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Altman Z-Score and Zmijewski X-Score Models on Performance to Assess the Bankruptcy Risk of Mining Companies on IDX Indonesia 2018-2022

Tresya Nerotumilena* **and Jaka Winarna**
**Correspondence Author: nerotumilenatresya6@student.uns.ac.id*
Master of Accounting, Universitas Sebelas Maret, Jalan Insinyur Sutami Nomor 36A Kentingan Surakarta and 57126, Indonesia

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ABSTRACT

Financial Distress Analysis is a method used to assess the financial condition of a company. This information is crucial for the company and stakeholders in the decision-making process. This research aims to project the potential financial distress of mining companies listed on the Indonesia Stock Exchange during the 2018-2022 period, using the Altman Z-Score and Zmijewski X-Score methods on financial performance. The research applied quantitative methods, with a descriptive and a different test assessment. Data analysis was carried out using the calculation of Altman Z-Score and Zmijewski X-Score using SPSS version 27. The results showed that over five years, out of 31 mining companies, the X-Score model had a significant value of 0.00 < 0.05 on performance, indicating that this method is good for use in mining companies. In conclusion, investors are advised to consider these findings when making investment decisions in the mining sector experiencing financial distress.

Keywords: Altman Z-Score; Bankruptcy; Financial Distress; Zmijewski X-Score

INTRODUCTION

The mining industry plays an important role in Indonesia's economy, making a significant contribution to exports and employment. However, mining companies often face financial challenges due to commodity price fluctuations, regulatory changes, and high operational costs. The risk of bankruptcy in this sector can have a wide impact on the overall economy. Therefore, it is important to assess the financial health of mining companies to prevent potential bankruptcies. Below are the sub-sectors of mining in Indonesia in 2024.

Table 1. Mining Sub-Industries in Indonesia

No.	Description	Number
1.	Coal Productions	34
2.	Oil & Gas refining production	6
3.	Golds	3
4.	Iron & Steel	10
5.	Metals and minerals	5
6.	Copper	1
7.	Aluminium	4
Total Company		**63**

Based on Table 1, it can be seen that there are not many mining companies, but compared to other types of companies, mining companies in Indonesia have different advantages, encompassing high global demand and strong fundamental analysis.

The Altman Z Score uses discriminant analysis and company financial metrics to predict financial distress (Altman, 2018). Matanga and Holman (2024) state that financial health can be observed in companies that are delisted from the stock exchange, allowing stakeholders to study the performance system of mining companies. Financial performance and capital structure mutually influence each other. Capital structure refers to the composition of debt and equity used by a company to finance its operations (Liu et al., 2022). Companies with an optimal capital structure tend to achieve better financial performance to increase profits (Duguleană et al., 2024). However, on the contrary, companies with poor financial performance will eventually face serious financial problems, including the possibility of bankruptcy (Tian & Yu, 2017).

If the issue of continuous revenue decline persists, it can increase the likelihood of the company experiencing financial distress, which can ultimately lead to bankruptcy and cause the company to fail in its operations (Chabachib et al., 2019; Moch et al., 2019). To prevent such financial distress conditions, each company should conduct financial performance detection based on certain guidelines that serve as indicators or early warning systems for potential financial difficulties using specific methods (Kebede et al., 2024). Hodge (2014) stated that when different values produce varied interpretations regarding the distribution of costs, risks, benefits, responsibilities, and accountability, this can be considered a primary source, such as financial issues in the mining industry in a certain region.

Financial statement analysis is the process of interpreting various accounts in the financial statements into simpler units of information and identifying meaningful relationships between these elements, both qualitative and quantitative. The main objective is to deeply understand the company's financial condition so as to support accurate and precise decision-making (Harahap, 2015). Therefore, an analytical tool that can combine various financial aspects is needed, and that tool is bankruptcy analysis (Aviantara, 2023; Syuhada et al., 2020). As an instrument used by companies to illuminate the company's condition, financial statements are prepared every period. To gain a clearer understanding of the current condition of the company, the company can compare the latest financial statements with those from previous periods (Ashraf, 2016; Fauzi et al., 2021).

