, making them vulnerable to financial pressure when project cash flows weaken. This study aims to analyze the potential for financial distress at PT Adhi Karya (Persero) Tbk., PT Waskita Karya (Persero) Tbk., PT Wijaya Karya (Persero) Tbk., and PT Pembangunan Perumahan (Persero) Tbk. during 2017–2024 using the modified Altman Z-Score and Zmijewski X-Score models; describe score dynamics over time; and verify score differences between the pre-pandemic, pandemic, and post-pandemic COVID-19 periods. The study employs a quantitative descriptive and comparative approach using secondary data from annual financial statements. The analysis involves calculating the ratios underlying both models, classifying scores, analyzing trends, and conducting the Kruskal–Wallis test. The results show that Altman Z-Score classifications are dominated by the grey and distress zones, with only a few observations in the safe zone. In contrast, Zmijewski produces more varied classifications across companies: PT Pembangunan Perumahan consistently falls into the safe category, while PT Adhi Karya and PT Waskita Karya are more frequently classified as distressed. Overall, Zmijewski scores across the 32 observations are relatively balanced between distress and non-distress. Trend analysis shows a marked decline in Altman scores during the pandemic, followed by gradual recovery. The Kruskal–Wallis test indicates significant differences between periods using Altman Z-Score, but no significant differences using Zmijewski. The findings suggest that the two models capture different dimensions of financial condition, making their complementary use more informative for understanding financial distress dynamics.

Keywords

Financial Distress; Altman Z-Score; Zmijewski; State-Owned Construction Companies; Trend Analysis



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INTRODUCTION

The construction sector is one of the strategic sectors in Indonesia's economy because it plays a role in providing infrastructure, connectivity, and development activities. Statistics Indonesia shows that the construction sector consistently contributes more than 10% to Gross Domestic Product, with its contribution reaching approximately 10.54% in 2023 (Badan Pusat Statistik, 2024). This position makes the sustainability of construction companies important not only to shareholders but also to the continuity of development activities. The project-based and long-term characteristics of the industry, its substantial working capital requirements, and its complex supply chains mean that construction companies face relatively high revenue and cash-flow uncertainty (Fellows et al., 2002; Myers, 2004).

In state-owned construction companies, these characteristics interact with their strategic role in implementing large-scale development projects. Project financing needs may encourage the use of substantial liabilities. From a financial perspective, a funding structure that increasingly relies on debt makes companies more sensitive to interest expenses, refinancing needs, and disruptions to operating cash flow (Ross et al., 2022). Pecking Order Theory explains that companies tend to use internal funding sources first and then turn to external financing, particularly debt, when internal funds are insufficient. For construction companies that require substantial capital at the beginning of projects, this tendency can increase leverage while also intensifying financial pressure when project payments are delayed.

Financial distress is a condition of declining financial health that emerges before bankruptcy. Hidayat (2024) explains financial distress as a situation in which a company experiences financial difficulties that may serve as an early indicator of bankruptcy. Sumarni (2022) regards financial distress as an important stage requiring management action before a company reaches bankruptcy. Relevant indicators include profitability, liquidity, leverage, solvency, earnings, and cash-flow coverage ratios, which are often used to detect signs of financial pressure (Hidayat, 2024; Sumarni, 2022). Therefore, identifying potential distress before financial failure is important as an early-warning mechanism.

Financial pressure on Indonesian construction companies became increasingly relevant during the COVID-19 pandemic. Mobility restrictions, supply-chain disruptions, and adjustments to project implementation affected construction activities and corporate cash flows (Kamiludin & Roy, 2022). Budiman (2023) highlighted the importance of financial ratios in assessing financial distress among construction companies during the PSBB-PPKM period. Kristanti et al. (2023) also

showed that Indonesian construction companies faced distress issues associated with their financial characteristics. These conditions reinforce the need for analysis that not only captures a single year's condition but also assesses changes before, during, and after the pandemic.

Two widely used models for identifying potential financial distress are the Altman Z-Score and Zmijewski models. The Altman Z-Score combines working capital, retained earnings, EBIT, and capital structure ratios into a composite score. In its modified version, the Altman model uses four ratios, allowing it to be applied to a wider range of companies (Abadi & Misidawati, 2023; Rohmah, 2021). The Zmijewski model uses three main ratios: Return on Assets, Debt Ratio, and Current Ratio. Differences in these components may cause the two models to produce different classifications for the same company.

