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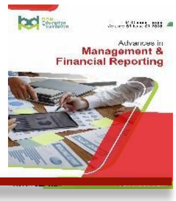

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Insolvency Forecasting using model Altman Z-Score and Springate Score Analysis

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Conflict of Interest Statement:

The author(s) declares that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

ABSTRACT

Purpose: This study aims to determine the level of bankruptcy risk among coal mining companies listed on the Indonesia Stock Exchange (IDX) using the Altman Z-Score and Springate Score models. Given the critical role of the coal mining industry in Indonesia's economy, assessing financial stability is essential for stakeholders, investors, and policymakers to anticipate and mitigate financial distress.

Research Design and Methodology: This study employs a quantitative approach using discriminant analysis to evaluate corporate financial health. The financial ratios used in the Altman Z-Score model include Working Capital to Total Assets, Retained Assets to Total Assets, Earnings Before Interest and Tax to Total Assets, and Total Equity to Total Liabilities. Meanwhile, the Springate Score model incorporates Working Capital to Total Assets, Earnings Before Interest and Tax to Total Assets, Earnings Before Tax to Current Liabilities, and Sales to Total Assets. Secondary data from annual financial reports in the Indonesian Capital Market Directory form the basis of this study.

Findings and Discussion: The findings indicate that financial statements can serve as an effective tool for predicting corporate bankruptcy. The analysis reveals that certain coal mining companies exhibit significant financial distress while others remain financially stable. The results suggest that both Altman Z-Score and Springate Score models are reliable in assessing the financial viability of companies in the coal sector.

Implications: This study provides practical insights for financial decision-making, allowing companies to implement preventive measures against financial distress. It also offers guidance for investors and policymakers to enhance risk assessment frameworks and promote economic stability in the mining sector.

Introduction

Indonesia has abundant natural and mineral resources, positioning itself as one of the world's largest coal producers. The country is crucial in ensuring global coal supply stability, making it a key player in the international energy sector (Purwanti, 2016). One of the defining characteristics of Indonesian coal is its high quality, mainly its low ash and sulfur content, making it more environmentally friendly than coal from other major producers. This environmental advantage is increasingly relevant as global concerns over sustainability and carbon emissions shape energy policies and trade regulations. Consequently, Indonesian coal remains highly competitive globally, attracting demand from various industrial sectors. The strong growth of Indonesia's coal industry has been supported by favorable government policies encouraging foreign investment and ensuring stable

production levels. These policies have facilitated the expansion of coal mining operations, improved infrastructure, and increased the country's export capacity. However, despite these advantages, the industry is not immune to external challenges, particularly economic fluctuations and regulatory shifts that affect global energy markets. The volatility of international coal demand, coupled with changing geopolitical dynamics, can significantly impact the financial performance of coal companies. In periods of economic uncertainty, the coal sector is often exposed to substantial risks, affecting production, profitability, and long-term sustainability. The potential for financial distress within coal companies highlights the need for robust analytical frameworks to assess financial stability and predict bankruptcy risks, ensuring that industry stakeholders are well-prepared to navigate economic downturns and mitigate adverse outcomes. The financial performance of Indonesia's coal industry has faced significant challenges, particularly during periods of economic decline. In 2015, coal companies in Indonesia experienced a sharp downturn, with overall performance declining by 31.22 percent. (Huda et al., 2022). This decline was primarily attributed to the economic slowdown in China, which serves as Indonesia's most important trading partner and one of the world's largest coal consumers. As the second-largest global economy, China's economic health directly influences Indonesia's export-driven coal sector. In response to internal economic challenges, the Chinese government implemented new policies to curb coal imports and reduce energy consumption intensity. These regulatory changes led to a substantial drop in demand for Indonesian coal, creating financial instability among coal companies reliant on Chinese markets. The continued decline in export revenues and weakening financial performance raised concerns among investors regarding the long-term viability of coal mining firms. Many companies may struggle to maintain operations if such financial distress persists, leading to increased bankruptcy risks. Corporate bankruptcy is often signified in capital markets by a company's delisting from the Indonesia Stock Exchange (IDX), signaling its inability to sustain business activities. (Mulyaningrum, 2008). This raises concerns for investors and industry stakeholders who seek to assess the financial health of coal companies before making investment decisions. Given these uncertainties, developing effective predictive models for bankruptcy assessment is essential. By analyzing financial statement data and financial ratios, researchers can evaluate corporate financial health and provide insights into the potential insolvency risks coal mining companies face in Indonesia.

The accuracy of bankruptcy prediction models has been extensively tested over time, with the Altman Z-Score model proving to be one of the most reliable tools for forecasting corporate insolvency. Altman (2018) Demonstrated that the model could predict bankruptcy with 95% accuracy for one year before bankruptcy, 72% for two years before, 48% for three years before, 29% for four years before, and 36% for five years before. While the model's predictive power declines over time, it remains a valuable tool for monitoring financial distress and directing attention to at-risk companies. The Z-Score's ability to filter and assess company performance makes it an essential tool for financial analysis. Gordon L.V. Springate developed the Springate Score in 1978 to improve the Z-Score model. Based on multiple discriminant analysis (MDA), this model refines bankruptcy prediction by utilizing a set of financial ratios that better distinguish between bankrupt and non-bankrupt firms. The Springate model selects four key financial ratios from an initial set of 19 commonly used ratios, emphasizing profitability as the most significant predictor of corporate insolvency. (Rachmawati & Ningsih, 2018; Sarjono, 2017). The combination of the Altman Z-Score and Springate Score models offers a more robust framework for analyzing financial distress, as both models leverage multiple financial indicators to provide a comprehensive assessment of corporate stability. Despite the widespread use of these models, researchers continue to refine predictive techniques to enhance their accuracy. Various studies have explored alternative statistical methods to improve bankruptcy forecasting, including machine learning and artificial intelligence. However, traditional models such as the Altman Z-Score and Springate Score remain widely used due to their simplicity, transparency, and substantial empirical foundations.

