

COMPARATIVE ANALYSIS OF ALTMAN, SPRINGATE AND ZMIJEWSKI MODELS IN PREDICTING BANKRUPTCY

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Abstract

This study aims to determine the potential for bankruptcy in timber sub-sector companies and their management that are listed on the Indonesia Stock Exchange for the 2017-2020 period using the Altman, Springate, and Zmijewski models and to find out the comparison of the three models. This type of research is quantitative research. The research population is the company's sub-sector of wood and its processing. The research sample is PT. SLJ Global Tbk (SULI) and PT. Tirta Mahakam Resources Tbk (TIRT). Data analysis techniques use the Altman, Springate, and Zmijewski models. The results of the study show that SULI and TIRT are predicted to experience potential bankruptcy in 2017-2021 using the Altman and Zmijewski model. 2018-2021 for SULI and 2020-2021 for TIRT using the Springate model. The results of the Mann Whitney test show that there is no difference in predicting the potential for bankruptcy of SULI and TIRT using the three models.

Keywords: *Altman (Z-Score), Springate (S-Score), Zmijewski (X-Score), and Bankruptcy.*

1. INTRODUCTION

A company was founded with the aim of getting maximum profits or profits and has the hope that the company can carry out activities for a long period of time and last. Various types of companies engaged in Indonesia include industrial companies, extractive companies, service companies, agricultural companies, trading companies and manufacturing companies. The manufacturing companies listed on the Indonesia Stock Exchange (IDX) consist of the basic chemical industry sector, the various industrial sectors and the consumer goods industry. These sectors are further divided into several sub-sectors. One of the companies included in the basic chemical industry sector, the sub-sector of wood and its processing, namely PT. SLJ Global Tbk., (SULI), and PT. Tirta Mahakam Resources Tbk., (TIRT). These two companies are engaged in producing processed wood as the main product. The development of the business world is increasing rapidly, including competition between companies in maintaining the continuity of their business. Companies that are unable to make profits will face financial problems such as losses and result in bankruptcy for the company. While carrying out its business activities, various obstacles both internal and external also approached PT. SLJ Global Tbk., (SULI), and PT. Tirta Mahakam Resources Tbk., (TIRT), thereby affecting the company's performance. Company performance can be used as one of the benchmarks for the success of a company which can be seen from the financial statements.

Based on the financial reports issued by PT. SLJ Global Tbk., (SULI), and PT. Tirta Mahakam Resources Tbk., (TIRT), in the period 2017 – 2021 it can be seen that the company experienced fluctuations. These financial reports can be an illustration of the level of financial position, especially the health of the company. In 2017 – 2021 it is known that there is a profit deficit from PT. SLJ Global Tbk (SULI), namely in 2019 and 2020 which was caused by an increase in the price of plywood due to a lack of supply and also due to the presence of Covid-19. Even so, the company was able to increase its profit again, which came from exports made after experiencing losses in the previous two years.

COMPARATIVE ANALYSIS OF ALTMAN, SPRINGATE AND ZMIJEWSKI MODELS IN PREDICTING BANKRUPTCY

Anwar¹, Reni Restriani Utami²

Then PT. Tirta Mahakam Resources Tbk. (TIRT) also experienced a profit deficit in 2018 to 2021. This was due to an increase in raw material prices and a decrease in selling prices where the loss began in 2018 and since the first 3 months of 2019. Until 2020 the decline in profits was due decreased demand for products and order cancellations. In addition, as a result of the Covid-19 pandemic, the company suspended operations for 3 months, as well as terminated employee relations which reduced the company's performance. Until 2021, the company will again experience losses due to unstable market conditions.

In addition, the two companies in 2020 and 2021 received a special notation from the Indonesia Stock Exchange because the latest financial statements showed negative equity because the companies recorded continuous losses so that the balance of minus profits recorded in the financial statements would erode the company's equity. Based on this, the company always tries to find various solutions and policies to avoid bankruptcy.

Bankruptcy is something that all companies avoid as much as possible. The bankruptcy of a company is characterized by financial distress, or financial difficulties which are also known as "financial crisis", referring to a situation when cash flow is insufficient to compensate for current debt (Sudrajat & Wijayanti, 2019:116). Financial Distress is a situation where the company is weak in generating profits or the company tends to experience a deficit. Financial distress or financial difficulties can be a sign of bankruptcy so it is necessary to predict bankruptcy. There are various models that can be used to predict the bankruptcy of a company, including the Altman model (Z-Score), the Springate model (S-Score) and the Zmijewski model (X-Score). Broadly speaking, all models used can be a signaling factor for the company's financial condition in certain situations and periods. Research using these various methods can show different results and levels of accuracy depending on the number of samples used, thereby affecting the overall level of prediction accuracy (Desmawati *et al.*, 2016: 3).