Previous studies have reported varying results across models. Edi and Tania (2018) found that both Altman and Zmijewski can be used to predict financial distress, although their sensitivity differs. Ulfah and Moin (2022) showed that classifications may differ for companies in certain sectors when Altman, Springate, and Zmijewski are applied simultaneously. Chua and Rustam (2023) likewise found that Altman, Zmijewski, and Springate may produce signals that are not always identical. In the context of the pandemic, Saadah and Salta (2021) and Regita et al. (2024) showed changes in the financial conditions of construction and property companies that can be captured through bankruptcy prediction models. Hayat et al. (2025) again demonstrated variations in classifications across models and the importance of statistical tests when prediction models are used to compare group conditions.

The research gap underlying this article is the need for a longer observation period for state-owned construction companies, particularly to capture changes in financial conditions across three phases: pre-pandemic (2017–2019), pandemic (2020–2021), and post-pandemic (2022–2024). This study does not aim to determine which model is the most accurate, but rather to use the Altman Z-Score and Zmijewski models complementarily. This approach allows classifications to be interpreted alongside changes in financial components and annual trends.

The Altman Z-Score was developed as a corporate-failure classification model based on a combination of financial ratios. Its development includes the original, revised, and modified models. The modified version is considered more flexible because it uses four ratios and excludes the sales-to-assets ratio and

market value of equity (Abadi & Misidawati, 2023; Sitorus & Yulita, 2023). This study uses the following modified form:

$$Z'' = 6,56X_1 + 3,26X_2 + 6,72X_3 + 1,05X_4$$

X₁ is Working Capital to Total Assets, calculated as (current assets – current liabilities) divided by total assets. This ratio reflects the adequacy of working capital relative to the company's asset size. X₂ is Retained Earnings to Total Assets, calculated as retained earnings divided by total assets. This ratio represents the accumulation of internal operating results and the company's capacity to finance growth from past earnings. X₃ is EBIT to Total Assets, calculated as earnings before interest and taxes divided by total assets. This ratio indicates the ability of assets to generate operating profit. X₄ is Book Value of Equity to Total Liabilities, calculated as the book value of equity divided by total liabilities. This ratio reflects the strength of the capital structure in covering obligations.

The score is interpreted using three zones. A Z-score > 2.60 is classified as the safe zone; 1.10 < Z < 2.60 is the grey zone; and Z < 1.10 is the distress zone (Abadi & Misidawati, 2023). The grey zone is important because it indicates a condition that cannot be definitively classified as either safe or distressed.

The Zmijewski model combines profitability, leverage, and liquidity ratios. It is relatively simple because it uses three variables representing Return on Assets, Debt Ratio, and Current Ratio. The score used in this study is:

$$X = -4,3 - 4,5X_1 + 5,72X_2 - 0,004X_3$$

X₁ is Return on Assets (net income/total assets); X₂ is Debt Ratio (total liabilities/total assets); and X₃ is Current Ratio (current assets/current liabilities).

The classification criteria use zero as the cutoff. X < 0 indicates that a company is not potentially experiencing financial distress, whereas X > 0 indicates potential financial distress (Sumarni, 2022). Because the signs and weights of the variables differ from those in Altman, the interpretation also differs: a more negative Zmijewski score generally indicates a safer condition, while an increase toward a positive value indicates rising financial pressure.

METHODS

This study uses a quantitative descriptive and comparative approach. The descriptive approach is used to describe financial distress based on score values, while the comparative approach compares scores across three observation periods (Sahir, 2022; Sugiyono, 2023). The study is not designed to test causal relationships. The research objects are the four parent state-owned construction companies listed

on the Indonesia Stock Exchange: PT Adhi Karya (Persero) Tbk. (ADHI), PT Waskita Karya (Persero) Tbk. (WSKT), PT Wijaya Karya (Persero) Tbk. (WIKA), and PT Pembangunan Perumahan (Persero) Tbk. (PTPP). The entire population was used as the sample (saturated sampling), resulting in 32 company-year observations.

The data are secondary data comprising annual statements of financial position and income statements for 2017–2024. The data components include current assets, total assets, current liabilities, total liabilities, book value of equity, retained earnings, EBIT, and net income. Data were obtained from companies' financial statement documents and publications of the Indonesia Stock Exchange, as used in the original final project. Data processing involved collecting and classifying data, calculating the ratios used in each model, calculating scores, classifying zones, analyzing trends, grouping periods, and conducting the Kruskal–Wallis test. The pre-pandemic period was defined as 2017–2019, the pandemic period as 2020–2021, and the post-pandemic period as 2022–2024.