Despite the extensive validation of the Altman Z-Score and Springate Score models, several limitations persist, creating the need for further research. A primary gap lies in the declining predictive accuracy of the Altman Z-Score over longer time horizons. Altman (2018) demonstrated that while the model is highly effective for short-term forecasting—achieving 95% accuracy one year

before bankruptcy—its reliability decreases significantly for more extended periods, dropping to just 36% five years before insolvency. This declining accuracy raises concerns about the model's robustness in predicting financial distress over extended periods. Similarly, while the Springate Score attempts to refine bankruptcy prediction by employing multiple discriminant analysis (MDA), its reliance on a fixed set of financial ratios may not fully capture the diverse financial conditions influencing corporate distress across different industries. This limitation suggests the need for further empirical testing, particularly in industry-specific contexts. Another key research gap is the limited application of these models in the Indonesian coal mining sector. While numerous studies have validated these predictive models in Western markets, few have examined their effectiveness in emerging economies, particularly in Indonesia. Given that Indonesia's coal industry is highly exposed to external risks, such as global price fluctuations and trade policies, the applicability of these models under such volatile conditions remains uncertain. Additionally, most previous research has focused on either the Altman Z-Score or the Springate Score in isolation rather than conducting a comparative analysis within a single study. This research seeks to address this gap by evaluating both models simultaneously, providing a more comprehensive assessment of insolvency risk specific to Indonesia's coal mining sector.

This study offers a novel contribution by systematically evaluating the predictive accuracy of the Altman Z-Score and Springate Score models in forecasting the financial distress of coal mining companies listed on the Indonesia Stock Exchange (IDX) during the 2014-2016 period. Unlike previous studies that have examined these models in isolation, this research conducts a direct comparative analysis within the same dataset, providing deeper insights into their strengths, limitations, and relative effectiveness in predicting bankruptcy. This approach addresses a critical gap in the literature by determining which model performs better in Indonesia's coal industry, a sector characterized by high volatility due to global price fluctuations and regulatory uncertainties. Furthermore, applying these models in the Indonesian context generates new empirical evidence of their applicability in emerging markets, where external economic pressures—such as China's coal import restrictions and shifts in global energy policies—can significantly impact financial stability. This study aims to refine existing bankruptcy prediction methodologies, improving their reliability and relevance in industry-specific contexts. The findings are expected to benefit investors, policymakers, and financial analysts by providing a more accurate tool for assessing corporate insolvency risks. Enhancing predictive accuracy will enable stakeholders to make more informed investment decisions, develop better risk management strategies, and strengthen corporate governance frameworks within Indonesia's coal mining sector.

Literature Review

Financial Statements

Financial statements provide an overview of a company's financial condition at a particular time or within a predetermined period (Kasmir, 2015). The primary purpose of financial statements is to present accurate and transparent information about a company's financial position so that stakeholders can evaluate the company's stability and performance. Generally, the company's financial condition is categorized into two main perspectives: on a specific date, as reflected in the balance sheet, and during a particular period, as illustrated in the income statement. Financial statements are essential for internal management, investors, regulators, and other stakeholders in assessing the company's financial position, profitability, and sustainability. Karina (2014) explains that financial statements generally consist of three main components: balance sheet, income statement, and statement of changes in equity. The balance sheet illustrates the company's financial position on a specific date, which includes total assets as company resources, liabilities as financial expenses, and equity, which reflects owner investments and retained earnings. Meanwhile, the income statement provides information on the company's financial performance in a given period by presenting the income, expenses, and profit or loss generated in that period. The statement of changes in equity explains the factors contributing to changes in the company's equity, including retained earnings, additional investments, or dividend distributions.

Financial Statement Analysis

Financial statement analysis is a method and technique used to examine financial statements to transform raw financial data into more meaningful and in-depth information through specific analytical techniques (Sukma, 2018). The main objective of financial statement analysis is to assess the company's performance, emphasizing evaluating financial health and predicting future performance. By systematically analyzing financial statements, stakeholders such as investors, creditors, and management can make more informed decisions regarding financial planning, investment strategies, and risk assessment. According to Bahri & Widyawati (2015), the three main techniques commonly used in financial statement analysis are horizontal, vertical, and ratio. Horizontal or trend analysis involves comparing financial statements, especially balance sheets and income statements, over several years. This technique aims to identify upward or downward trends in various financial metrics and provide insights into the company's long-term financial trajectory. Meanwhile, vertical analysis examines proportional relationships in financial statements by calculating the percentage of each item against a specific total, such as total assets in the balance sheet or total income in the income statement, thus helping to understand the internal structure of financial statements. Ratio analysis, on the other hand, evaluates the relationship between elements in financial statements to produce key financial indicators that can be used to assess a company's liquidity, profitability, and operational efficiency. This financial statement analysis technique increases transparency and accountability by comprehensively evaluating a company's financial condition.

Types of Financial Ratios

Financial ratios are essential in evaluating the company's financial performance by providing insights into financial stability, operational efficiency, and profitability. According to Melissa (2020) and Thohari et al. (2015), financial ratios can be categorized into four main types: liquidity ratio, activity ratio, financial leverage ratio, and profitability ratio. These ratios allow stakeholders, including investors, creditors, and management, to assess the company's financial health, operational efficiency, and the level of risk faced. The liquidity ratio measures the company's ability to meet its short-term obligations using cash or other current assets (Wakla et al., 2023). The activity or efficiency ratio evaluates the company's effectiveness in utilizing its income-generating assets (Kusnomo, 2022). Meanwhile, the financial leverage ratio measures the extent to which the company relies on borrowed funds to finance its operations. In contrast, a higher leverage ratio indicates greater dependence on debt, potentially increasing financial risk and the opportunity for higher returns. Finally, the profitability ratio assesses a company's ability to generate profit relative to its income, assets, or equity, with key indicators such as return on assets (ROA) and return on equity (ROE). By analyzing these financial ratios, stakeholders can better understand the company's financial condition and potential for future growth.

