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Analysis of The Altman Z Score To Predict Bankruptcy In The Mining Industry Listed on IDX for the Period 2018-2022

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Abstract. In a study entitled "Analysis of The Altman Z Score To Predict Bankruptcy In The Mining Industry Listed on IDX for the Period 2018-2022", aims to determine the potential bankruptcy of mining industry companies listed on the Indonesia Stock Exchange in 2018-2022. The research background shows that company bankruptcy is a phenomenon that often occurs and can be influenced by internal and external factors of the company. This study uses Altman's Z-Score model as an analytical tool to predict the tendency of corporate bankruptcy. The method used in this research is quantitative by summing up the variable formulation of the ratios in the financial statements according to Altman to obtain Altman's Z score. Based on the research results, it was found that PT Aneka Tambang Tbk and PT Vale Indonesia Tbk showed a healthy financial condition with a high and stable Z-Score value above 2.99 during the research period. Meanwhile, PT Archi Indonesia Tbk and PT Adaro Energy Indonesia Tbk showed bankruptcy-prone financial conditions with low Z-Score values below 2.99 during the same period. These results indicate that on average the four mining industries on the IDX in 2018-2022 show a healthy category with an overall Z-score of 3.262.

Keywords: altman; bankruptcy; industry; mining; healthy; Z score analysis.

A. INTRODUCTION

In the business world, company bankruptcy is a phenomenon that often occurs and can be influenced by internal and external factors. For example, the cost of raw materials, wages, electricity, or other costs that increase without being offset by the company's ability, competition with superior products from competitors, and deficiencies in the company's management capabilities. These events can have a negative impact on company performance and potentially lead to bankruptcy.

To anticipate bankruptcy, companies need to make early preparations to prevent unwanted things. Companies must be able to evaluate the current condition of the company to gain a clearer understanding of the current situation. Thus, they can find out

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the right steps to maintain and improve the company's weaknesses to survive and compete.

One of the tools that companies use to assess their condition is the financial statements prepared every period. By comparing the current financial statements with the financial statements of the previous period, companies can get a more accurate picture of their financial condition. One model that has proven useful in assessing bankruptcy is the Z-Score model developed by Edward I. Altman, a financial economist.

The Z-Score model is a development of multiple discriminant statistical techniques that combine the effects of several variables. The Altman model has become one of the most widely used financial analysis models in the United States. Bankruptcy analysis is very important because it can provide an indication of whether a company is threatened with bankruptcy or not. If bankruptcy occurs, it can harm many parties, including managers, investors, creditors, and employees.

Based on the importance of bankruptcy analysis, this study will focus on the use of the Altman Z-Score model in predicting the tendency of corporate bankruptcy. This research will be conducted by analyzing bankruptcy in the mining industry listed on the Indonesia Stock Exchange in the period 2018-2022. The objectives of this study are: (1) to determine indications of bankruptcy in the mining subsector; and (2) to evaluate whether the Altman Z-Score model can be used as a tool in predicting trends in corporate bankruptcy.

According to Edward I. Altman, after selecting 22 financial ratios, he found five financial ratios that can be used to detect corporate bankruptcy some time before it occurs. The five ratios include working capital to assets, retained earnings to total assets, earnings before interest and taxes to assets, market value of share capital to book value of debt, and sales to assets. This analysis is known as Z-Score analysis, which can accurately predict a company's future performance and financial condition, including whether the company is at risk of bankruptcy, vulnerable to bankruptcy, or in good health. This information is very useful for investors in making investment decisions, whether they will sell, buy, or hold their investment in the company in question. Likewise for company leaders, they need to compile, consider, and improve and make the right decisions to be accountable to shareholders and investors.

B. LITERATURE REVIEW

Bankruptcy

Bankruptcy is an undesirable situation that can occur in a company. According to Prihadi (2010: 333), a company can be categorised as bankrupt if it is unable to meet its debt obligations. Lesmana & Surjanto (2013: 174) explain that bankruptcy occurs when a company faces uncertainty in continuing its operational activities. According to Law Number 4 of 1998, bankruptcy occurs when a company is unable to pay at least one due debt, and this is decided through a legal process.

