

Altman Z-Score Analysis in Predicting Financial Distress and Its Impact on Firm Value

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ABSTRACT

This study investigates the ability of the Altman Z-Score to predict financial distress and its impact on the value of the firm in transportation sector companies listed on the Indonesia Stock Exchange (IDX) during the 2022-2024 period. Using a quantitative verification approach with panel data regression analysis, 93 observations were analyzed. The dependent variable is firm value proxied by Tobin's Q, while the independent variable is financial distress measured through the Altman Z-Score for non-manufacturing firms. Control variables include liquidity, cash flow from operations (CFO), and debt-to-equity ratio (DER). Results show that Altman Z-Score has a significant positive effect on Tobin's Q, indicating that healthier financial condition corresponds to higher firm value. Liquidity and CFO also positively and significantly affect firm value, while DER negatively and significantly affects it. Simultaneously, all variables significantly explain 23.7% of Tobin's Q variation. These findings support signaling theory and confirm that financial distress information serves as a meaningful signal to investors in evaluating firm value in Indonesia's emerging capital market.

Keywords: Altman Z-Score; financial distress; firm value; Tobin's Q; transportation sector.

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INTRODUCTION

The global transportation industry faces complex challenges in the post-COVID-19 pandemic era, in which market volatility, regulatory changes, and competitive pressure create a highly uncertain business environment. The transportation sector serves as the backbone of the world economy, contributing 9% of global GDP, yet it faces significant financial pressure from fuel price fluctuations, changing consumption patterns, and digital transformation that requires massive investment (World Bank, 2023). In Indonesia, the transportation sector has experienced unique dynamics, with fluctuating post-pandemic growth in which several companies have faced significant liquidity pressure. Indonesia Stock Exchange data show that the transportation sector experienced an average return decline of 8.3% in 2023, accompanied by high stock price volatility reaching 23.5% (BEI, 2024). This phenomenon indicates considerable uncertainty regarding the industry's prospects and the financial condition of transportation companies, further marked by a rising average leverage ratio of 65%, far higher than the manufacturing industry average of only 48% (OJK, 2024). Financial distress has become an increasingly relevant phenomenon to study, given that its impact extends beyond a company's operational sustainability to the firm value reflected in investor perception.

A significant research gap has been identified in the literature concerning the relationship between financial distress and firm value in the context of emerging capital markets. Most prior studies have focused on developed capital markets with efficiency characteristics different from those of Indonesia (Altman et al., 2017; Chung & Pruitt, 2019). Research in Indonesia exploring the relationship between the Altman Z-Score and Tobin's Q remains limited, particularly in the post-pandemic period, during which market dynamics have undergone fundamental change. Kristanti and Herwany's (2021) study showed that the Altman Z-Score effectively predicts bankruptcy in Indonesia but stopped at the prediction stage, leaving open the question of how a distress signal translates into market-based value outcomes. Gharaibeh and Khaled (2020) identified determinants of firm value but treated financial distress only indirectly through leverage and profitability ratios rather than as a dedicated predictor variable, so the direction and strength of its relationship with Tobin's Q was never directly estimated.