One of the most commonly used methods to predict corporate bankruptcy is the Altman Z-Score model. Developed by Edward Altman in 1968, the Z-Score combines various financial ratios to assess the likelihood of a company's bankruptcy. This study compares the Altman Z-Score model and the Zmijewski Model (X-Score) on several mining companies listed on the IDX (Bryan et al., 2013; Jan et al., 2023). Based on the background, this research aims to analyze financial performance by predicting bankruptcy potential, using Altman Z-Score and Zmijewski (X-Score) as comparative tools for mining companies listed on the Indonesia Stock Exchange for the period 2018-2022.

LITERATURE REVIEW

Agency Theory

Agency Theory describes the relationship between shareholders as principals and management as agents. Management is contracted by shareholders to act in their best interests. Since the shareholders appoint them, management is accountable for all their

actions and must report back to the shareholders (Al-Absy et al., 2020; Pham Vo Ninh et al., 2018).

Signaling Theory

Signaling Theory explains that financial statements are used to convey either good news or bad news to their users. These signals contain information about the actions taken by management to fulfill the interests of the owners.

Ratio of Working Capital

Every business requires working capital for its survival, which refers to the concept of Working Capital Management (WCM) concerning how it manages its assets and liabilities. This requires a strategy consisting of two components including the amount of current assets and the method used in managing these assets (Alarussi & Alhaderi, 2018; Mengstie et al., 2024). Mengstie et al. (2024) states that lending and advances to total assets have a significant influence on bank profitability. The ratio of loans and advances to total assets is an indicator that is often used to evaluate the working capital management of banks.

Total Assets

The increase in total assets over time indicates the company's growth and potential for generating future profits (Pham Vo Ninh et al., 2018). Paltrinieri et al. (2021) revealed that total asset growth is used to reflect the possibility of a non-linear relationship between bank expansion and risk-adjusted-performance. To control the impact of leverage, we utilize the tangible equity-to-total assets ratio (Equity Ratio). The loan-to-total assets ratio (Loans/TA) is employed to assess the bank's lending strategy (Rosli et al., 2018). A higher value in this ratio may indicate greater profitability potential but also increases exposure to risk (Armanious & Zhao, 2024; Mengstie et al., 2024; Prokopenko et al., 2023).

Retained Earning

Retained earnings can be used to pay off debt, reduce interest costs, and increase the company's financial flexibility. A high retained earnings ratio in a company, as explained in Risk Society Theory, can be a bulwark against financial difficulties. This is because retained earnings can be used to finance operations, repay debt, and even expand the business (Chabachib et al., 2019; Tian & Yu, 2017).

Earnings before Interest and Taxes (EBIT)

EBIT is often used as an indicator of a company's operational performance because it provides a clearer picture of the company's ability to generate profit from its core business activities without being influenced by external factors such as interest rates and tax policies (Abdullah et al., 2023; Prokopenko et al., 2023).

Market Value of Equity (MVE)

MVE is an important indicator for investors as it reflects the company's value in the eyes of the market. The higher the MVE, the greater the company's value in the eyes of investors. The obtained results are then divided by the company's total debt, and the resulting

ratio can be used as an indicator of the company's value in the market, often referred to as market capitalization (Chabachib et al., 2019).

Book Value of Total Assets

Refers to the total value of a company's assets as recorded in its financial statements. It represents the historical value of all assets owned by the company, including fixed assets (such as buildings and equipment), current assets (such as inventory and receivables), as well as intangible assets (such as patents or goodwill), minus depreciation. The book value of total assets is used as a divisor in financial ratio calculations, and nominally, this method is considered more accurate (Ashraf, 2016).

Ashraf (2016) stated that based on financial screening criteria, investors are allowed to invest in companies' stocks that have limited debt, fewer receivables, as well as lower cash and interest-bearing securities compared to the book value of total assets or market equity value in the last 12-36 months.

Sales

Revenue from sales is usually recorded on the income statement and is an important component of financial analysis (Syuhada et al., 2020). The higher the net profit margin of a company, the more efficient the company is in converting revenue into profit. Conversely, a low net profit margin indicates that the company is less effective in managing costs and generating profits.