A company can be declared bankrupt if it fulfils certain requirements. According to Hartini (2009: 76), the conditions for bankruptcy of a company (debtor) are if the company has more than two creditors but is unable to pay at least one due debt, then the company can be declared bankrupt either through a request from the company itself or other related parties. Corporate bankruptcy can be caused by two factors, namely financial distress, and economic distress. Financial failure occurs when the company has difficulty in obtaining

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capital or funds, while economic failure occurs when the company is unable to finance its operational activities or experiences financial losses (Brigham & Houston, 2012: 1-3).

Information about the bankruptcy of a company has an important value for interested parties in making policies, decisions, or procedures. For investors, bankruptcy information can be used as a reference in selling shares. For creditors (Banks), bankruptcy information can assist in monitoring loans that have been given and determining companies that are eligible for loans in the future. The government can use bankruptcy information of State-Owned Enterprises (SOEs) as a reference to take preventive or countermeasures. For management, early detection of potential bankruptcy can be a clue to the bankruptcy of a company so that steps can be taken to anticipate it (Hanafi & Halim, 2012: 260).

Bankruptcy-related issues may include:

a. Financial Problems: The company faces difficulties in meeting financial obligations, such as paying maturing debts, employee salaries, or interest on debt. The inability to obtain sufficient financial resources may also be a problem.
b. Liquidity Problems: The company has difficulty generating enough cash flow to fulfil short-term obligations. This can occur if the company experiences a decline in revenue or an inability to manage cash flow efficiently.
c. Management Problems: Lack of effective management in managing the company, including inappropriate decisions in investment, financing, or business strategy. Lack of oversight and internal controls can also be an issue.
d. Operational Issues: The company's inability to generate sufficient revenue or low operational efficiency can cause a decline in financial performance and potentially lead to bankruptcy.

Internal factors that can affect corporate bankruptcy include:

a. Financial Management: Inappropriate financial policies, poor cash management, or low quality of financial reporting.
b. Capital Structure: High debt burden or unbalanced capital structure, with too many short-term liabilities compared to long-term liabilities.
c. Operating Performance: Weak operating performance, declining sales, or low profit margins can affect a company's ability to fulfil financial obligations.

External factors that can affect corporate bankruptcy include:

a. Economic Changes: Changes in general economic conditions, including economic slowdowns, interest rate fluctuations, or high inflation, can affect a company's financial performance.
b. Industry Competition: A high level of competition in the industry, the emergence of new competitors, or changes in consumer preferences may negatively impact the company's revenues and profitability.
c. Government Regulation: Changes in government policies or regulations that affect a company's operations or costs can be a significant risk factor.

Z-Score Ratio

The approach developed by Altman in 1968 uses the Multiple Discriminant Analysis (MDA) method. Altman stated that although the MDA method is not as popular as regression analysis, it has various uses including in predicting corporate bankruptcy. MDA is a statistical technique used to observe and classify data based on certain characteristics. The advantage of using this method is its ability to reduce the complexity of analysis to a few independent variables (Altman, 1968).

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The Altman method has undergone several refinements until finally the Altman Z-Score method emerged. There are differences in variable coefficients between the 1968 Altman method and the Altman Z-Score method. The Altjman Z-Score method has a fairly high accuracy rate. The discriminant function of the Altman Z-Score model is as follows:

$$Z = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.42X_4 + 0.988X_5$$

Description=
Z = Bankruptcy Index
X_1 = Working Capital / Total Asset
X_2 = Retained Earning / Total Asset
X_3 = Earning Before Interest and Tax / Total Asset
X_4 = Market Value of Equity / Total Debt
X_5 = Sales / Total Assets

a. Working Capital to Total Assets Ratio. This ratio describes the liquidity of the company by comparing working capital to total assets. Working capital is calculated by subtracting current liabilities from current assets. This ratio can identify liquidity problems in the company, such as high debt that is difficult to control or cash shortages.

b. Retained Earnings to Total Assets Ratio. This ratio measures the company's ability to generate profits by comparing retained earnings to total assets. Retained earnings are used as additional capital for the company. The comparison between retained earnings and working capital provides an overview of the company's ability to earn profits.

c. Ratio of Earnings Before Interest and Taxes to Total Assets. This ratio illustrates the company's ability to generate profits by comparing earnings before interest and taxes with total assets. This income is the company's overall income after deducting operating expenses. This ratio is also known as operating profit in financial statements.

d. Ratio of Market Value of Capital to Book Value of Total Debt. This ratio indicates the company's ability to meet long-term obligations from the value of common stock. This ratio is obtained by comparing the market value of common stock to the book value of total debt. This measurement gives an idea of the extent to which the value of assets can fall before the value of debt exceeds the value of assets.

e. Sales to Total Assets Ratio. This ratio illustrates the company's efficiency in generating sales by comparing total sales to total assets. This ratio indicates the company's ability to manage funds invested in asset turnover. A low ratio indicates low corporate earnings and may indicate an unhealthy financial condition.