Altman Z-Score Discriminant Analysis

The Altman Z-Score model integrates several key financial indicators into a single score used to classify companies as healthy or at risk of bankruptcy based on predetermined thresholds (Adnan & Arisudhana, 2017). This model combines financial ratios that include liquidity, profitability, leverage, and operational efficiency to improve the accuracy of financial risk assessment. With this approach, the Z-Score model overcomes the limitations of univariate financial analysis, which only evaluates ratios separately without considering the impact of the combination of various factors. This model has been widely applied in corporate financial analysis, especially in predicting bankruptcy risk, assessing investment risk, and determining creditworthiness. The lower the Z-score, the higher the likelihood of bankruptcy so that investors, creditors, and regulators can take appropriate mitigation measures.

Springate Score Model

The Springate model was developed by Gordon L.V. Springate in 1978 as an extension of the Altman Z-Score and uses the multivariate discriminant analysis (MDA) method to select four of the 19

financial ratios that are most effective in distinguishing between companies that experience bankruptcy and those that do not (Prasetiyani & Sofyan, 2020). This model emphasizes profitability as the most influential component in detecting the risk of bankruptcy, so it is often used in research related to companies' financial stability.

Financial Distress

Financial distress occurs when a company's operating cash flow is insufficient to meet its short-term obligations, including trade debts and interest expenses (Prabowo, 2019). The main factors causing this condition include declining income, cost management inefficiency, and worsening macroeconomic conditions. If not addressed immediately, financial distress can develop into insolvency, where the company's liabilities exceed its total assets, potentially leading to bankruptcy (Sembiring, 2015). One of the crucial aspects in understanding financial distress is distinguishing between cash flow-based insolvency, where the company cannot fulfill its obligations when they are due, and balance sheet-based insolvency, where total liabilities exceed total assets. Inefficient management, excessive debt accumulation, and moral hazards such as corruption can worsen the company's financial condition (Winaya et al., 2020).

Bankruptcy and Causes of Corporate Failure

Bankruptcy is the final stage of financial distress, where a company can no longer meet its financial obligations on an ongoing basis (Daryanto et al., 2021). The main factors causing corporate failure can be classified into internal factors, such as the inability of management to manage finances and business strategies, as well as external factors, including changes in macroeconomic conditions and regulations (Shafitranata & Arshed, 2020). Previous studies have shown that early warning systems using the Altman Z-Score and Springate Score models can help predict financial distress and support bankruptcy mitigation strategies (Kürklü & Türk, 2017).

Research Design and Methodology

Study Design

This research employs a quantitative design, focusing on statistical and numerical data analysis to assess the financial health and bankruptcy prediction of coal mining companies listed on the Indonesia Stock Exchange (IDX) between 2014 and 2016. The study applies financial ratio analysis through two widely recognized predictive models: the Altman Z-Score discriminant model and the Springate Score analysis. These models are utilized to examine the probability of bankruptcy by analyzing financial ratios derived from company financial statements. The study follows an explanatory research approach to establish relationships between financial indicators and corporate financial distress. The primary objective is to provide empirical evidence on the applicability and reliability of these models in forecasting insolvency within the coal mining industry.

Sample Population or Research Subjects

The population of this study consists of ten coal mining companies listed on the Indonesia Stock Exchange (IDX) during the period 2014–2016. The study employs purposive sampling, a non-random sampling technique for selecting the sample based on specific criteria (Sugiyono, 2017). The selected companies must have been continuously listed on the IDX throughout the research period and must have submitted complete financial reports for 2014, 2015, and 2016. These criteria ensure consistency in financial reporting, allowing for a reliable analysis of financial data over time and enhancing the accuracy of bankruptcy prediction using financial ratio models.

Data Collection Techniques and Instrument Development

This study relies on secondary data, consisting of financial information obtained from publicly available sources. The documentation method is employed to collect financial statements and independent auditor reports from the Makassar Representative Office of the Indonesia Stock Exchange (PIPM), the official website of the Indonesia Stock Exchange (www.idx.co.id), and the official websites of selected coal mining companies. The primary instrument used in this research is financial

statement analysis, where financial ratios are extracted and processed using the Altman Z-Score and Springate Score models. The Altman Z-Score model assesses bankruptcy risk by applying a discriminant equation to financial ratios. At the same time, the Springate Score method evaluates corporate viability by combining multiple financial ratios with specific weighting factors to enhance predictive accuracy.

Data Analysis Techniques

The data analysis process involves quantitative statistical techniques to evaluate the financial health of the selected coal mining companies. The financial ratios obtained from the company reports are input into the Altman Z-Score and Springate Score models to calculate the probability of bankruptcy. The Altman Z-Score is computed using a linear discriminant function, which assigns coefficients to selected financial ratios to generate a composite score classifying companies as "safe," "at risk," or "bankrupt." Similarly, the Springate Score applies a multiple discriminant analysis (MDA) technique to assess corporate financial viability. The results of these models are then interpreted to determine the extent to which each company is at risk of financial distress. To ensure the validity and reliability of the findings, the computed scores are compared across different companies and analyzed over time. Additionally, the results are cross-referenced with historical financial data to validate the accuracy of the bankruptcy predictions. This analytical approach provides critical insights into the effectiveness of these models in predicting financial distress within Indonesia's coal mining industry and offers recommendations for stakeholders regarding financial risk management.