Altman Z-Score

The Altman Z-Score model has been widely used across various industries to assess bankruptcy risk (Khan et al., 2022). This model employs a linear combination of five key financial ratios: working capital to total assets, retained earnings to total assets, earnings before interest and taxes (EBIT) to total assets, market value of equity to total liabilities, and sales to total assets (Destriwanti et al., 2022; Mehmood & De Luca, 2023; Mushafiq et al., 2023). The resulting score classifies companies into three categories: safe, at risk of bankruptcy, or highly likely to go bankrupt.

Several studies have applied the Z-Score to various sectors, including manufacturing, retail, and services. However, research focusing on the mining industry is limited, especially in emerging markets such as Indonesia. Given the volatility of the mining sector, this study aims to fill that gap by evaluating the applicability of Z-Score in this context.

Table 2. Variables used to Assess Company's Financial Health

Variable	Index	Description
Y	Z-SCORE	$Z=1.2*X_1+ 1.4*X_2 + 3.3*X_3 + 0.6*X_4 + 0.99*X_5$
X_1	WC/TA	Ratio of working capital/ total assets
X_2	RE/TA	Retained Earnings / Total Assets
X_3	EBIT/TA	Earnings Before Interest and Taxes / Total Assets
X_4	MVE/TA	Market Value of the Equity / Book Value of Total Assets
X_5	S/TA	Sales / Total Assets
Z		Overall Index

Table 2 shows the variable that was used to assess a company's financial health. X_1: This ratio measures the company's liquidity, indicating the extent to which the company's current assets can cover its short-term liabilities. X_2: This ratio shows the proportion of the company's retained earnings to total assets. It indicates the company's ability to generate profits from its own operations. X_3: This ratio measures the company's ability to generate operating profits relative to its assets. The higher this ratio, the more efficient the company is in generating profits from its assets. X_4: This ratio compares the market value of the company's equity with its total liabilities. A high ratio indicates that the company has strong equity compared to its debt. X_5: This ratio shows the efficiency of the company in using its assets to generate sales. The higher the ratio, the more efficient the company is in managing its assets.

This ratio evaluates the contribution of total assets to the company's sales. In Table 3 presents that a score of < 1.10 indicates a potential bankruptcy risk, a score between 1.10 and 2.60 is considered a gray area, and a score > 2.60 indicates a safe zone (Asif et al., 2024; Aviantara, 2023; Bryan et al., 2013).

Table 3. Altman Bankruptcy Criteria

Zone		Financial status
Safe Zone	Z" > 2.60	The company is considered healthy and has a low risk of bankruptcy.
Grey Zone	1.10 < Z" ≤ 2.60	The company is in an unclear position, and the risk of bankruptcy is present but not very high.
Distress Zone	Z" ≤ 1.10	The company is in poor financial condition and has a high probability of facing financial difficulties or bankruptcy in the near future.

Source: Asif et al. (2024)

Zmijewski (X-Score) Models

Zmijewski (1984) The prediction model developed by Zmijewski in 1983 is a study that is repeated every two decades. This model uses ratio analysis to assess the company's performance, leverage, and liquidity (Mulyati & Ilyasa, 2020). The results of their research indicate that the Zmijewski model is the most appropriate prediction model to be applied to mining companies listed on the Indonesia Stock Exchange, with an accuracy rate of 88.89%. The Zmijewski (X-Score) Models are presented in the formula below.

$$X\text{-}Score = -4.3 - 4.5\,(X_1) + 5.7\,(X_2) - 0.004\,(X_3) \quad (1)$$

Where X_1 was Earning After Tax / Total Assets (ROA), X_2 was Total Debt / Total Assets (Debt Ratio), and X_3 was Current Assets / Current Liabilities (Current Ratio)

The description of each financial ratio is contained in the Zmijewski X-Score method as below:

1. Earning after Tax to Total Assets (ROA)

ROA is used to indicate the company's ability to generate profit by utilizing its total assets (Kebede et al., 2024; Moch et al., 2019).

2. The Ratio of Total Debt to Total Assets (Debt Ratio)

The debt ratio is used to measure the proportion of a company's assets financed by debt or the extent to which the company's debt affects asset management (Marsenne et al., 2024).