The Altman Z-Score method has advantages and disadvantages in predicting bankruptcy. The advantages include ease of application to a wide range of companies, the use of a combination of financial ratios, assigning a value to each coefficient of the financial ratios, a high level of accuracy, and having a more specific bankruptcy index with three categories. However, the disadvantages include unsuitability for new loss-making companies, possible manipulation of financial statements, and other factors.

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C. RESEARCH METHODOLOGY

Research Method

This research uses quantitative methods that focus on quantitative measurements of each variable and the relationship between variables.

The population of this study includes mining companies listed on the Indonesia Stock Exchange in the period 2018-2022. The research sample consists of:

a. PT Aneka Tambang Tbk (ANTM)
b. PT Archi Indonesia Tbk (ARCI)
c. PT Adaro Energy Indonesia Tbk (ADRO)
d. PT Vale Indonesia Tbk (INCO)

Variable identification is as follows:

a. X1 = Ratio of working capital to total assets
b. (current assets - current liabilities) ÷ total assets
c. X2 = Retained earnings to total assets ratio
   retained earnings ÷ total assets
d. X3 = Ratio of earnings before interest and tax to total assets
   EBIT ÷ total assets
e. X4 = Ratio of market value of capital to total debt
   (number of shares * share price) ÷ total debt
f. X5 = Ratio of sales to total assets
   sales ÷ total assets

2. Data Analysis Technique

In this study, a quantitative data analysis method was used, which involves the use of numerical calculations from financial statements such as balance sheets, profit and loss, and sales. The purpose of this analysis is to provide a basis that can be used in decision making. The following are the analysis techniques used in this study:

a. Calculate several financial ratios of companies contained in the research sample.
b. The results of the calculation of financial ratios are then analysed using the formula developed by Altman:

$$\mathbf{Z = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.42X_4 + 0.988X_5}$$

(Hanafi, 2008:656)

Description=
Z = Bankruptcy Index
X_1 = Working Capital / Total Asset
X_2 = Retained Earning / Total Asset
X_3 = Earning Before Interest and Tax / Total Asset
X_4 = Market Value of Equity / Total Debt
X_5 = Sales / Total Assets

c. Analyse each research sample according to Altman's bankruptcy criteria as follows:

Num.	Z-Score Altman	Predicate
1.	Zi > 2,99	Healthy
2.	1,81 < Zi < 2,99	Bankruptcy-prone (*Grey Area/Zone of Ignorance*)
3.	Zi < 1,81	Bankrupt

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D. RESULTS AND DISCUSSION

Calculation of Altman's Z Score Analysis

PT Aneka Tambang Tbk.