Findings and Discussion

Findings

Calculate the Z-Score value for the four ratios above, and each ratio is multiplied by the standard value specified in the Altman Z-Score analysis model using the formula:

$$Z = 6.33\ X1 + 3.23\ X2 + 6.81X3 + 1.14\ X4$$

Then, it will get the Z-Score value of each company. Altman model cutoff points based on market value are:

Z greater than 2.8 = Safe Zone
1.26 smaller than Z smaller than 2.9 = Gray Zone
Z smaller than 1.24 = Danger Zone

Table 1. 2014 Altman Z- Score

No	Code Sample	Company Name (Sample)	Altman Z- Value 2014 scores	predictions
1	HRUM	Harum Energy Tbk	14.7721 228	Safe zone
2	GEMS	Golden Energy Mines Tbk	11,928 343	Safe zone
3	ANTM	Aneka Tambang Persero Tbk	5.9681 43	Safe zone
4	EARTH	Bumi Resources Tbk	-3.2603 33	**Danger Zone**
5	BSSR	Baramulti Suksessarana Tbk	7.87 843	Safe zone
6	ADRO	Adaro Energy Tbk	5.3266 853	Safe zone
7	ATPK	Bara Jaya Internasional Tbk	5,696 442	Safe zone
8	ARII	Atlas Resources Tbk	-0.7129 975	**Danger Zone**
9	GOD	Darma Henwa Tbk	5,9918 9	Safe zone
10	BYAN	Bayan Resources Tbk	2.00796 87	Gray Zone

Source: Processed data

Table 1 explains that not all financial performance of coal mining companies in 2014 was healthy or in a safe zone. PT Bumi Resources Tbk is in a dangerous zone with a Z-Score of -3.260333, less than 1.23. Altman's model cutoff point based on market value explains that if Z is smaller than 1.23 the company is in a dangerous zone. Likewise, PT Atlas Resources Tbk has a Z-Score value of -0.7129975, less than 1.23, which means the company is predicted to be in a dangerous zone in 2014. PT Bayan Resources Tbk is in a gray zone due to its Z-Score value of 2.0079687, which is at 1.23 and

2.9. In 2015, two companies were in a dangerous zone, and the rest were in a safe zone. PT Bumi Resources Tbk and PT Atlas Resources Tbk are in an unsafe zone where the Z-Score is below the cutoff point of 1.23. PT Bayan Resources Tbk has succeeded in improving its financial performance so that in 2014, it was in the gray zone, and 2015, it was in the safe zone.

Table 2. 2015 Altman Z- Score

No	Code Sample	Company Name (Sample)	Altman Z- Value 2015 scores	predictions
1	HRUM	Harum Energy Tbk	17,445 822	Safe zone
2	GEMS	Golden Energy Mines Tbk	9.04 822	Safe zone
3	ANTM	Aneka Tambang Persero Tbk	6.1006 012	Safe zone
4	EARTH	Bumi Resources Tbk	-7.6586 923	**Danger Zone**
5	BSSR	Baramulti Suksessarana Tbk	9,901 2123	Safe zone
6	ADRO	Adaro Energy Tbk	5.5429 843	Safe zone
7	ATPK	Bara Jaya Internasional Tbk	2.9739 923	Safe zone
8	ARII	Atlas Resources Tbk	-2,983 454	**Danger Zone**
9	GOD	Darma Henwa Tbk	5.2258 822	Safe zone
10	BYAN	Bayan Resources Tbk	2.5838 343	Safe zone

Table 3. 2016 Altman Z- Score

No	Code Sample	Company Name (Sample)	Altman Z- Value 2016 scores	predictions
1	HRUM	Harum Energy Tbk	15,946 3232	Safe zone
2	GEMS	Golden Energy Mines Tbk	8.7952 344	Safe zone
3	ANTM	Aneka Tambang Persero Tbk	6,000 2326	Safe zone
4	EARTH	Bumi Resources Tbk	-12.77 454	**Danger Zone**
5	BSSR	Baramulti Suksessarana Tbk	10.89 456	Safe zone
6	ADRO	Adaro Energy Tbk	5,677 963	Safe zone
7	ATPK	Bara Jaya Internasional Tbk	1.0091 532	**Danger Zone**
8	ARII	Atlas Resources Tbk	-3,708 945	**Danger Zone**
9	GOD	Darma Henwa Tbk	3,548 66	Safe zone
10	BYAN	Bayan Resources Tbk	2.507 82	Gray Zone

PT Bara Jaya Internasional Tbk 2016 is predicted to be in a dangerous zone with a Z-Score value of 1.0091 532. In 2014 and 2015, the company was in a safe zone. Meanwhile, PT Bumi Resources Tbk and PT Atlas Resources Tbk have been in the danger zone for three consecutive years. PT Bayan Resources in 2016 was again in the gray zone; in 2015, the company was in the safe zone. Prediction results from data on the probability of bankruptcy from 2014 to 2016 are presented in the following table:

Table 4. Predicted Percentage of Bankruptcy Probability 2014-2016

Percentage predictions	Year 2014	2015	2016
Danger Zone	30 %	30 %	33 %
Gray Zone	20 %	0 %	20 %
Safe zone	50 %	70 %	47%

Source: Processed data

Table 4 describes the percentage of predicted bankruptcy probability for ten coal mining companies in 2014-2016. In 2014, companies in the danger zone were 30%,, which continued in 2015 by 30%. Companies in the Danger Zone in 2014 and 2015 included PT Bumi Resources Tbk and PT Atlas Resources Tbk. In 2016, the number of companies in the danger zone increased by 33%. There were three companies, namely PT Bumi Resources Tbk, PT Bara Jaya Internasional Tbk, and PT Atlas Resources Tbk. In 2016, many companies experienced financial difficulties but could still cover these conditions. Furthermore, in the gray zone in 2014, as many as 20% of companies are predicted to be in the zone; only one company out of ten companies in this zone is PT Bayan Resources Tbk, 2015 it is 0%, which means that there are no more companies that are in that zone. Still, in 2016, there was an increase again by 20%, namely PT Bayan Resources Tbk, which is again predicted to be in the gray zone. In 2014, as many as 50% of coal mining companies were in the safe zone, including PT Harum Energy Tbk, PT Golden Energy Mines Tbk, PT Aneka Tambang Tbk, PT Baramulti Suksessarana Tbk,