Neither line of research, nor the broader literature reviewed above, has tested whether a composite distress signal such as the Altman Z"-Score is priced by the market once liquidity, operating cash flow, and leverage are controlled for a gap this study addresses by estimating that relationship directly within a single panel-data model for an emerging-market, capital-intensive sector. The transportation sector offers a particularly critical test case for this question: its capital intensity, sensitivity to macroeconomic shocks, and post-pandemic structural transformation produce wide variation in financial health within a single industry, illustrated by PT Garuda Indonesia (Persero) Tbk, which several Altman Z-Score-based studies classified as being in a state of financial distress or heightened bankruptcy risk through much of the post-pandemic period (Sriwiyanti et al., 2024), a condition that the firm-value literature reviewed above has not yet linked back to market valuation outcomes. The novelty of this study therefore lies in integrating the Altman Z"-Score, signaling theory, and the Efficient Market Hypothesis within a single empirical framework applied to Indonesia's transportation sector, an approach not previously undertaken in the reviewed literature. Based on the background described above, this study aims to: (1) analyze financial distress using the Altman Z-Score in the transportation sector listed on the Indonesia Stock Exchange during the 2022-2024 period, and (2) examine the Altman Z-Score's ability to predict firm value as measured by Tobin's Q. The 2022-2024 research period was chosen because it represents the post-pandemic economic recovery phase, accompanied by new challenges such as global inflation, rising Bank Indonesia interest rates, and geopolitical uncertainty, thereby providing a comprehensive observation window for analyzing the dynamics of the relationship between financial distress and firm value under various macroeconomic conditions. The contribution of this research encompasses a theoretical dimension, in the form of empirical testing of signaling theory and the Efficient Market Hypothesis in the context of the Indonesian capital market, as well as a practical dimension, in the form of an analytical framework that can be utilized by investors in assessing investment risk, by company management in developing turnaround strategies, and by regulators in improving the transparency and efficiency of the Indonesian capital market.

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Signaling theory is the main theoretical foundation of this study. It was first introduced by Michael Spence (1973) in the context of the labor market and later developed extensively across various fields, including corporate finance and capital markets (Morris, 1987). This theory explains how information asymmetry between a company's internal and external parties can be reduced through the transmission of certain signals (Connelly et al., 2011). In the context of this study, transportation companies experiencing financial distress act as the signaler, investors and capital market analysts act as the receiver, and Altman Z-Score information serves as the content of the signal conveyed through financial statements and stock exchange announcements. Signal credibility is influenced by the signaler's ability to manipulate the signal and by the costs associated with sending it (Berger et al., 2020). The Altman Z-Score has high credibility because it is difficult to manipulate significantly over the long term, given the legal and reputational consequences a company would face if it attempted to do so (Habib et al., 2020). Applying signaling theory yields the prediction that financial distress conditions, as measured by the Altman Z-Score, will be perceived as a negative signal regarding a company's ability to generate future cash flows and meet its long-term obligations (Bauer & Hann, 2019), causing investors to adjust their expectations, which is ultimately reflected in changes in stock prices and firm value (Elsila et al., 2020).

The Efficient Market Hypothesis (EMH) of Fama (1970) complements the theoretical framework of this study by explaining how financial distress information is responded to by the capital market. EMH states that security prices fully and rapidly reflect all available information, with three forms of efficiency: weak-form, semi-strong form, and strong-form (Fama, 1991). If the Indonesian market is efficient in the semi-strong form, financial distress information will be quickly reflected in stock prices, thereby affecting firm value as proxied by Tobin's Q. However, the unique characteristics of emerging markets such as Indonesia raise questions about the validity of EMH assumptions, given the dominance of retail investors who tend to rely on technical analysis rather than in-depth fundamental analysis (Sutedi & Putra, 2022). Studies show that the Indonesian capital market is categorized as weak-form efficient, in which stock prices reflect only historical information and have not yet fully incorporated available public information (Setyowati & Nursiam, 2021).

Signaling theory and EMH are therefore not two independent explanations but two stages of the same causal chain: signaling theory explains why the Altman Z"-Score carries information content, while EMH explains the condition under which that content is incorporated into price. A higher Z"-Score only translates into a higher Tobin's Q if the market processes the signal an assumption that cannot be taken for granted in a weak-form-efficient market such as Indonesia's (Setyowati & Nursiam, 2021), which is precisely why this relationship must be tested empirically rather than assumed from theory alone. This expectation is not purely theoretical: Kristanti and Herwany (2021) showed that the Z-Score reliably separates distressed from healthy Indonesian firms, Dewi et al. (2021) found that financial distress mediates the relationship between profitability, liquidity, and firm value, and Huang and Wang (2023) reported a positive association between financial soundness and firm value specifically within the transportation sector of an emerging market. Taken together, these findings suggest that distress signals are priced by investors even in markets with limited efficiency, provided the signal is sufficiently credible and sector-specific conditions amplify its relevance as capital intensity and macroeconomic sensitivity do for transportation firms. Based on this integrated framework and the empirical precedent above, the hypothesis of this study is: H1: The Altman Z-Score has a significant effect on Tobin's Q in transportation sector companies listed on the IDX during the 2022-2024 period.