Table 1. PT Aneka Tambang Tbk 2018-2022 Z-Score Altman

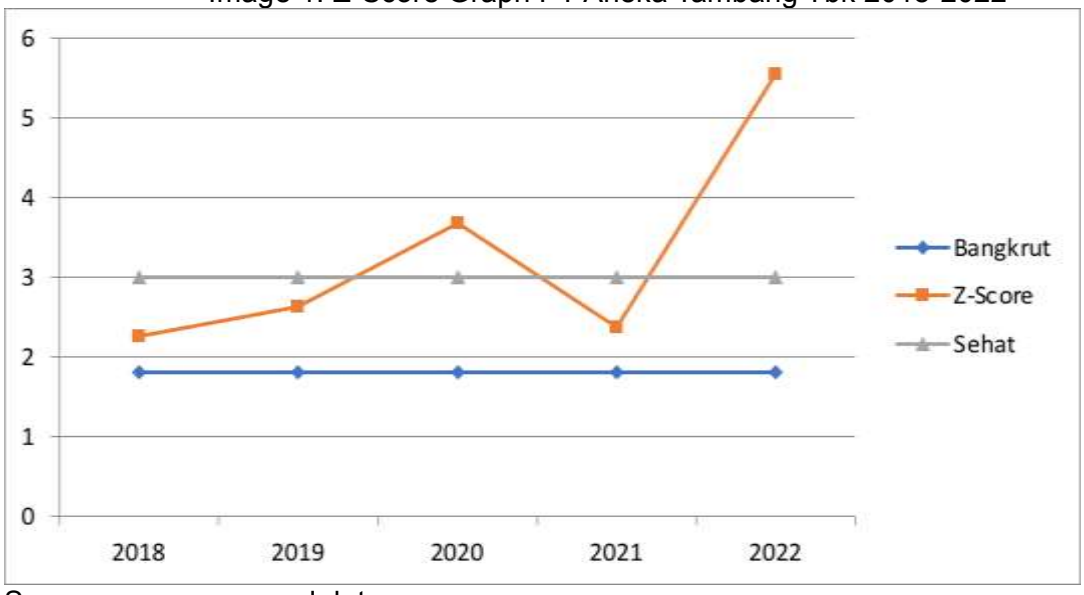
Period	*Z-Score Altman*					Zi	Predicate
	X1	X2	X3	X4	X5		
2018	0.090	0.318	0.038	1.355	0.758	2.249	Bankruptcy-prone
2019	0.079	0.262	0.023	1.674	1.084	2.624	Bankruptcy-prone
2020	0.050	0.277	0.052	3.664	0.863	3.680	Healthy
2021	0.157	0.312	0.092	0.448	1.168	2.367	Bankruptcy-prone
2022	0.158	0.397	0.157	4.809	1.386	5.536	Healthy
Average	**0.107**	**0.313**	**0.072**	**2.390**	**1.052**	**3.291**	**Healthy**

Source: own processed data

From the data above that for 5 years from 2018-2022, PT Aneka Tambang Tbk is in a safe position on average on its Altman Z score. In 2018 and 2019, the company had a score below 2.99, which indicates a bankruptcy-prone condition. However, in 2020, the company managed to increase its score to 3.680, which indicates a healthier financial condition. Then, in 2021, the score dropped again to 2.367, which again indicates a higher level of bankruptcy risk. However, in 2022, the company managed to improve its financial condition and reached a score of 5.536, indicating a healthy condition.

This analysis shows that PT Aneka Tambang Tbk experiences changes in financial performance and bankruptcy risk from year to year. Graphically, the Z score fluctuations can be seen as follows:

Image 1. Z-Score Graph PT Aneka Tambang Tbk 2018-2022



Source: own processed data

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PT. Archi Indonesia Tbk.

Table 3. PT. Archi Indonesia Tbk. 2018-2022 Z-Score Altman

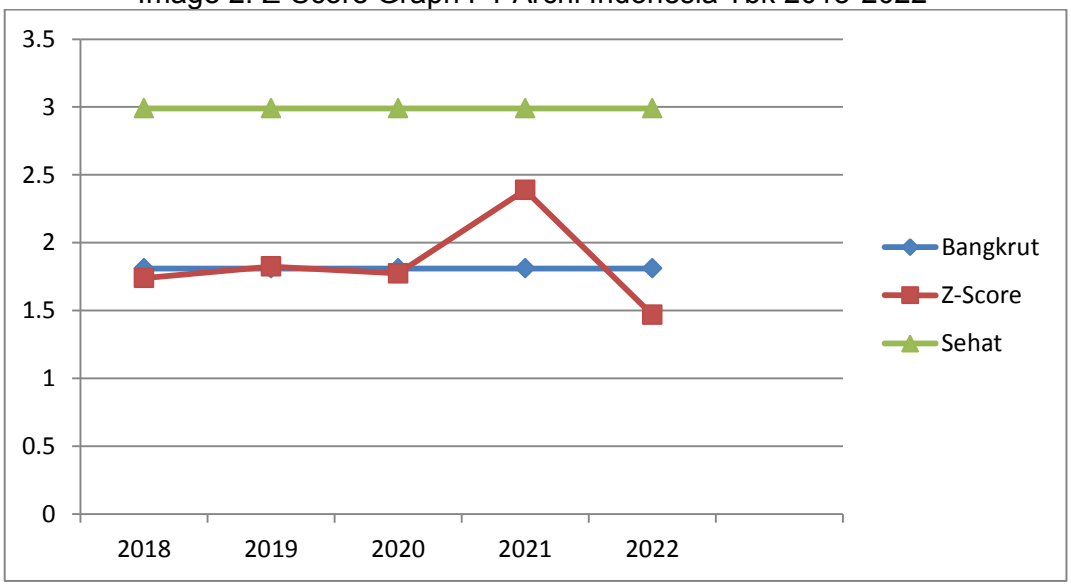
Period	*Z-Score Altman*					Zi	Predicate
	X1	X2	X3	X4	X5		
2018	0.136	0.171	0.238	-	0.552	1.739	Bankrupt
2019	0.110	0.205	0.236	-	0.626	1.824	Bankruptcy Prone
2020	- 0.040	0.077	0.321	-	0.655	1.774	Bankrupt
2021	- 0.177	0.177	0.170	2.152	0.502	2.388	Bankrupt Prone
2022	0.330	0.111	0.023	1.116	0.174	1.470	Bankrupt
Average	**0.072**	**0.148**	**0.198**	**0.653**	**0.502**	**1.839**	**Bankrupt Prone**