The original study used a normality test as the basis for selecting a non-parametric test. Because the number of observations in each group was limited and the test results indicated the use of a non-parametric method, differences were verified using the Kruskal–Wallis test at a 5% significance level. Statistical decisions were based on the p-value: $p < 0.05$ indicates a significant difference between periods, whereas $p \geq 0.05$ indicates insufficient evidence to conclude that a significant difference exists.

Table 1. Formulas and Criteria for Measuring Financial Distress

Model	Equation	Criteria
Modified Altman Z-Score	$Z = 6,56X_1 + 3,26X_2 + 6,72X_3 + 1,05X_4$	$Z > 2.60$: Safe; $1.10 < Z < 2.60$: Grey; $Z < 1.10$: Distress
Zmijewski X-Score	$X = -4,3 - 4,5X_1 + 5,72X_2 - 0,004X_3$	$X < 0$: Not potentially distressed; $X > 0$: Potentially distressed

FINDINGS AND DISCUSSION

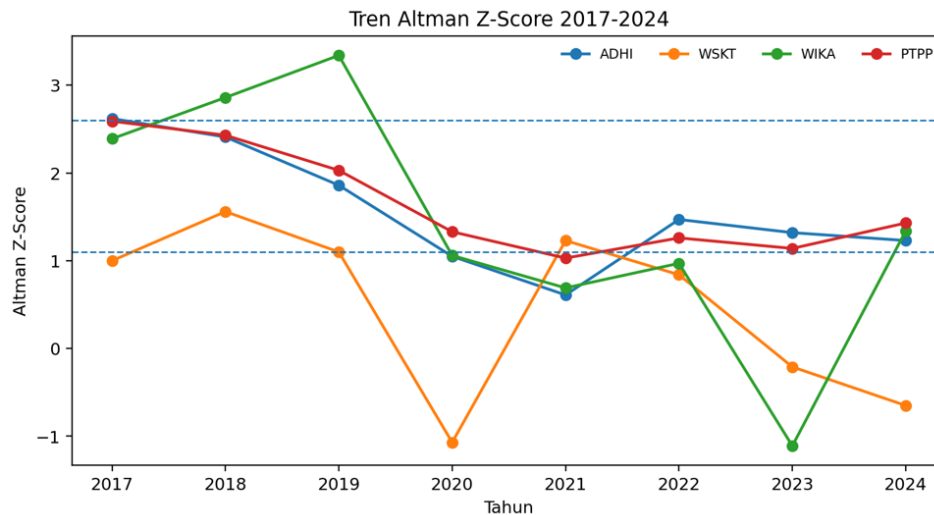
The Altman Z-Score calculations show that the financial conditions of the four state-owned construction companies changed considerably throughout the study period. Of the 32 observations, the Altman classifications comprised 3 safe-zone observations, 17 grey-zone observations, and 12 distress-zone observations. The dominance of the grey and distress zones indicates that most observations did not consistently fall within the safe range.

Table 2. Altman Z-Score Calculation Results

Year	ADHI Z	Classification	WSKT Z	Classification	WIKI Z	Classification	PTPP Z	Classification
2017	2.62	Safe	1.00	Distress	2.39	Grey	2.59	Grey
2018	2.41	Grey	1.56	Grey	2.86	Safe	2.43	Grey
2019	1.86	Grey	1.10	Grey	3.34	Safe	2.03	Grey
2020	1.05	Distress	-1.07	Distress	1.06	Distress	1.33	Grey
2021	0.61	Distress	1.23	Grey	0.69	Distress	1.03	Distress
2022	1.47	Grey	0.84	Distress	0.97	Distress	1.26	Grey
2023	1.32	Grey	-0.21	Distress	-1.11	Distress	1.14	Grey

Year	ADHI Z	Classification	WSKT Z	Classification	WIKI Z	Classification	PTPP Z	Classification
2024	1.23	Grey	-0.65	Distress	1.34	Grey	1.43	Grey

Figure 1. Altman Z-Score trends for the four companies, 2017–2024



The companies exhibit different patterns. ADHI was in the safe zone in 2017, declined to the grey zone in 2018–2019, entered the distress zone in 2020–2021, and returned to the grey zone in 2022–2024. This pattern is consistent with changes in working-capital pressure, operating profitability, and capital structure discussed in the final project. ADHI's lowest value occurred in 2021 at 0.61, while its recovery to 1.23 in 2024 was insufficient to return to the safe zone.