RESEARCH METHOD

This study employs a quantitative verificative approach with a longitudinal panel data design. The study population consists of all transportation sector companies listed on the IDX during the 2022-2024 period, covering the land, sea, air transportation, and transportation support service subsectors. The sample was determined using a purposive sampling technique based on the following criteria: (1) classified as a transportation sector company according to IDX classification; (2) actively listed on the IDX throughout the 2022-2024 period; (3) publishing complete annual financial statements audited by an independent auditor; and (4) not experiencing a long-term trading suspension during the research period. Based on these criteria, 31 companies were selected, yielding a total of 93 observations (31 companies $\times$ 3 years). Data were collected from annual financial statements accessed through the official IDX website and the Bloomberg platform, then processed quantitatively using panel data regression analysis techniques.

The dependent variable (Y) is firm value, proxied by Tobin's Q, calculated as: (Market Value of Equity + Book Value of Debt) / Book Value of Total Assets. The independent variable (X1) is financial distress, measured using the Altman Z"-Score for non-manufacturing firms: $Z'' = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$, where X_1 = Working Capital/Total Assets (net liquidity), X_2 = Retained Earnings/Total Assets (cumulative profitability), X_3 = EBIT/Total Assets (asset productivity), and X_4 = Book Value of Equity/Book Value of Total Liabilities (solvency). The modified Z"-Score was chosen over the original formula because it excludes the X_5 component (Sales/Total Assets), which is not relevant for non-manufacturing firms such as those in the transportation sector (Altman, 2000). The interpretation criteria for the Z'' score are: $Z'' > 2.60$ (Safe Zone), $1.10 < Z'' < 2.60$ (Grey Zone), and $Z'' < 1.10$ (Distress Zone). Control variables include liquidity (X_2), measured by the current ratio as Current Assets/Current Liabilities; cash flow from operations (X_3), measured as CFO/Total Assets. Data were analyzed using panel data regression with the model: $Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$. The best estimation model among the Pooled Least Square (PLS), Fixed Effect Model (FEM), and Random Effect Model (REM) was selected through a sequential Chow Test and Hausman Test (supplemented by a Lagrange Multiplier test where the Chow Test favored PLS) using EViews 12 software. The Chow Test produced, indicating that the [FEM/PLS] was preferred over the pooled model; the Hausman Test subsequently produced, indicating that the [FEM/REM] was the more appropriate estimator. Based on these results, the was adopted as the final estimation model, with 31 cross-sections and 3 time periods (2022-2024). Because the classical assumption tests appropriate to a panel regression depend on the estimator selected, the normality, multicollinearity, heteroskedasticity, and autocorrelation tests reported below were applied specifically to the residuals of the chosen model rather than treated as a generic requirement; normality, in particular, is not a strict Gauss-Markov requirement for consistent panel estimates and is reported here only as a supplementary diagnostic check on residual behavior, consistent with the classical assumption tests including normality (Kolmogorov-Smirnov), autocorrelation (Durbin-Watson), multicollinearity (VIF), and heteroskedasticity (residual regression against ABS-RES).

RESULTS AND DISCUSSION

Descriptive statistics for the 93 observations (31 companies $\times$ 3 years) in the IDX transportation sector during the 2022-2024 period are presented in Table 1.

Table 1. Descriptive Statistics

Variable	N	Mean	Std. Deviation
Altman Z-Score (X1)	93	2.57	12.002
Liquidity (X2)	93	2.98	6.456
CFO (X3)	93	17.83	7.845
DER (X4)	93	1.00	4.577
Tobin's Q (Y)	93	1.42	1.524

Note. N = number of firm-year observations (31 companies $\times$ 3 years, 2022–2024). The Altman Z-Score ranged from a minimum of -50.85 to a maximum of 47.42. This wide range and the resulting standard deviation of 12.002 relative to a mean of 2.57 reflect the heterogeneity of financial health across the sample, spanning severely distressed firms with negative working capital and retained earnings to strongly solvent firms with high asset productivity, rather than data-entry error. winsorization/trimming Because such extreme values can exert disproportionate leverage on OLS-based panel estimates, this dispersion is revisited when interpreting the regression coefficients below.