Source: own processed data

Based on the data above, it can be seen that PT Archi Indonesia Tbk has a low Altman Z-Score throughout 2018 to 2022. A score below 1.81 indicates a high probability of bankruptcy. During that period, the company experienced fluctuations in Altman's Z-Score. In 2018, 2020, and 2022, the company had a score below 1.81, which indicates a financial condition that is highly vulnerable to bankruptcy. In 2019 and 2021, the score slightly increased to between 1.81 to 2.99, which still indicates a bankruptcy-prone condition. X4 in 2018-2020 does not show a value because the industry of PT Archi Indonesia Tbk has not IPO in that year so there is no share price value on the IDX that can be a calculation of capital market value.

This analysis indicates that PT Archi Indonesia Tbk faced a high risk of bankruptcy during that period.

Image 2. Z-Score Graph PT Archi Indonesia Tbk 2018-2022



Source: own processed data

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PT. Adaro Energy Indonesia Tbk.

Table 3. PT. Adaro Energy Indonesia Tbk. 2018-2022 Z-Score Altman

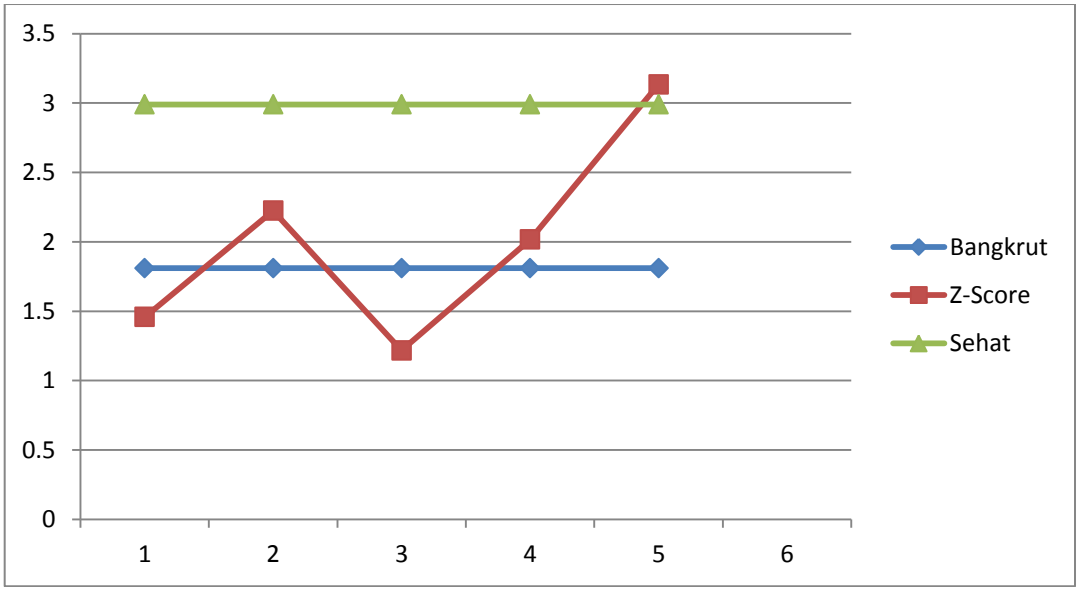
Period	*Z-Score Altman*					Zi	Predicate
	X1	X2	X3	X4	X5		
2018	0.111	0.306	0.116	-	0.513	1.458	Bankrupt
2019	0.122	0.317	0.091	1.422	0.479	2.224	Bankruptcy Prone
2020	0.092	0.368	0.035	0.134	0.397	1.218	Bankrupt
2021	0.195	0.367	0.196	0.161	0.526	2.017	Bankrupt Prone
2022	0.266	0.416	0.415	0.185	0.751	3.134	Healthy
Average	**0.157**	**0.355**	**0.171**	**0.380**	**0.533**	**2.010**	**Bankrupt Prone**