According to Altman, WSKT showed the most persistent position in the vulnerable zones. Of its eight observations, five were in the distress zone and three in the grey zone; none were in the safe zone. After improving in 2018–2019, its score returned to distress in 2020, briefly rose to 1.23 in 2021, and then fell to 0.84 in 2022, -0.21 in 2023, and -0.65 in 2024. This pattern indicates that the annual improvements did not develop into a stable recovery.

WIKI showed the largest changes between classifications. It was in the grey zone in 2017, the safe zone in 2018–2019, the distress zone in 2020–2021 and 2022–2023, and then returned to the grey zone in 2024. Its lowest point occurred in 2023 at -1.11, when retained earnings and EBIT were both negative. The increase to 1.34 in 2024 indicates recovery from distress to the grey zone, but not to the safe threshold.

PTPP was relatively more stable than the other three companies, although it still weakened in 2021. Seven of its eight observations were in the grey zone, while one observation—in 2021, with a score of 1.03—was in the distress zone. The decline before and during the pandemic was mainly associated with weaker EBIT relative to assets and a decrease in working capital relative to total assets. In 2022–2024, its score returned to the grey zone and remained relatively stable.

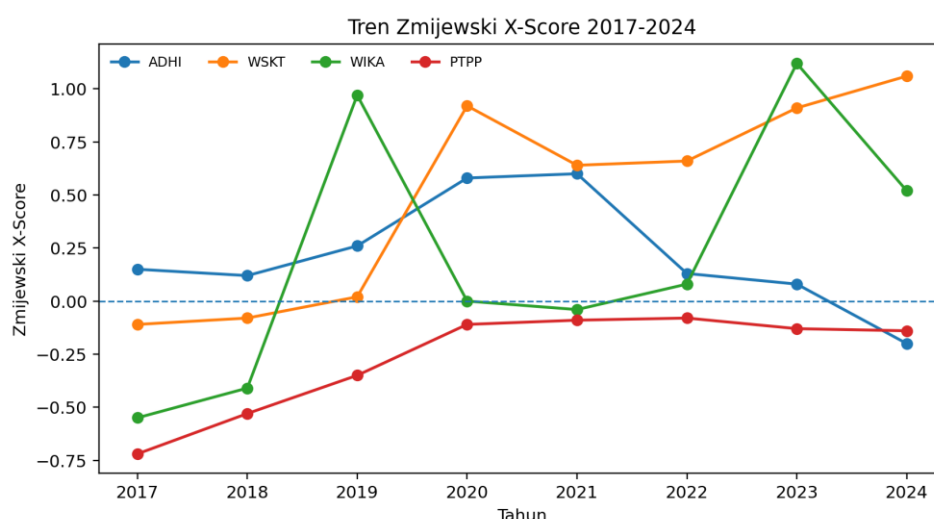
The Zmijewski model produced a different classification pattern. Of the 32 observations, 17 were classified as distress and 15 as not potentially distressed. Thus, in

aggregate, the Zmijewski results did not show a strong dominance of either category. The main differences appeared across companies: PTPP consistently remained below zero, while ADHI, WSKT, and WIKA showed varying levels of pressure.

Table 3. Zmijewski Model Calculation Results

Year	ADHI X	Classification	WSKT X	Classification	WIKI X	Classification	PTPP X	Classification
2017	0.15	Distress	-0.11	Safe	-0.55	Safe	-0.72	Safe
2018	0.12	Distress	-0.08	Safe	-0.41	Safe	-0.53	Safe
2019	0.26	Distress	0.02	Distress	0.97	Distress	-0.35	Safe
2020	0.58	Distress	0.92	Distress	0.00	Safe	-0.11	Safe
2021	0.60	Distress	0.64	Distress	-0.04	Safe	-0.09	Safe
2022	0.13	Distress	0.66	Distress	0.08	Distress	-0.08	Safe
2023	0.08	Distress	0.91	Distress	1.12	Distress	-0.13	Safe
2024	-0.20	Safe	1.06	Distress	0.52	Distress	-0.14	Safe

Figure 2. Zmijewski X-Score trends for the four companies, 2017–2024



ADHI was classified as distressed from 2017 through 2023, then moved into the safe category in 2024. The increase in its X-Score to 0.60 in 2021 was mainly associated with a decline in net income and an increase in the proportion of liabilities to assets. The decline to -0.20 in 2024 indicates simultaneous improvements in profitability and liability structure, while liquidity remained relatively stable. Thus, for ADHI, Zmijewski highlights the combination of low profitability and high leverage during periods of pressure.