3. Current Asset to Current Liabilities (Current Ratio)

The current ratio is used to assess a company's ability to meet its short-term obligations or debts that are due for payment in full. In other words, how many current assets can be used to meet short-term obligations that will soon be due? The current ratio can be considered an indicator to assess the level of security of a company (Marsenne et al., 2024; Mulyati & Ilyasa, 2020).

Financial Performance

The company's financial performance can be measured using a ratio known as the total asset turnover ratio. This ratio calculates how effectively the company generates sales from its total assets (Destriwanti et al., 2022).

Previous research

This research is supported by the findings of several previous researchers who serve as references for this study, including Matanga and Holman (2024), who conducted a study titled "Adapting Altman Z-score models for early warning signals: Evidence from delisted mining stocks on the Johannesburg Stock Exchange." The research method used a quantitative approach with the Altman Z-score and prime score, and the findings were: 1) The debt ratio negatively impacts the Z-score of mining companies, and 2) The Z-score of listed companies is generally higher than that of delisted companies.

Mulyati and Ilyasa (2020) the research method used compared four financial distress prediction models: Altman Z-Score, Springate, Zmijewski, and Internal Growth Rate. The research results were as follows: 1) The Springate model has an accuracy of 88.89% and a Type I error of 8%. 2) The Zmijewski model also has an accuracy of 88.89% but a Type I error of 42.86%. 3) The Altman model shows an accuracy of 75% with a Type I error of 46.67%, and the Internal Growth Rate model has an accuracy of 66.67% and a Type I error of 11.11%.

Azam (2024), in used the Zmijewski X-Score Model for analysis. The following are the research findings: 1) Jayaswal Neco Industries Ltd. shows a stable financial position, 2) Incredible Industries Ltd. has a low risk of financial distress, 3) Sarda Energy Minerals Ltd. has experienced a significant decline in X score, 4) Hariom Pipe Industries Ltd. consistently shows a higher risk of financial pressure, 5) Multivariate tests show a significant impact of the intercept on financial health, and 6) Other models do not show a significant impact on financial health. The distinguishes of this research from previous studies is that the two earlier studies only focused on one type of sub-mining from two different countries.

Research Framework and Hypothesis

One way to assess financial performance is by observing whether the company experiences an increase or decrease in sales, which in turn can impact on the development of the company. Performance ratios are measured using the sales-to-total-assets ratio. This ratio measures how efficiently the assets are used to generate revenue from sales. A comparison of measurements is conducted using the Altman Z-Score and Zmijewski X-Score to predict the financial distress conditions of mining companies listed on the Indonesia Stock Exchange. Figure 1 was the framework of this research.

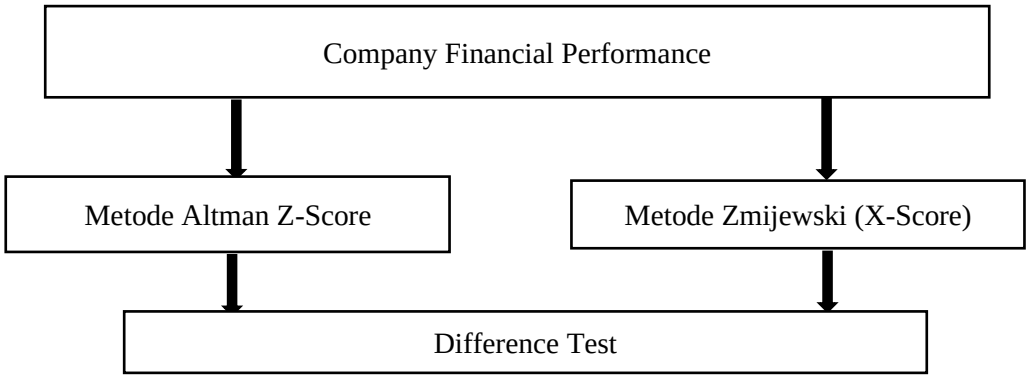

Figure 1. Research Framework

Research Hypothesis

Based on the previous studies, the hypothesis of this research is:

Ha = It is suspected that there is a difference in bankruptcy prediction models for mining companies listed on the IDX during the period 2018 – 2022 using the Z-Score Model and X-Score Model on the company's financial performance.