It can be said that the bankruptcy prediction analysis is carried out to obtain an early warning of bankruptcy. In addition, the earlier the signs of bankruptcy are known, the better it is for management to make improvements and for creditors and shareholders to make preparations to deal with various bad possibilities. In predicting the potential bankruptcy of PT. SLJ Global Tbk (SULI), and PT. Tirta Mahakam Resources Tbk. (TIRT), can use the Altman Model (Z-Score), the Springate model (S-Score), and the Zmijewski model (X-Score), in order to determine the consistency of the conditions of financial performance and to be able to make preparations to overcome various bad possibilities. Much research has been done on bankruptcy prediction before, but there are inconsistent results in several studies such as different research objects or even the same research object giving different research results regarding which predictive model is best for predicting bankruptcy in that object. Thus, with the difference in the results of previous studies, it becomes the basis for conducting research to test the right company bankruptcy prediction model.

The purpose of this research is to first identify and analyze the potential for bankruptcy in timber and timber processing sub-sector companies listed on the Indonesia Stock Exchange using the Altman model (Z-Score), Springate model (S-Score), Zmijewski model (X-score). Then the second is to find out the differences in the assessment of potential bankruptcy in companies in the wood sub-sector and its management using the Altman model (Z-Score), the Springate model (S-Score), and the Zmijewski model (X-Score).

2. IMPLEMENTATION METHOD

a. Altman Model (Z-Score)

The Z-Score formula for predicting the bankruptcy of companies was first published by Edward I. Altman in the United States in 1968 which was used to predict the probability that companies would go bankrupt within two years (Desmawati et al., 2016: 5). The discovery of the model continues to be expanded by Altman so that its application is not only to public manufacturing companies but includes non-public manufacturing companies, non-manufacturing companies, and corporate bond companies. This is Altman's first model for a manufacturing company going public.

$$Z = 1,2X_1 + 1,4X_2 + 3,3X_3 + 0,6X_4 + 1,0X_5$$

Information:

Z = *bankruptcy index*

X₁ = *working capital / total asset*

X₂ = *retained earnings / total asset*

X₃ = *earning before interest and taxes/total asset*

X₄ = *market value of equity / book value of total debt*

X₅ = *sales / total asset.*

The classification of healthy and bankrupt companies is based on the Z-Score value, which is divided into three categories: If the Z value < 1.8, it is a bankrupt company, 1.8 < Z < 2.99, it is included in the gray area (it cannot be determined whether the company healthy or bankrupt), and Z value > 2.99, it is a company that is not bankrupt.

b. Springate Model (S-Score)

The Springate analysis model or also known as the S-Score was first carried out in 1978 by Gordon L.V Springate and produced a bankruptcy prediction model that was made to follow the Altman model. The Springate model uses Step-Wise Multiple Discriminant Analysis (MDA).

$$S = 1.03X_1 + 3.07X_2 + 0.66X_3 + 0.4X_4$$

Information:

Z = *bankruptcy index*

X₁ = *Working Capital / Total Assets*

X₂ = *EBIT / Total Assets*

X₃ = *EBIT / Current Liabilities*

X₄ = *Sales / Total Assets*

The cut-off point in the Springate model (S-Score) is if the Z value > 1.062 then it is included in the Non-Bankrupt Zones, the value 0.862 < Z < 1.062 is included in the Gray Zones and the Z value < 0.862 then it is included in the Bankrupt Zones.

c. Zmijewski Model (X-Score)

This analysis model is also known as (X-Score) was first developed in 1983 by Mark E. Zmijewski using the "probit technique" or according to experts called the probability technique to build a bankruptcy prediction model (Desmawati et al., 2016 :6). This model uses ratio analysis which measures the performance, leverage, and liquidity of a company for its prediction model. The

COMPARATIVE ANALYSIS OF ALTMAN, SPRINGATE AND ZMIJEWSKI MODELS IN
PREDICTING BANKRUPTCY

Anwar¹, Reni Restriani Utami²

variables used in the Zmijewski Model equation (X-Score) are Return of Assets (ROA), Debt Ratio, and Current Ratio. The following is the equation of the Zmijewski model.

$$X = -4,3 - 4,5X_1 + 5,7X_2 - 0,004X_3$$

Information:

X = *Bankruptcy index*

X₁ = *Return on Asset (ROA)*

X₂ = *Debt Ratio*

X₃ = *Current Ratio*

The cut-off point classification used in the Zmijewski model (X-Score) is that if the score obtained by a company exceeds 0 then the company is predicted to experience bankruptcy, conversely if the score obtained by a company has a score below 0 then the company is predicted not to experience bankruptcy.

d. Types of research

This type of research used is quantitative research. The data in this study are figures from financial reports in the form of income statements, balance sheets and cash flows.

e. Population and Research Sample

As for the population in this study are the financial reports of companies in the Timber and Its Processing Sub Sector. The sample in this study was determined using a purposive sampling technique, namely a sampling technique with several criteria as consideration. Following are the sampling criteria in this study:

1. The research sample is the timber sub-sector companies and their management which are listed on the IDX in 2017 – 2021.
2. The company used as the sample provides annual financial reports for 2017 – 2021.

Based on the sample criteria, there are two samples in this study, namely PT. SLJ Global Tbk., (SULI), and PT. Tirta Mahakam Resources Tbk., (TIRT).

f. Data analysis technique

Stages of data analysis starting from data collection in the form of financial statements of PT. SLJ Global Tbk., (SULI), and PT. Tirta Mahakam Resources Tbk., (TIRT) which consists of income statements, balance sheets and cash flows obtained from the official website of the Indonesia Stock Exchange (www.idx.co.id). Then calculate the financial ratios used in the Altman, Springate, and Zmijewski formulas, so that the score of each bankruptcy model can be known. After all the data in this study were collected and calculated, data analysis was then carried out using descriptive statistics, normality test, and Mann Whitney test which were used to answer the hypothesis.

3. RESULTS AND DISCUSSION

RESULTS

The following table is presented which is the overall ratio analysis that has been obtained at PT. SLJ Global Tbk., (SULI), and PT. Tirta Mahakam Resources Tbk., (TIRT) listed on the Indonesia Stock Exchange in 2017 – 2015.

3.1. Calculations with the Altman Model (Z-Score)

Table 1 Results of the Altman Model Analysis (Z-Score) in SULI and TIRT for the 2017 - 2021 period

ISSUER	YEAR	X1	X2	X3	X4	X5	Z- SCORE	PREDICTION
SULI	2017	-0.02	-2.59	0.01	0.69	0.80	-2.41	Bankrupt
	2018	-0.49	-2.08	0.01	0.29	0.93	-2.34	Bankrupt
	2019	-0.60	-2.09	-0.09	0.14	0.63	-3.22	Bankrupt
	2020	-0.96	-2.81	-0.25	0.14	0.62	-5.21	Bankrupt
	2021	-0.83	-2.63	0.04	0.13	0.79	-3.67	Bankrupt
TIRT	2017	0.09	-0.12	0.00	0.12	0.93	0.95	Bankrupt
	2018	0.05	-0.15	-0.04	0.08	1.13	0.89	Bankrupt
	2019	0.01	-0.21	-0.06	0.06	0.72	0.28	Bankrupt
	2020	-0.71	-1.53	-1.01	0.07	0.43	-5.87	Bankrupt
	2021	-0.51	-2.58	-0.44	0.15	0.06	-5.55	Bankrupt

Based on table 1, it is known that during 2017-2021 the two companies are predicted to experience potential bankruptcy. The ratio of working capital to total assets (X1) in SULI has decreased every year because current debt is greater than current assets so that the resulting working capital is smaller than total assets. For TIRT itself in 2017-2019 there was an increase in working capital even though in 2020-2021 the company's working capital has decreased. The ratio of retained earnings to total assets (X2) of both companies fluctuated and showed a negative value due to the company's retained earnings deficit. The ratio of earnings before interest and tax to total assets (X3) of the two companies also fluctuated and was negative in 2019-2020 for SULI and 2018-2021 for TIRT. The ratio of stock market value to debt book value (X4) also fluctuated. And the ratio of sales to total assets (X5) has fluctuated during 2017-2021.

3.2. Calculations with the Springate Model (S-Score)

Table 2 Results of the Springate Model Analysis (S-Score) in SULI and TIRT for the 2017 - 2021 period

ISSUER	YEAR	X1	X2	X3	X4	S-SCORE	CLASSIFICATION
SULI	2017	-0.02	0.01	0.02	0.80	0.33	Bankrupt
	2018	-0.49	0.01	0.03	0.93	-0.07	Bankrupt
	2019	-0.60	-0.09	-0.29	0.63	-0.83	Bankrupt
	2020	-0.96	-0.25	-1.26	0.62	-2.34	Bankrupt
	2021	-0.83	0.04	0.14	0.79	-0.32	Bankrupt
TIRT	2017	0.09	0.00	0.00	0.93	0.47	No Bankrupt
	2018	0.05	-0.04	-0.06	1.13	0.34	No Bankrupt
	2019	0.01	-0.06	-0.09	0.72	0.06	No Bankrupt
	2020	-0.71	-1.01	-2.79	0.43	-5.52	Bankrupt