PT Adaro Energy Tbk, PT Barajaya Internasional Tbk, and PT Darma Henwa Tbk. In 2015, coal mining companies experienced an increase in the prediction of safe zones, companies including PT Harum Energy Tbk, PT Golden Energy Mines Tbk, PT Aneka Tambang Tbk, PT Baramulti Suksessarana Tbk, PT Adaro Energy Tbk, PT Bara Jaya Internasional Tbk, PT Darma Henwa Tbk, and PT Bayan Resources Tbk. Then in 2016 there was a decrease in companies in the safe zone, including PT Harum Energy Tbk, PT Golden Energy Mines Tbk, PT Aneka Tambang Tbk, PT Baramulti Suksessarana Tbk, PT Adaro Energy Tbk, and PT Darma Henwa Tbk Calculate the Z-Score value for the four ratios above, each ratio is multiplied by the standard value specified in the Springate score analysis model using the formula:

$$Z = 1.21X1 + 3.08X2 + 0.71X3 + 0.42X4$$

Then, it will get the Z-Score value of each company. The Springate model cutoff points based on market value are:

Z greater than 0.872 = Healthy Company
Z smaller than 0.872 = Potential Bankrupt Company

Table 5. Springate score analysis method values 2014

No	Code Sample	Company Name (Sample)	Springate Value 2014 scores	predictions
1	HRUM	Harum Energy Tbk	3.71342239	Healthy
2	GEMS	Golden Energy Mines Tbk	3.77110486	Healthy
3	ANTM	Aneka Tambang Persero Tbk	1.23228249	Healthy
4	EARTH	Bumi Resources Tbk	0.4353023	Potential Bankruptcy
5	BSSR	Baramulti Suksessarana Tbk	3.67415816	Healthy
6	ADRO	Adaro Energy Tbk	1.962440717	Healthy
7	ATPK	Bara Jaya Internasional Tbk	1.6586384	Healthy
8	ARII	Atlas Resources Tbk	-0.23150866	Potential Bankruptcy
9	GOD	Darma Henwa Tbk	2.39468	Healthy
10	BYAN	Bayan Resources Tbk	1.25992321	Healthy

According to the Springate score analysis method in 2014, PT Bumi Resources Tbk is predicted to experience potential bankruptcy in 2014, with a Z-Score of 0.4353023. The negative EBT value of -3,855,389 means that PT Bumi Resources cannot pay its short-term obligations. PT Atlas Resources Tbk is also predicted to experience a potential bankruptcy due to the low value of the X4 variable (Total Assets Turn Over) with a value of 0.1134250.

Table 6. Springate score analysis method values 2015

No	Code Sample	Company Name (Sample)	Springate Value 2015 scores	predictions
1	HRUM	Harum Energy Tbk	1.924222604	Healthy
2	GEMS	Golden Energy Mines Tbk	2.667456	Healthy
3	ANTM	Aneka Tambang Persero Tbk	0.99102688	Healthy
4	EARTH	Bumi Resources Tbk	0.8968157	Healthy
5	BSSR	Baramulti Suksessarana Tbk	4.63159094	Healthy
6	ADRO	Adaro Energy Tbk	1.94450559	Healthy
7	ATPK	Bara Jaya Internasional Tbk	-0.01958018	Potential bankruptcy
8	ARII	Atlas Resources Tbk	-0.42908477	Potential bankruptcy
9	GOD	Darma Henwa Tbk	2.190524	Healthy
10	BYAN	Bayan Resources Tbk	0.8834605	Healthy

In 2015, PT Atlas Resources Tbk is still predicted to experience potential bankruptcy with a negative Z-Score of -0.01958018, where this value is smaller than the standard Springate score analysis method where the assessment is to assess the company's survival. PT Bara Jaya Internasional Tbk is also predicted to have the potential to go bankrupt in 2015 due to the low earnings before Interest and Tax (EBIT) with a value of 161,692.

In 2016, the level of coal mining companies studied experienced an increase in predictions of the possibility of bankruptcy increasing, in 2015 Only two companies were predicted to go bankrupt, but in 2016, three companies that had the potential to go bankrupt, namely PT Bumi Resources Tbk, PT Bara Jaya Internasional Tbk, and PT Atlas Resources Tbk. Each negative Z-Score is PT Bumi Resources Tbk -1.34178735, PT Bara Jaya Internasional Tbk -0.2275522, and PT Atlas Resources Tbk -0.5222583.

Table 7. Springate score analysis method values 2016

No	Code Sample	Company Name (Sample)	Springate Value 2016 scores	predictions
1	HRUM	Harum Energy Tbk	1.842967	Healthy
2	GEMS	Golden Energy Mines Tbk	2.68549302	Healthy
3	ANTM	Aneka Tambang Persero Tbk	1.242673961	Healthy
4	EARTH	Bumi Resources Tbk	-1.34178735	**Potential Bankruptcy**
5	BSSR	Baramulti Suksessarana Tbk	4.39148912	Healthy
6	ADRO	Adaro Energy Tbk	1.98699331	Healthy
7	ATPK	Bara Jaya Internasional Tbk	-0.2275522	**Potential Bankruptcy**
8	ARII	Atlas Resources Tbk	-0.5222583	**Potential Bankruptcy**
9	GOD	Darma Henwa Tbk	1.568508344	Healthy
10	BYAN	Bayan Resources Tbk	1.01180116	Healthy

Table 8. Predicted Percentage of Bankruptcy Probability 2014-2016

Percentage predictions	Year		
	2014	2015	2016
Potential Bankruptcy	20%	20%	30%
Healthy	80%	80%	70%