RESEARCH METHOD

The analysis technique used quantitative research data with descriptive analysis, with a sample size of 31 mining companies listed on the Indonesia Stock Exchange (IDX) during the period 2018-2022. The data management used SPSS version 27 and focused on mining companies listed on the Indonesia Stock Exchange (IDX) over the past five years, using a descriptive quantitative approach. Financial data, including the balance sheet, income statement, and cash flow statement, were collected from public financial reports. The methodological steps were as follows:

1. Data Collection: Financial reports from the selected mining companies for the years 2018-2023 were gathered.
2. Financial Ratio Calculation: The components of Altman's Z-Score and Zmijewski X-Score are calculated using these financial data.
3. Classification: Companies are classified into three categories: safe ($Z > 2.60$), risky ($1.10 < Z < 2.60$), or possibly bankrupt ($Z < 1.10$).
4. The criteria used in the X-Score model are a) If $X>0$, the company falls into the distress zone category, and 2) if $X<0$, the company falls into the safe zone category.

The data analysis method applied is the Altman Z-Score analysis, which involves calculating five ratios, namely the ratio of working capital to total assets (X_1), the ratio of retained earnings to total assets (X_2), the ratio of earnings before interest and taxes to total assets (X_3), the ratio of market value of equity to total liabilities (X_4), and the ratio of sales to total assets (X_5) (Al Zaabi, 2011; Pham Vo Ninh et al., 2018).

The second data analysis method uses the Zmijewski X-Score: Net Income after Tax to Total Assets (X_1), Total Debt to Total Assets (X_2), and Current Assets to Current Liabilities (X_3) (Manalu et al., 2017; Marsenne et al., 2024).

RESULTS AND DISCUSSION

Results

The performance application through the Altman Z-Score model and the X-score model on the selected mining companies shows that most of the companies fall into the "risky" or "likely to go bankrupt" category. The modified Altman Z-score model utilizes four financial ratios explained in the previous chapter to assess the bankruptcy potential of mining companies in Indonesia, using data from www.idx.co.id for the years 2018–2022 from 31 companies. These four ratios, namely the equity-to-total-assets ratio, retained earnings-to-total-assets ratio, EBIT-to-total-assets ratio, and book equity-to-book debt ratio, collectively provide a comprehensive picture of the company's financial condition. Next is the X-score Model, which uses the financial ratios of net income after tax to total assets, total debt to total assets, and current assets to current liabilities.

Results of A Descriptive Statistical Test

Based on the data in Table 4, the descriptive statistics for the three variables above explain. The financial performance range of 24.08 indicates a wide distribution of performance values, from a minimum of -13.24 from PT Medco Energi Internasional - MEDC to a maximum of 10.84 from PT Indika Energy Tbk - INDY, with an average performance of 1.3892 and a standard deviation of 1.80024, indicating some data variability.

Table 4. Descriptive Statistical Test

Test Category	N	Range	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
PERFORMANCE	210	24.08	-13.24	10.84	1.3892	.12423	1.80024
Z-SCORE	210	10.93	-3.48	7.45	2.0046	.11823	1.71326
X-SCORE	210	6.83	-5.95	.88	-2.1069	.10826	1.56885
Valid N (listwise)	210						

The Z-score model prediction range of 10.93 varies from a minimum value of -3.48 for PT. Pelayaran Nasional Bina Buana Raya Tbk - BBRM to a maximum value of 7.45 for PT. Alakasa Industrindo Tbk - ALKA, with an average of 2.0046, which is relatively close with less variability compared to performance (standard deviation = 1.71326).

Next the X-score model range of 6.83 is narrower, with a minimum value between -5.95 PT. Mitrabara Adiperdana Tbk - MBAP and 0.88 PT. Saranacentral Bajatama Tbk - BAJA. The negative average value (-2.1069) indicates that the average X-SCORE value is below zero. The standard deviation (1.56885) indicates moderate variability.

Data Normality Test

According to the data in Table 5, it can be seen that the sig value for the Altman Z-score data is 0.062 > 0.05, indicating that the Z-score data is normally distributed, while the Zmijewski X-Score has a value of 0.00 < 0.05, indicating that the data is not normally distributed in comparison. This suggests that there is a significant difference in the financial performance of the companies when using both methods to assess financial distress in mining companies.