COMPARATIVE ANALYSIS OF ALTMAN, SPRINGATE AND ZMIJEWSKI MODELS IN PREDICTING BANKRUPTCY

Anwar¹, Reni Restriani Utami²

	2021	-0.51	-0.44	-2.35	0.06	-3.42	Bankrupt
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Based on table 2, it is known that in 2017 SULI is predicted not to go bankrupt while in 2018-2021 the company is predicted to go bankrupt and for TIRT in 2017-2019 it is predicted not to go bankrupt while in 2020-2021 it is predicted not to go bankrupt. The ratio of working capital to total assets (X1) in SULI has decreased every year because the value of current liabilities is greater than the value of current assets so that the working capital generated is smaller than the value of total assets. For TIRT itself in 2017-2019 there was an increase in working capital even though in 2020-2021 the company's working capital has decreased. For the ratio of profit before interest and tax to total assets (X2) and the ratio of profit before interest and tax to current debt (X3) both companies experienced fluctuations and were negative in 2019-2020 for SULI and 2018-2021 for TIRT due to profit before interest and taxes are in deficit. And the ratio of sales to total assets (X4) has fluctuated during 2017-2021.

3.3. Calculations with the Zmijewski Model (X-Score)

Table 3 Results of the Zmijewski Model Analysis (X-Score) in SULI and TIRT for the 2017 – 2021 period

ISSUER	YEAR	X1	X2	X3	X-SCORE	CLASSIFICATION
SULI	2017	0.02	0.99	0.96	1.26	Bankrupt
	2018	0.03	0.95	0.46	0.97	Bankrupt
	2019	-0.09	0.96	0.34	1.55	Bankrupt
	2020	-0.25	1.21	0.17	3.72	Bankrupt
	2021	0.04	1.16	0.26	2.15	Bankrupt
TIRT	2017	0.00	0.86	1.15	0.57	Bankrupt
	2018	-0.04	0.91	1.08	1.03	Bankrupt
	2019	-0.06	0.96	1.02	1.43	Bankrupt
	2020	-1.05	1.99	0.34	11.76	Bankrupt
	2021	-0.45	2.82	0.27	13.79	Bankrupt

Based on table 3, it is known that both companies are predicted to go bankrupt during 2017-2020. The ratio of net profit to total assets (X1) at SULI has fluctuated and was negative in 2019-2020 due to a deficit in net profit. For TIRT itself, it has decreased every year due to a deficit in net profit obtained. The ratio of total debt to total assets (X2) fluctuates where the company's total debt is greater than total assets. And the ratio of current assets to current liabilities (X3) of the two companies experienced fluctuations with the company's current debt being greater than its current assets.

3.4. Calculation of Descriptive Statistics

Table 4 Descriptive Statistical Results

	N	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
ALTMAN	10	-5.87	.95	-2.6146	.82316	2.60305
SPRINGATE	10	-5.52	.47	-1.1290	.63361	2.00365
ZMIJEWSKI	10	.57	13.80	3.8240	1.52463	4.82130

From table 4 above it can be seen that the Altman model score has a minimum value of -5.87, a maximum value of 0.95, a mean value of -2.6146, and a standard deviation value of 2.60305. As for the Springgate model, the minimum value is -5.51, the maximum value is 0.47 and the mean value is -1.1290 with a standard deviation of 2.00365. The Zmijewski model has a minimum value of 0.57, a maximum value of 13.80 and a mean value of 3.8240 with a standard deviation of 4.82130.

Table 5 Normality Test Results

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
ALTMAN	.167	10	.200*	.900	10	.217
SPRINGATE	.260	10	.055	.797	10	.013
ZMIJEWSKI	.336	10	.002	.669	10	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on table 5 it is known that the Kolmogorov-Smirnov test results for the Altman, Springate and Grover models have a Sig value > 0.05, so the data is normally distributed. Then for the Kolmogorov-Smirnov test results the Zmijewski model has a Sig value <0.05, so the data is not normally distributed. Because there are some data that are not normally distributed, then non-parametric testing is carried out.

Table 6. Mann Whitney Test Results for the Altman and Springate Models

ALTMAN & SPRINGATE	
Mann-Whitney U	9.000
Wilcoxon W	145.000
Z	-2.174
Asymp. Sig. (2-tailed)	.030
Exact Sig. [2*(1-tailed Sig.)]	.029 ^b

a. Grouping Variable: Evaluation

b. Not corrected for ties.