Source: Processed data

Unlike the Altman Z-Score analysis method, this Springate score analysis method only has two predictions: potentially bankrupt and healthy companies. This differs from the Altman analysis method, which has a gray zone for companies that can still be saved. Potential companies that went bankrupt in 2014 were 20%, including PT Bumi Resources Tbk and PT Atlas Resources Tbk. The analysis value of PT Bumi Resources Tbk's Springate score is 0.4353023, which is potentially bankrupt because the Z-Score value is smaller than the cutoff point of the Springate score analysis method, which is 0.862. PT Atlas Resources Tbk, with a negative Z-Score of -0.23150866, is even smaller than the cutoff point. In 2015, the percentage of companies that could go bankrupt was the same as in 2014. However, with different companies except for PT Atlas Resources, it is still predicted to have the potential to go bankrupt in 2015 with a negative Z-Score - 0.42908477. PT Bara Jaya Internasional is predicted to go bankrupt in 2015 with a Z-Score value of -0.01958018, the lowest Z-Score value among other companies in 2015. In 2016, the number of companies that could go bankrupt increased to 30% from 20% in 2014 and 2015. Three companies that could go bankrupt in 2016 have a negative Z-Score, including PT Bumi Resources Tbk, PT Bara Jaya Internasional Tbk, and PT Atlas Resources Tbk. The Z-Score value of PT Bumi Resources Tbk is -1.34178735, the value of PT Bara Jaya Internasional is -0.2275522, while the value of PT Atlas Resources Tbk is -0.5222583, the Z-Score value is negative. Hence, this value is smaller than the cutoff point of the Springate Score analysis method, namely 0.862. 80% of the companies whose financial performance is predicted to be healthy in 2014 include PT Harum Energy Tbk, PT Golden Energy Tbk, PT Darma Henwa Tbk, PT Bayan Resources Tbk, PT Aneka Tambang Tbk, PT Adaro Energy Tbk, PT Baramulti Suksessarana Tbk, PT Bara Jaya Internasional Tbk.

Discussion

Danger Zone in 2014-2016

In 2014, it can be seen from the calculations that two coal mining companies were categorized as being in a dangerous zone, namely PT Bumi Resources Tbk and PT Atlas Resources Tbk. This is seen in the very low Z-Score. If analyzed through the four indicators used in the Altman Z-Score calculation model, it can be said that the indicator that most influences the value of the Z-Score for the two companies, namely PT Bumi Resources Tbk and PT Atlas Resources Tbk, which experience dangerous conditions lies in their high sales ratio. Low compared to other companies. This can be seen in Table 15; PT Bumi Resources is experiencing a hazardous condition due to the low X3 Indicator, namely

Earning Before Interest and Tax (EBITTA), which is only worth 0.30591 Sales, which are only worth 34,647,530 while PT Atlas Resources Tbk's X3 value is 0.05160 and Sales amounted to 478,388, the lowest sales ratio among the ten coal mining companies in 2014. Management's ability to face competitive conditions is not good enough. The results of calculations in 2015 show two companies that have the potential to go bankrupt, the same as in 2014 companies that are at a dangerous level, namely PT Bumi Resources Tbk and PT Atlas Resources Tbk. This is due to the low value of the X4 indicator and the value of the sales ratio. PT Bumi Resources Tbk X4 value in 2015 was 0.461156, the total equity of PT Bumi Resources Tbk in 2015 was -40,070,352 while the total debt was 75,510,462 This means that the total value of debt to PT Bumi Resources Tbk is greater than the value equity so that they are unable to finance funding using their sources of funds. The sales ratio of PT Bumi Resources in 2015 was 558,747, a low sales value in 2015. PT Atlas Resources Tbk in 2015 had a low X4 ratio value of 0.30425 with an equity value of 1,201,771 and a debt value of 3,949,930 where the total debt is more outstanding than the total equity, so they are unable to finance funding using their sources of funds. The sales ratio value of PT Atlas Resources Tbk also decreased compared to 2014, amounting to 415,409.

In 2016, three companies were in a dangerous zone: PT Bumi Resources Tbk, PT Atlas Resources Tbk, and PT Bara Jaya Internasional Tbk. This is because the X1 variable at PT Bumi Resources in 2016 was lower than that of other companies, namely -1.40208. This indicator is included in the liquidity ratio, which measures the company's ability to meet its short-term obligations. If the X1 indicator is low, then PT Bumi Resources Tbk can be said to be unable to meet its short-term obligations. Furthermore, the retained earnings ratio of PT Bumi Resources Tbk decreased in 2016, namely -42,686,590. If the total retained earnings declined, the company could lose. The sales ratio 2016 also reduced from 2015, amounting to 234,905, which was the lowest sales value among other companies in 2016. At PT Atlas Resources Tbk in 2016, the X3 variable was worth 0.00953; the X3 variable can measure the company's ability to generate profit from assets. The weakening of this factor is a strong indicator of bankruptcy. In addition, PT Atlas Resources Tbk's X4 variable is lower with a value of 0.25597 where the total equity is 907,715, and the total debt is 3,546,166; this proves that the total debt is more outstanding than the total equity, so it is unable to finance funding using its funding sources. PT Bara Jaya Internasional Tbk is one of the companies that is predicted to have the potential to go bankrupt in 2016 due to the low variable X3 (Earning Before Interest and Tax to Total Assets) among other companies of -0.00878, weakening company indicators in generating profits can mean the strength of the company has the potential to go bankrupt.

Gray Zone in 2014-2016

According to Altman, the gray zone is the position of a company experiencing financial difficulties. However, the possibility of being saved and the possibility of bankruptcy is just as great, depending on how the company's management can immediately take action to overcome the problems experienced by the company. In 2014, the percentage level of coal mining companies in this zone was 20%. Research results show one company in this zone, PT Bayan Resources Tbk. This is because variable X1 -0.168340 is low among other companies. According to Altman, the X1 indicator has proven to be the most capable of showing a decline in company value. The X4 indicator for PT Bayan Resources Tbk worth 0.28200 proves that the total debt generated by this company is more outstanding than the total equity generated, so PT Bayan Resources Tbk cannot pay its obligations at its own expense. In 2015, 0% of companies occupied this zone. So, only two predictions in 2015 are of dangerous and safe potential. In 2016, PT Bayan Resources Tbk again occupied the grey zone's potential with a value of 2.50734 due to the low X4 indicator with a value of 0.20651. Where the total debt is more outstanding than the total equity, PT Bayan Resources Tbk cannot pay its obligations at its own expense.