Table 5. Normality Test use Shapiro-Wilk

Variable	Sig. Shapiro Wilk	Criteria	Description
Altman Z-score	0.062	Sig. > 0.05 Normal Sig. < 0.05 Not Normal	Data is Normally Distributed
Zmijewski X-Score	0.00	Sig. > 0.05 Normal Sig. < 0.05 Not Normal	Data Not Normally Distributed

Difference Test Results

Table 6 shows that the bankruptcy prediction shows Z-Score: t-value = -0.949, and Sig. = 0.344 (> 0.05), which means this variable does not have a significant influence on performance, and X-Score: t-value = -3.660 means there is not a strong enough influence to state the relationship between Z-Score and the company's performance. The Sig. level = 0.000 (< 0.05), indicating that X-Score has a significant influence on performance. This means that the higher the X-Score, the lower the company's financial performance. This aligns with the purpose of predicting X-Score as an indicator of financial risk.

Table 6. Difference Test

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.158	.252		12.524	.000
Transform2_Z-Score	-.074	.078	-.070	-.949	.344
Transform2_X-Score	-.301	.082	-.270	-3.660	.000

Analysis of Z-Score Calculation Results

Based on the Z-Score calculation results from Table 7, the following is a detailed description of each mining company with codes from 2018 to 2022. Green Zone, PT. Alakasa Industrindo Tbk (ALKA) The Z-Score of this company shows an overall positive trend with a sharp increase from 2020 to 2021 (from 5.31 to 7.45), despite a decline from 2018 to 2019. Overall, the company's performance is stable and has good growth. PT. Baramulti Suksessarana Tbk (BSSR) This company experienced Z-Score fluctuations within the green zone from year to year but generally showed a positive trend. A significant increase occurred from 2020 to 2022, indicating improved performance during this period. ITMG experienced a decline in 2020, but the Z-Score gradually increased again until 2022. The company demonstrated a solid recovery after the temporary drop in 2020. KKGI showed Z-Score fluctuations with a decline in 2020 but experienced consistent growth until 2022. The company's performance indicates a recovery after the 2020 downturn. MBAP showed relatively stable Z-Score fluctuations and a significant increase in 2021 and 2022, indicating strong company performance with a positive growth trend in recent years.

Gray Zone, PT. Dian Swastatika Sentosa Tbk (DSSA) The Z-Score of DSSA remained stable at a low range from 2018 to 2020 but showed consistent improvement from 2020 to 2022, indicating an enhancement in performance. PT. Garda Tujuh Buana Tbk (GTBO) This company showed a decline in its Z-Score from 2018 to 2020 but began to recover in 2021 and 2022. Although its initial performance declined, the latest trend indicates positive

growth. The Z-Score for MDKA was relatively stable but tended to decrease from 2021 to 2022, indicating challenges in maintaining consistent growth. The RIGS company experienced a significant increase in its Z-Score in 2022 after a period of stagnation, demonstrating substantial improvement in its performance. The Z-Score for TCPI was relatively stable from 2018 to 2022, with slight fluctuations, but remained in a positive range, reflecting stable performance during this period.

Table 7. Z-Score

Z-Score	Years				
	2018	**2019**	**2020**	**2021**	**2022**
PT. Alakasa Industrindo Tbk - ALKA	5.83	3.95	5.31	7.45	7.22
PT. Baramulti Suksessarana Tbk - BSSR	4.24	3.57	3.26	4.86	6.21
PT. Indo Tambangraya Megah Tbk - ITMG	3.63	3.41	2.71	4.07	5.02
PT. Resource Alam Indonesia Tbk - KKGI	2.73	3.29	2.70	4.40	4.75
PT. Mitrabara Adiperdana Tbk - MBAP	4.41	3.95	3.54	4.71	5.94
PT. Dian Swastatika Sentosa Tbk - DSSA	1.54	1.34	1.49	2.18	2.59
PT. Garda Tujuh Buana Tbk - GTBO	2.00	1.38	1.13	1.19	2.31
PT. Merdeka Copper Gold Tbk - MDKA	1.50	1.68	1.55	1.42	1.00
PT. Rig Tenders Indonesia Tbk - RIGS	0.25	0.33	1.18	0.18	1.80
PT. Transcoal Pacific Tbk - TCPI	1.85	1.83	1.57	1.63	1.82
PT. Atlas Resources Tbk - ARII	-0.65	-0.25	-0.53	-0.09	0.59
PT. Pelayaran Nasional Bina Buana Raya Tbk - BBRM	-0.81	-0.93	-3.48	-1.50	-2.01
PT. Bumi Resources Tbk - BUMI	-0.39	-0.63	-1.28	-0.31	0.93
PT. Central Omega Resources Tbk - DKFT	0.53	0.38	0.19	0.09	0.14
PT. Krakatau Steel (Persero) Tbk - KRAS	-0.04	-0.9	-0.33	0.22	0.23