Source: own processed data

Based on the data above, PT Adaro Energy Indonesia Tbk experienced variations in Altman's Z-Score during the period. In 2018, 2019, and 2020, the company had a score below 1.81, which indicates a financial condition that is vulnerable to bankruptcy. In 2021, the score slightly improved to be within the bankruptcy-prone range. However, in 2022, the company managed to achieve a score above 2.99, indicating a healthy financial condition.

This analysis shows that PT Adaro Energy Indonesia Tbk experienced an improvement in financial health from 2021 to 2022.

Image 3. Z-Score Graph PT Adaro Energy Indonesia Tbk 2018-2022



Source: own processed data

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PT. Vale Indonesia Tbk.

Table 4. PT. Adaro Energy Indonesia Tbk. 2018-2022 Z-Score Altman

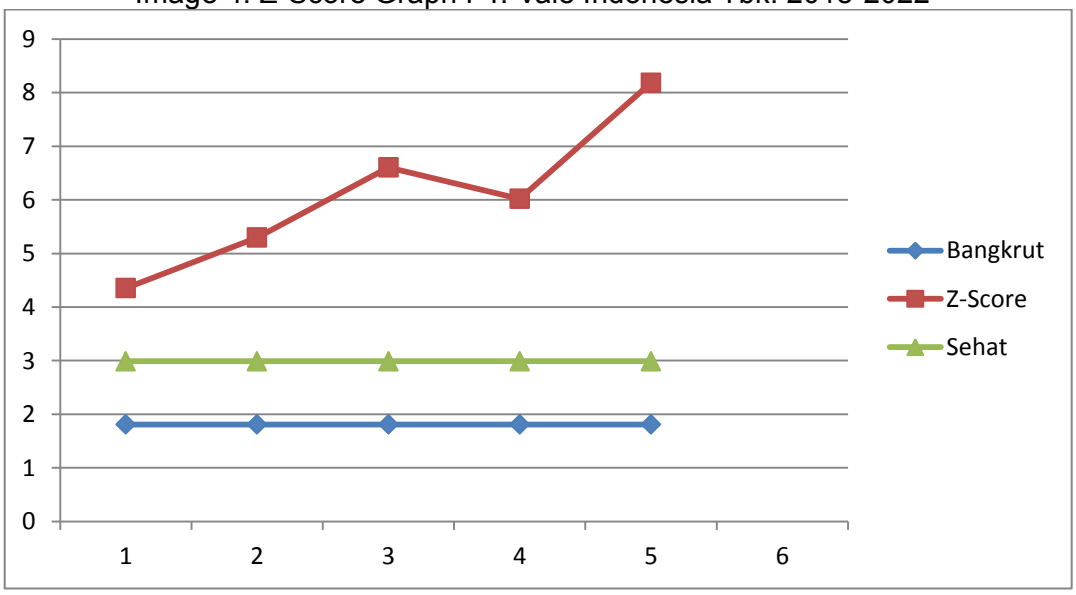
Periode	*Nilai Z Score*					Zi	Predikat
	X1	X2	X3	X4	X5		
2018	0.207	0.667	0.038	7.057	0.353	4.353	Healthy
2019	0.203	0.687	0.040	9.262	0.352	5.297	Healthy
2020	0.231	0.694	0.045	12.262	0.330	6.605	Healthy
2021	0.270	0.704	0.089	10.235	0.385	6.021	Healthy
2022	0.307	0.730	0.104	14.934	0.444	8.182	Healthy
Average	**0.244**	**0.696**	**0.063**	**10.750**	**0.373**	**6.092**	**Healthy**

Source: own processed data

In Altman's Z-Score method, a score above 2.99 indicates a healthy financial condition. All scores given to PT Vale Indonesia Tbk during the period are above 2.99, indicating that the company is in a healthy financial condition and has a low risk of bankruptcy. The increase in scores from year to year indicates an improvement in the company's financial condition over time. The company seems to have managed to maintain good financial performance and manage risks well.