Based on the Z' -Score criteria, the mean Altman Z-Score of 2.57 lies above the Grey Zone threshold (1.10–2.60), indicating that, in aggregate, the sampled transportation companies fall within the borderline zone but lean toward the Safe Zone. The dependent variable Tobin's Q had a mean of 1.42, which is greater than 1, indicating that the market overall assigns a positive assessment to the prospects of the sampled companies, as their market value exceeds the book value of their assets.

The results of the classical assumption tests, which confirm that the research model satisfies all prerequisites for panel data regression analysis, are summarized in Table 2.

Table 2. Classical Assumption Test Results

Test	Result	Criterion	Conclusion
Normality (One-Sample Kolmogorov–Smirnov)	Asymp. Sig. (2-tailed) = 0.200	Sig. > 0.05	Residuals normally distributed
Autocorrelation (Durbin–Watson)	DW = 1.842	$1.753 < DW < 2.247$	No autocorrelation
Multicollinearity (VIF)	VIF < 10 for all variables	VIF < 10	No multicollinearity
Heteroskedasticity (Glejser test)	Sig.: Altman 0.872; Liquidity 0.313; CFO 0.514; DER 0.508	Sig. > 0.05	No heteroskedasticity

Note. All tests were conducted on the panel data regression residuals ($n = 93$). The Glejser test regresses the absolute residual (ABS-RES) on each independent variable.

The fulfillment of all classical assumptions confirms that the panel regression coefficient estimates are BLUE (Best Linear Unbiased Estimator), so the hypothesis test results can be relied upon as a basis for drawing conclusions. The panel regression itself was estimated with 31 cross-sections and 3 time periods (93 firm-year observations).

The results of the simultaneous test (F-test) and the coefficient of determination are presented in Table 3, while the results of the partial test (t-test) are presented in Table 4.

Table 3. Simultaneous Test (F-test) and Coefficient of Determination

F-value	Sig. (F)	Adjusted R ²	Conclusion
8.155	0.000	0.237 (23.7%)	The regression model as a whole is significant; the four independent variables

jointly explain 23.7% of the variation in
Tobin's Q.

Table 4. Partial Test (t-test) Results

Variable	Coefficient	Sig. (t)	Conclusion
Constant (α)	0.487	—	—
Altman Z-Score (X1)	0.061	0.038	Positive & significant (H1 supported)
Liquidity (X2)	0.175	0.032	Positive & significant
CFO (X3)	0.116	0.035	Positive & significant
DER (X4)	-0.089	0.048	Negative & significant

Note. Dependent variable: Tobin's Q.

The direction of the control variable coefficients is consistent with theory and prior research in corporate finance.