Note: Z > 2.6: Healthy Company; 1.1 < Z > 2.6: Possibility of experiencing financial distress; Z < 1.1: Experiencing Financial Distress at high risk

Red Zone, PT. Atlas Resources Tbk (ARII) experienced negative fluctuations in its Z-Score from 2018 to 2020 but then showed improvement and entered the positive zone in 2022, indicating performance recovery. The Z-Score for BBRM continued to decline until 2020, and although it slightly recovered, it remained in the negative zone up to 2022, indicating challenging company performance during this period. BUMI experienced a sharp decline until 2020 but began to recover in 2021 and 2022, with the Z-Score moving toward the positive zone in 2022, showing signs of company performance recovery. PT. Central Omega Resources Tbk (DKFT) had a relatively low and fluctuating Z-Score throughout the period but remained in the positive zone, indicating stable company performance despite not showing significant growth. KRAS experienced a decline in its Z-Score in 2019 and 2020 but started to recover in 2021 and 2022, although growth remained low. Despite showing positive aspects, it fell into financial distress as a mining company in the red zone (Kalash, 2023).

Analysis of X-Score Calculation Results

Table 8 shows that PT. Betonjaya Manunggal Tbk (BTON), PT. Harum Energy Tbk (HRUM), PT. Lionmesh Prima Tbk (LMSH), and PT. Bukit Asam Tbk (PTBA) has shown a high risk of bankruptcy for five consecutive years. Companies with consistently negative X-scores that are PT. Betonjaya Manunggal Tbk (BTON), PT. Harum Energy Tbk (HRUM), PT. Lionmesh Prima Tbk (LMSH), and PT. Bukit Asam Tbk (PTBA) has shown a high risk of bankruptcy for five consecutive years.

Table 8. X-Score

X-Score	Years				
	2018	**2019**	**2020**	**2021**	**2022**
PT. Betonjaya Manunggal Tbk - BTON	-4.00	-3.22	-3.55	-2.95	-3.08
PT. Harum Energy Tbk - HRUM	-3.75	-3.93	-4.37	-3.33	-4.41
PT. Lionmesh Prima Tbk - LMSH	-3.49	-3.59	-3.22	-3.30	-3.59
PT. Bukit Asam Tbk - PTBA	-3.37	-3.33	-3.05	-3.42	-3.52
PT. Tembaga Mulia Semanan Tbk TBMS	0.01	-0.55	-0.62	-1.05	-1.41
PT. Alakasa Industrindo Tbk - ALKA	0.30	0.38	-0.12	-0.22	-0.62
PT. Atlas Resources Tbk - ARII	0.87	0.57	0.72	0.77	0.22
PT. Saranacentral Bajatama Tbk - BAJA	0.45	0.88	0.11	0.80	0.09

Notes: X> 0 = Experiencing Financial Distress and X < 0 = Not experiencing financial distress

Next company with varying conditions that are PT. Tembaga Mulia Semanan Tbk (TBMS) had a positive value in 2018 (0.01) but a negative value from 2019 to 2022, indicating a decline in financial condition. PT. Alakasa Industrindo Tbk (ALKA) transitioned from positive (2018-2019) to negative in the following year. Followed by companies that are still surviving PT. Atlas Resources Tbk (ARII) and PT. Saranacentral Bajatama Tbk (BAJA) has scores above zero, indicating no risk of bankruptcy. And the last companies with the Highest Bankruptcy Risk PT. Harum Energy Tbk (HRUM) showed the lowest X-Score, especially in 2022. (-4.41).