WSKT was classified as safe only in 2017–2018 and as distressed throughout 2019–2024. Its score rose from -0.11 in 2017 to 1.06 in 2024. This pattern indicates continuing pressure, mainly due to a combination of negative net income in most years, a high ratio of liabilities to assets, and changes in liquidity. This result aligns with the Altman classification, which also indicates prolonged distress.

WIKI was classified as safe in 2017–2018 and 2020–2021, then changed to distress in 2019 and 2022–2024. Its worst point occurred in 2023, with an X-Score of 1.12, when net income was substantially negative and retained earnings were also negative. The increase to 0.52 in 2024 indicates improvement, but did not return the company to the safe category. Unlike WSKT, WIKI's Zmijewski results were more volatile.

PTPP consistently remained in the safe category throughout 2017–2024, with its lowest score of -0.72 in 2017 and highest score of -0.08 in 2022. Although net income and ROA weakened during the pandemic, the Debt Ratio and Current Ratio still produced a negative combined score. This explains why PTPP appears more stable under Zmijewski than under Altman, which placed it in the grey zone and once in the distress zone.

Differences in classification do not mean that either model is invalid. The two models are built from different financial-ratio components. Altman places substantial weight on working capital relative to assets, retained earnings, the ability to generate EBIT, and the strength of equity relative to liabilities. Zmijewski uses ROA, Debt Ratio, and Current Ratio more directly. Therefore, a company may maintain adequate short-term liquidity and still produce a negative Zmijewski score, while also having relatively low working capital or weakened operating capacity that places its Altman score in the grey or distress zone.

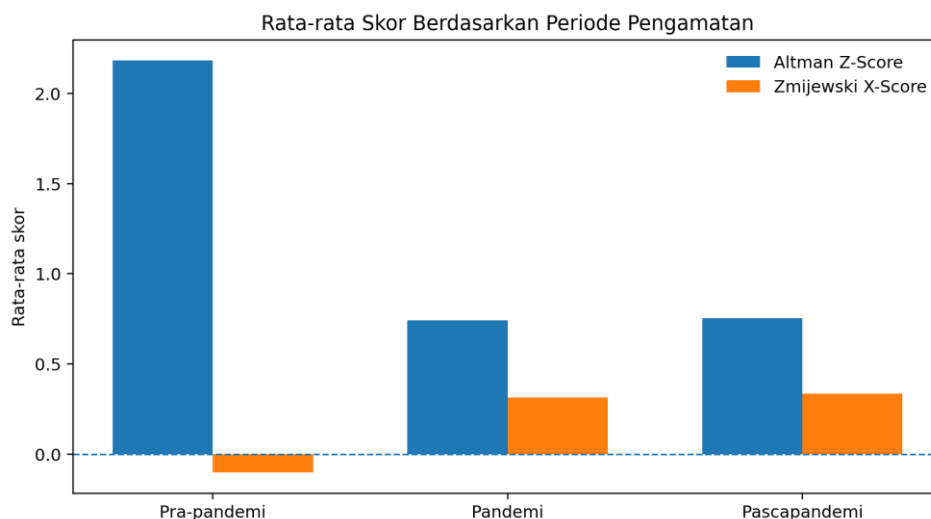
Table 4. Comparison of Altman Z-Score and Zmijewski Test Results

Code	Company	Altman Safe	Altman Grey	Altman Distress	Zmijewski Safe	Zmijewski Distress	Average Altman	Average Zmijewski
ADHI	Adhi Karya	1	5	2	1	7	1.57	0.21
WSKT	Waskita Karya	0	3	5	2	6	0.48	0.50
WIKA	Wijaya Karya	2	2	4	4	4	1.44	0.21
PTPP	Pembangunan Perumahan	0	7	1	8	0	1.65	-0.27
Total	32 observations	3	17	12	15	17	1.29	0.16

PTPP clearly illustrates this difference. According to Altman, the company was in the grey zone for most of the period and briefly entered distress in 2021. Under Zmijewski, however, all scores remained negative. Analytically, this indicates that declines in EBIT and working capital relative to assets are captured more strongly by Altman, while stable Debt Ratio and Current Ratio values keep the X-Score below zero. A similar interpretation applies to ADHI and WIKA, although the direction and magnitude of their changes differ.