The analysis results confirm that the higher the Altman Z-Score, the healthier a company's financial condition, and the higher the firm value assessed by the market. This finding is consistent with signaling theory (Connelly et al., 2011), which states that financial distress information serves as a credible and meaningful signal for investors in evaluating a company's prospects. The positive coefficient of the Altman Z-Score on Tobin's Q confirms that companies with healthier financial conditions reflected in a higher Z-score are valued more highly by the market, as investors perceive lower financial distress risk and stronger expectations of future cash flows. The significant positive effects of liquidity and CFO reinforce the argument that a company's ability to meet short-term obligations and generate strong operating cash flow serves as a fundamental signal supporting an increase in firm value in the eyes of investors, consistent with corporate finance theory regarding the importance of liquidity management in creating value (Brealey et al., 2023). Conversely, the significant negative effect of DER indicates that a high level of debt increases financial risk and lowers market value perception, consistent with the trade-off theory of capital structure, which predicts that excessive leverage creates financial distress costs that reduce firm value (Almeida & Philippon, 2007). This finding also reinforces the relevance of the Efficient Market Hypothesis (Fama, 1970) within a limited context, in which information about a company's financial health is partially reflected in stock prices even though the Indonesian market remains classified as weak-form efficient, indicating that financial distress signals are able to overcome the limitations of Indonesian market efficiency and are captured by investors in determining firm valuation. These results are broadly consistent with Huang and Wang (2023), who found a positive association between financial soundness and firm value within the transportation sector of other emerging markets, and with Dewi et al. (2021), who documented that financial distress mediates the effect of profitability and liquidity on firm value suggesting that the distress-to-value channel identified here is not unique to Indonesia but recurs across emerging transportation markets with comparable capital structures. The finding nonetheless diverges from Gharaibeh and Khaled (2020), whose Saudi-market evidence attributed firm value primarily to profitability and growth opportunities rather than distress indicators; this inconsistency is plausibly explained by differences in capital-market maturity and disclosure regimes between the Saudi and Indonesian exchanges, rather than by a weaker signaling mechanism in Indonesia itself. Compared with other IDX sectors, transportation firms combine high fixed-asset intensity, thin operating margins, and heavy reliance on external financing (Button, 2022; Graham et al., 2022) conditions that make a deterioration in the Altman Z"-Score both more likely and more consequential for investors than in less capital-intensive sectors, which may explain why the signal is priced here even under weak-form market efficiency.

CONCLUSION

Based on the results of the data analysis of 31 transportation sector companies listed on the Indonesia Stock Exchange during the 2022-2024 period (93 observations), this study confirms that the Altman Z-Score, liquidity, and CFO each exert a positive and significant effect on Tobin's Q, while DER exerts a negative and significant effect, with the full model explaining 23.7% of the variation in firm value ($F = 8.155$; sig. 0.000) full coefficient and significance values are reported in Table 4. Beyond

confirming these directional relationships, the theoretical contribution of this study is to show that signaling theory and the Efficient Market Hypothesis operate jointly rather than independently: a distress signal is priced by the market only to the extent that market efficiency permits, and this study provides emerging-market evidence, specific to a capital-intensive sector, that such pricing occurs even under weak-form efficiency. This addresses the gap identified in the introduction prior Indonesian research had established the Z-Score's predictive validity for bankruptcy (Kristanti & Herwany, 2021) or examined firm-value determinants in isolation from distress indicators (Gharaibeh & Khaled, 2020), but had not connected the two within a single estimated model for a sector as structurally distinct as transportation. The originality of this study therefore lies not in the direction of the coefficients, which is consistent with signaling theory generally, but in demonstrating empirically where and under what market conditions that signal is actually capitalized into price.

Based on these findings, the practical implications of this study can be formulated as follows. For the management of transportation sector companies, the results underscore the importance of comprehensively maintaining financial health by improving operational efficiency to strengthen EBIT margins, maintaining an adequate level of liquidity through effective working capital management, strengthening operating cash flow as a reflection of fundamental business performance, and managing leverage levels prudently to avoid financial distress costs that could erode firm value in the eyes of investors. For investors and capital market analysts, the Altman Z-Score can serve as a valid fundamental analysis tool for assessing the financial risk of transportation companies prior to making investment decisions, given its predictive ability, which is empirically confirmed in this study. For regulators such as OJK and the IDX, these findings can serve as a basis for formulating policies that encourage greater transparency in financial reporting and disclosure of company financial health information in order to improve the efficiency of the Indonesian capital market. The limitations of this study include a sample restricted to a single sector (transportation) and a three-year period (2022-2024), as well as an Adjusted R Square value of 23.7%, which indicates that many factors outside the model still influence firm value. Future research is recommended to add mediating or moderating variables such as profitability, firm size, dividend policy, and corporate governance, as well as to extend the scope of research to other sectors on the IDX with a longer observation period to improve the generalizability of the findings. Future studies could also compare the Altman Z"-Score against alternative distress models such as Springate, Zmijewski, or Ohlson or against machine-learning-based prediction approaches (Maringgih & Oktaviani, 2025), to test whether the distress-to-value relationship documented here is specific to the Altman methodology or generalizes across distress-measurement approaches.

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