The X-Score method serves to identify companies that may be experiencing financial problems. Mining companies that receive a negative score must immediately analyze their financial structure and seek strategic measures to improve the situation. On the other hand, mining companies with a positive score need to maintain their stability while managing long-term risks. From the table above, it can be concluded that mining companies experiencing financial distress are making efforts to improve their financial performance periodically.

Discussion

Findings show that many mining companies listed on the IDX are vulnerable to financial difficulties. Investors must carefully evaluate the financial health of these companies before making investment decisions. In addition, regulators and policymakers need to closely monitor the financial performance of the mining sector to prevent systemic risks. Based on the z-score table above, five companies with the codes ALKA, BSSR, ITMG, KKGI, and MBAP show that the companies from 2018 to 2022 are in a safe zone or in a safe zone with a value (Z > 2.60), meaning the companies are not in financial distress that could lead to bankruptcy.

Then, companies in the grey zone with the codes DSSA, GTBO, MDKA, RIGS, and TCPI during the period 2018-2022 are in a vulnerable condition with Z-Scores of 1.10 < Z'' < 2.60. Companies in the distress zone or at risk of bankruptcy during the period 2018-2022 are those with the codes ARII, BBRM, BUMI, DKFT, and KRAS, where the average score is <1.10, indicating that these companies are experiencing financial distress. This reflects the company's unsafe condition or indicates problems in financial performance. Therefore, these companies should improve their management and financial conditions through innovation, development, and evaluation to enhance their operational and financial performance.

Therefore, the Z-Score should be used alongside other financial and sector-specific indicators for a comprehensive assessment. Generally, the Z-scores of the mining companies in the table show unstable performance with year-to-year fluctuations or financial distress (Nugrahanti et al., 2020). However, some companies like ALKA, BSSR, and MBAP show consistently positive trends and good performance growth. The results of the difference test indicate that the Z-score method on mining companies with a significant value of 0.344 means that this method does not affect the financial performance of the companies. The results above illustrate the Zmijewski (X-Score). The selected companies are 8 companies with a significance level of 0.00 < 0.05 in Table 8, indicating that the X-score model can be used to predict mining companies in Indonesia.

PT. Betonjaya Manunggal Tbk (BTON): This company has consistently faced financial difficulties since 2019. PT. Harum Energy Tbk (HRUM): HRUM has also continued to experience financial difficulties during the period analyzed. PT. Lionmesh Prima Tbk (LMSH): LMSH shows relatively stable performance but remains in a state of financial difficulty. PT. Bukit Asam Tbk (PTBA): PTBA experiences fluctuations but is generally in a state of financial difficulty. PT. Tembaga Mulia Semanan Tbk (TBMS): TBMS has gradually declining financial performance, PT. Alakasa Industrindo Tbk (ALKA): ALKA has shown improvement in financial performance in recent years, PT. Atlas Resources Tbk (ARII): ARII has also shown improvement in financial performance but experienced a decline in 2022 and PT. Saranacentral Bajatama Tbk (BAJA): BAJA has experienced significant fluctuations.

CONCLUSION

The Altman Z-Score model is an effective method for assessing bankruptcy risk among mining companies on the IDX. The results indicate that a significant number of companies are at risk, and companies and stakeholders must take proactive measures to mitigate financial difficulties. Investors are advised to consider these findings when making investment decisions in the mining sector.

Unlike the results obtained using the Zmijewski X-Score model, mining companies in Indonesia listed on the IDX during the 2018-2022 period had an X-Score > 0 each year. This means that they were experiencing financial difficulties, but the companies were trying to improve their conditions. The Zmijewski Z-Score difference test data showed a significant result of 0.00 < 0.05, indicating that the hypothesis for this method can be applied to mining companies in Indonesia because it has a significant impact on financial performance as a predictor of financial difficulties.

Future research could explore the integration of additional financial models and industry-specific factors to enhance the predictive power of bankruptcy risk assessment in the mining industry. The use of various analytical models can serve as a comparative tool to produce more accurate analyses, as each model has its own advantages and disadvantages as well as different assessment standards.

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