In aggregate, the average Altman score declined from 2.18 in the pre-pandemic period to 0.74 during the pandemic, then stood at 0.75 in the post-pandemic period. The largest decline occurred during 2020–2021, while the recovery in 2022–2024 did not restore the aggregate score to its pre-pandemic level. This result indicates that financial pressure on state-owned construction companies did not fully disappear after the pandemic ended.

Figure 3. Average scores by observation phase



The Zmijewski pattern differed. The aggregate average moved from -0.10 before the pandemic to 0.31 during the pandemic and 0.33 after the pandemic. The increase indicates rising pressure according to the Zmijewski scale, but the change was not uniform across companies. PTPP remained consistently negative, while WSKT showed a sustained increase into positive values and ADHI began to decline toward the end of the period. Thus, aggregation conceals company-level heterogeneity, making analysis of individual companies necessary.

The Kruskal–Wallis test was then conducted on 32 score observations grouped into 12 pre-pandemic observations, 8 pandemic observations, and 12 post-pandemic observations. For the Altman model, $H = 15.188$, $df = 2$, and $p < 0.001$ indicate a significant difference between periods. The pre-pandemic mean rank of 24.75 was the highest, followed by 12.54 post-pandemic and 10.06 during the pandemic. These results are consistent with the decline in Altman scores in 2020–2021 and the partial recovery thereafter.

Table 5. Kruskal–Wallis Test Results

Model	H	df	p-value	Pre-pandemic Mean Rank	Pandemic Mean Rank	Post-pandemic Mean Rank	Conclusion
Altman Z-Score	15,188	2	<0,001	24,75	10,06	12,54	Significantly different
Zmijewski X-Score	4,259	2	0,119	12,08	19,19	19,13	No significant difference

For the Zmijewski model, $H = 4.259$, $df = 2$, and $p = 0.119$, which is greater than 0.05 . Therefore, there is insufficient evidence to conclude that the distribution of Zmijewski scores differed significantly across periods. The mean ranks for the pandemic (19.19) and post-pandemic (19.13) periods were higher than the pre-pandemic mean rank (12.08), but the difference was not statistically significant. The differing statistical results reinforce the descriptive findings. Altman more clearly captures changes across periods because it simultaneously incorporates working capital, retained earnings, EBIT, and equity strength relative to liabilities. Zmijewski, meanwhile, incorporates ROA, Debt Ratio, and Current Ratio. Heterogeneity across companies means that changes in Zmijewski scores at the group level did not produce a statistically significant difference. In other words, the statistical test

was not used to determine which model is superior, but to assess whether descriptively observed changes were also evident at the level of period groups.

CONCLUSION

First, applying the modified Altman Z-Score shows that the conditions of the four state-owned construction companies in 2017–2024 were dominated by the grey and distress zones. Of the 32 observations, 3 were safe, 17 grey, and 12 distressed. WSKT had the highest proportion of distress observations, while PTPP was most often in the grey zone and entered distress only once. ADHI and WIKA showed more fluctuating patterns.

Second, the Zmijewski model produced different results. Of the 32 observations, 15 had negative scores and 17 had positive scores. PTPP consistently remained below zero, ADHI moved into the safe category in 2024, WSKT remained relatively consistently distressed from 2019, and WIKA showed a more fluctuating pattern. This difference indicates that profitability, leverage, and liquidity—the components of Zmijewski—provide a perspective that does not always match the combination of ratios used by Altman.

Third, trend analysis shows that Altman scores declined sharply during the pandemic and partially recovered in 2022–2024. The average Altman score fell from 2.18 before the pandemic to 0.74 during the pandemic and 0.75 after it. The average Zmijewski score moved from -0.10 to 0.31 and 0.33, respectively, but patterns differed across companies.

Fourth, the Kruskal–Wallis test showed a significant difference in Altman scores across periods ($H = 15.188$; $p < 0.001$), but no significant difference in Zmijewski scores ($H = 4.259$; $p = 0.119$). These results support the complementary use of both models. Altman provides a clearer signal of changes across periods in the study observations, whereas Zmijewski more clearly reflects heterogeneous differences between companies.

The practical implication is that financial conditions should be monitored regularly using more than one predictive indicator, particularly for construction companies with high working-capital needs and long project cash-flow cycles. Management can use score changes as an early-warning signal and relate them to working-capital policies, liability structure, operating profitability, and liquidity. Future research could extend the observation period, add models such as Springate, Grover, or Ohlson, and test factors contributing to financial distress using inferential approaches.

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