Safe Zone in 2014-2016

In 2014, 50% of coal mining companies in the safe zone included PT Harum Energy Tbk, PT Golden Energy Mines Tbk, PT Aneka Tambang Tbk, PT Baramulti Suksessarana Tbk, PT Adaro Energy Tbk, PT Bara Jaya Internasional Tbk, and PT Darma Henwa Tbk. In 2015, the percentage of coal mining

companies predicted to be in the safe zone was 70%, but this percentage increased from 2015. PT Bayan Resources Tbk was successfully predicted to be in the safe zone in 2015, which was previously predicted to be in the gray zone in 2014. because PT Bayan Resources Tbk increased its Working Capital in 2015. Previously, in 2014, its working capital was negative. In 2016, the coal mining companies studied experienced a decrease in the percentage in the safe zone by 47%. PT Bayan Resources Tbk in 2015 was in a safe zone. In 2016, it was again predicted to be in the gray zone; PT Bayan Resources' working capital fluctuated for three years, experiencing a changing zone prediction. In addition, PT Bara Jaya Internasional Tbk in 2014-2015 is predicted to be in a safe zone. However, in 2016, it is predicted to be in a dangerous zone again due to the negative EBIT (Earning Before Interest and Tax) value 2016.

Conclusion

This study examined the financial distress of coal mining companies listed on the Indonesia Stock Exchange (IDX) from 2014 to 2016, employing the Altman Z-Score and Springate Score models to predict the probability of bankruptcy. The findings indicate that both models effectively classify companies into distinct financial health categories, allowing for the identification of firms at risk of bankruptcy. The analysis revealed that certain companies, particularly PT Bumi Resources Tbk, PT Atlas Resources Tbk, and PT Bara Jaya Internasional Tbk, consistently appeared in the danger zone across multiple years, highlighting their financial vulnerabilities. Moreover, the study confirmed that the financial statements of coal mining companies provide valuable insights into predicting corporate insolvency, reinforcing the applicability of these models in assessing financial distress. Consequently, the study validates that the Altman Z-Score and Springate Score models are reliable for bankruptcy prediction, enabling companies to take early preventive measures to address financial instability.

The research contributes to academic knowledge and practical decision-making by offering empirical evidence on the effectiveness of bankruptcy prediction models in Indonesia's mining sector. The study enhances the understanding of financial distress by demonstrating how financial ratios can be leveraged to anticipate insolvency risks. Practically, this study provides valuable insights for investors, financial analysts, and corporate managers in evaluating financial stability, making informed investment decisions, and implementing risk mitigation strategies. Policymakers and regulatory bodies can use these findings to develop better financial monitoring mechanisms, ensuring corporate sustainability and preventing systemic risks in the mining industry. The study also emphasizes the importance of financial transparency and proactive management in mitigating financial distress, thereby preserving corporate value and investor confidence.

Despite its contributions, this study has several limitations that should be addressed in future research. First, the sample size is relatively small, consisting of only ten coal mining companies, and the study period is limited to 2014-2016. Future research should explore multi-model comparisons to determine which model offers the highest predictive reliability across different industries. Lastly, this study focuses solely on financial indicators, while non-financial factors, such as corporate governance, market conditions, and macroeconomic trends, influence financial distress. Future research could integrate quantitative and qualitative approaches to develop a more comprehensive bankruptcy prediction framework. Researchers are encouraged to explore how external economic factors and corporate strategies impact financial distress, offering a more holistic perspective on corporate survival and risk management.

References

Adnan, H., & Arisudhana, D. (2017). Analisis kebangkrutan model Altman Z-Score dan Springate pada perusahaan industri property. Jurnal Akuntansi Dan Keuangan, 1(1). https://doi.org/10.36080/jak.v1i1.362

Altman, E. I. (2018). A fifty-year retrospective on credit risk models, the Altman Z-score family of models, and their applications to financial markets and managerial strategies. Journal of Credit Risk. https://doi.org/10.21314/JCR.2018.243

Bahri, S., & Widyawati, N. (2015). Analisis prediksi kebangkrutan pada perusahaan yang di-delisting di bursa efek Indonesia. Jurnal Ilmu Dan Riset Manajemen (JIRM), 4(4).

Daryanto, W. M., Pricillia, M., & Andarini, K. (2021). Financial Report Analysis of Pt Pakuwon Jati Tbk Using Z-Score Altman, S-Score Springate, And X-Score Zmijewski Models to Analyze Company" s Bankruptcy. South

East Asia Journal of Contemporary Business, 87–91. https://seajbel.com/wp-content/uploads/2021/06/SEAJBEL24_729.pdf.

Elviani, S., Simbolon, R., Riana, Z., Khairani, F., Dewi, S. P., & Fauzi, F. (2020). The accuracy of the Altman, Ohlson, Springate and Zmejewski models in bankruptcy predicting trade sector companies in Indonesia. Budapest International Research and Critics Institute (BIRCI-Journal), 3, 334–347. https://pdfs.semanticscholar.org/f424/d2a930be99138ce1887bfcc3001a06163ad6.pdf

Fredy, H. (2018). The prediction of bankruptcy in the pulp and paper industry company listed in Indonesia stock exchange on 2011-2016 period using Z-Score Altman, Springate and Grover Model. South East Asia Journal of Contemporary Business, Economics and Law, 15(5), 1560–2289.