A consistent score above the bankruptcy threshold indicates the stability and consistency of the company's financial performance over the period.

Image 4. Z-Score Graph PT. Vale Indonesia Tbk. 2018-2022



Source: own processed data

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Analysis of Altman's Z Score to Predict Bankruptcy in the Mining Industry on the IDX in 2018-2022

Table 5. Average Z Altman score of the Mining Industry on the IDX in 2018-2022

Industry Name	*Altman Z-Score Analysis*					Zi	Predicate
	2018	2019	2020	2021	2022		
PT Aneka Tambang Tbk	2.249	2.624	3.680	2.367	5.536	3.291	Healthy
PT Archi Indonesia Tbk	1.739	1.824	1.774	2.388	1.470	1.839	Bankruptcy Prone
PT Adaro Energy Indonesia Tbk	1.458	2.224	2.224	1.218	2.017	1.828	Bankruptcy Prone
PT Vale Indonesia Tbk	4.353	5.297	6.605	6.021	8.182	6.092	Healthy
Bankruptcy Rates						**3.262**	**Healthy**

Source: own processed data

PT Aneka Tambang Tbk showed an increase in Z-Score from 2018 to 2022. In 2020, the company reached the highest score of 3,680, indicating a healthy financial position. In 2022, the company reached the highest score of 5,536, which confirms the company's financial health. The average Z-Score score of the company during the period was 3,291, which also indicates a healthy financial condition. Therefore, PT Aneka Tambang Tbk can be categorised as a healthy company in terms of bankruptcy risk.

PT Archi Indonesia Tbk has a low Z-Score value below 2.99 during the period 2018-2022. The average Z-Score of the company during the period was 1.839 which indicates a financial condition that is vulnerable to bankruptcy. Therefore, PT Archi Indonesia Tbk can be categorised as a bankruptcy-prone company in terms of bankruptcy risk.

PT Adaro Energy Indonesia Tbk also has a low Z-Score below 2.99 during the period 2018-2022. The average Z-Score of the company during the period was 1.828 which indicates a bankruptcy-prone financial condition. Therefore, PT Adaro Energy Indonesia Tbk can also be categorised as a bankruptcy-prone company in terms of bankruptcy risk.

PT Vale Indonesia Tbk has a high Z-Score which is above 2.99 for the period 2018-2022. The average Z-Score of the company during the period was 6.092 which indicates a very healthy financial position. Therefore, PT Vale Indonesia Tbk can be categorised as a healthy company in terms of bankruptcy risk.

Based on the analysis of the table above, PT Aneka Tambang Tbk and PT Vale Indonesia Tbk showed a healthy financial condition with a high and stable Z-Score value above 2.99 during the period. Meanwhile, PT Archi Indonesia Tbk and PT Adaro Energy Indonesia Tbk showed bankruptcy-prone financial conditions with low Z-Score values below 2.99 during the same period. The bankruptcy rate of state-owned banks showed an average Z-Score of 3.262 during the period, indicating a healthy financial state.

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E. CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on research conducted using the Altman Z-Score model in the mining industry listed on the Indonesia Stock Exchange in the 2018-2022 period, several significant results were found. PT Aneka Tambang Tbk and PT Vale Indonesia Tbk showed a healthy financial condition with a high and stable Z-Score value above 2.99 during the period. This indicates that these companies have a good ability to deal with bankruptcy risk and have the potential to survive in the long term. On the other hand, PT Archi Indonesia Tbk and PT Adaro Energy Indonesia Tbk showed bankruptcy-prone financial conditions with low Z-Score values below 2.99 during the same period. These results indicate that on average the four mining industries on the IDX in 2018-2022 show a healthy category with an overall Z-score value of 3.262.

Suggestion

These companies need to take prudent measures to improve their financial condition to reduce the risk of bankruptcy. While the Altman Z-Score model can provide an early indication of a company's bankruptcy propensity, it is important to consider other factors such as cash flow, other financial ratios, and industry analysis to get a completer and more accurate picture of a company's financial condition and bankruptcy risk. The results of this study provide valuable input for investors, company management, and other stakeholders in making the right investment decisions and business strategies to avoid the risk of bankruptcy.

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