Huda, N., Astuti, E. S., Martawardaya, B., Purwanto, D. A., Listiyanto, E., & Fahmid, M. M. (2022). Proyeksi Ekonomi Indonesia 2022: Pemulihan di atas Fundamental Rapuh. Indef.

Karina, S. D. (2014). Prediksi Kebangkrutan pada Perusahaan Media yang terdaftar diBursa Efek Indonesia. Politeknik Negeri Sriwijaya. https://digilib.uns.ac.id/dokumen/detail/6482

Kasmir, S. E. (2015). Studi kelayakan bisnis: edisi revisi. Prenada Media.

Kürklü, E., & Türk, Z. (2017). Financial failure estimate in bist companies with Altman (Z-score) and Springate (S-score) models. Osmaniye Korkut Ata Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 1(1), 1–14.

Kusnomo, N. A. (2022). Pengaruh Likuiditas, Aktivitas Dan Solvabilitas Terhadap Profitabilitas Pada Perusahaan Food And Beverage Di Bursa Efek Indonesia Periode 2016-2020. Universitas Hayam Wuruk Perbanas Surabaya. http://eprints.perbanas.ac.id/id/eprint/9178

Melissa, P. (2020). Analisis prediksi kebangkrutan menggunakan model altman z-score, springate dan zmijewski yang terdaftar di Bursa Efek Indonesia. Prodi Akuntansi. http://repository.upbatam.ac.id/id/eprint/2067

Mulyaningrum, P. (2008). Analisis Rasio Keuangan Sebagai Indikator Prediksi Kebangkrutan Bank di Indonesia. Diponegoro University.

Prabowo, S. C. B. (2019). Analysis on the prediction of bankruptcy of cigarette companies listed in the Indonesia Stock Exchange using altman (z-score) model and zmijewski (x-score) model. Jurnal Aplikasi Manajemen, 17(2), 254–260. https://doi.org/10.21776/ub.jam.2019.017.02.08

Prasetiyani, E., & Sofyan, M. (2020). Bankruptcy analysis using Altman Z-score model and Springate model in retail trading company listed in Indonesia Stock Exchange. Ilomata International Journal of Tax and Accounting, 1(3), 139–144.

Purwanti, E. (2016). Analisis Perbedaan Model Altman Z Score Dan Model Springate Dalam Memprediksi Kebangkrutan Pada Perusahaan Pertambangan Di Indonesia. Jurnal STIE Semarang, 8(2). https://www.neliti.com/publications/131639/analisis-perbedaan-model-altman-z-score-dan-model-springate-dalam-memprediksi-ke#cite

Rachmawati, L., & Ningsih, W. F. (2018). Analisis Rasio Keuangan sebagai Indikator Prediksi Kebangkrutan pada Bank Pembiayaan Rakyat Syariah di Jawa Timur. JABE (Journal of Applied Business and Economic), 5(1), 1–17. https://doi.org/10.30998/jabe.v5i1.3159

Sarjono, H. (2017). Analisis laporan keuangan sebagai alat prediksi kemungkinan kebangkrutan dengan model diskriminan altman pada sepuluh perusahaan properti di bursa efek Jakarta. Business Management Journal, 2(1). https://doi.org/10.30813/bmj.v2i1.587

Sembiring, T. M. (2015). Bankruptcy prediction analysis of manufacturing companies listed in Indonesia stock exchange. International Journal of Economics and Financial Issues, 5(1), 354–359.

Shafitranata, R. C., & Arshed, N. (2020). Prediction of Islamic Banking Bankruptcy in Indonesia: Comparative Study of Altman Z-Score and Springate Models. Ikonomika: Jurnal Ekonomi Dan Bisnis Islam, 5(2), 231–248.

Sugiyono. (2017). Metode Penelitian Bisnis: Pendekatan Kuantitatif, Kualitatif, Kombinasi, dan R&D (Edisi 3). Alfabeta.

Sukma, S. (2018). Analisis Laporan Keuangan Sebagai Alat Prediksi Kebangkrutan Pada Perusahaan Properti Yang Terdaftar Di Bursa Efek Indonesia. Center for Open Science. https://doi.org/10.31219/osf.io/dk9j6_v1

Tanjung, P. R. S. (2020). Comparative analysis of Altman Z-Score, Springate, Zmijewski and Ohlson models in predicting financial distress. EPRA International Journal of Multidisciplinary Research (IJMR)-Peer Reviewed Journal, 6(3), 126–137. https://eprajournals.com/jpanel/upload/712pm_22.EPRA_JOURNALS-4162.pdf

Thohari, M. Z., Sudjana, N., & A., Z. Z. (2015). Prediksi Kebangkrutan Menggunakan Analisis Model Z-Score (Studi Pada Subsektor Textile Mill Products Yang Terdaftar Di Bursa Efek Indonesia Periode 2009-2013). Jurnal Administrasi Bisnis S1 Universitas Brawijaya, 28(1), 149–157. https://www.neliti.com/publications/86439/prediksi-kebangkrutan-menggunakan-analisis-model-z-score-studi-pada-subsektor-te#cite

Wakla, U., Syafii, M., Toatubun, N., & Rerung, A. (2023). Analisis Kinerja Keuangan Yang Ditinjau Melalui Rasio Likuiditas Dan Profitabilitas PT Merck Tbk. Jurnal Ekonomi Dan Bisnis, 15(1), 15–24. https://doi.org/10.55049/jeb.v15i1.143

Winaya, G. Y., RM, K. M., Budiasih, I., & Wiratmaja, I. D. N. (2020). Analysis of Altman Z-Score and Zmijewski Bankruptcy Prediction in Telecommunication Sub-Sectors Registered in Indonesia Stock Exchange in 2016-2018. American Journal of Humanities and Social Sciences Research, 4(1), 313–322. http://www.ajhssr.com/wp-content/uploads/2020/01/ZQ2041313322.pdf.