Based on the SPSS output results in table 6, the Asymp.Sig (2-tailed) value is 0.030, it is concluded that the hypothesis is rejected, meaning that there is no significant difference between the Altman model and the Springate model.

Table 7. Results of the Mann Whitney Test of the Altman and Zmijewski Models

	Evaluation	N	Mean Rank	Sum of Ranks
ZMIJEWSKI & OHLSON	Bankrupt	20	10.50	210.00
	No bankrupt	0 ^a	.00	.00
	Total	20		

a. Mann-Whitney Test cannot be performed on empty groups.

COMPARATIVE ANALYSIS OF ALTMAN, SPRINGATE AND ZMIJEWSKI MODELS IN PREDICTING BANKRUPTCY

Anwar¹, Reni Restriani Utami²

Table 7 displays the SPSS output results which only display rank values because the Altman and Zmijewski models predict bankruptcy so it can be concluded that there is no difference between the two models.

Table 8. Springate and Zmijewski Mann Whitney Model Test Results

	SPRINGATE & ZMIJEWSKI
Mann-Whitney U	37.000
Wilcoxon W	157.000
Z	-.044
Asymp. Sig. (2-tailed)	.965
Exact Sig. [2*(1-tailed Sig.)]	1.000 ^b

a. Grouping Variable: Evaluation

Based on the SPSS output results in table 8, the Asymp.Sig (2-tailed) value is 0.450. It can be concluded that the hypothesis is rejected, meaning that there is no significant difference between the Springate model and the Zmijewski model.

DISCUSSION

Based on table 1 it can be seen that by using the Altman analysis model (Z-Score) PT SLJ Global Tbk (SULI) and PT. Tirta Mahakam Resources Tbk (TIRT) during the 2017-2021 period is predicted to experience potential bankruptcy. This means that the two companies have poor financial performance. SULI's operating profit has fluctuated, which has a deficit value starting from 2019-2020, followed by a decrease in sales and an increase in operational expenses. total debt has increased due to an increase in the company's current debt to finance the business of suppliers of raw materials and other production. In addition, the company's current assets decreased as a result of a decrease in operating income. For TIRT itself, there has been a decrease in operating profit which is a deficit starting in 2018-2021 accompanied by sales which have also decreased as a result of rising raw material prices, cancellations of purchases. As well as the decrease in current assets as a result of a decrease in cash and bank accounts, receivables, inventories and prepaid taxes due to the company temporarily stopping production activities.

Based on table 2, it is known that the potential for bankruptcy at PT SLJ Global Tbk (SULI) and PT. Tirta Mahakam Resources Tbk (TIRT) using the Springate analysis model (S-Score) in 2017 SULI is predicted not to experience bankruptcy potential, which means that the company can maintain its financial performance well so that it can avoid financial difficulties which are the initial stages of bankruptcy. However, in the following year, the company is predicted to experience potential bankruptcy, starting from 2018 to 2021 due to the value of working capital to total assets which is negative and also the value of the company's retained earnings which has experienced a deficit for 5 years and decreased sales. This means that the company has poor financial performance so that the company experiences financial difficulties, where financial difficulties are the initial stages of bankruptcy. For TIRT, during the period 2017 to 2019, it is predicted that the company will not experience the potential for business bankruptcy. As for 2020 to 2021, the company is predicted to experience the potential for bankruptcy as a result of declining sales, earnings before interest and

tax on total assets and the value of profit before interest and tax on current debt which is negative, this is due to the value of profit before interest and tax experienced a deficit, as well as decreased total assets and current asset values.

Based on table 3 it is known that PT. SLJ Global Tbk., (SULI) and PT. Tirta Mahakam Resources Tbk., (TIRT) is predicted to go bankrupt during the period 2017 – 2021 using the Zmijewski analysis model (X-Score). SULI in 2017 to 2021 is predicted to experience potential business bankruptcy. This is caused by the company's net profit which has fluctuated, in 2018 net profit has increased but in 2019 and 2020 the company's net profit has experienced a deficit, even though in 2021 net profit has increased, the company remains in a position predicted to experience bankruptcy potential. Total debt is also a factor for companies predicted to experience bankruptcy, this is because the company's total debt continues to increase every year while the company's total assets have fluctuated plus in 2018 to 2021 it has decreased. For TIRT in 2017 the net profit earned was quite low, this was due to an increase in cost of goods sold. Then in the following years net profit experienced a deficit as a result of decreased sales, an increase in a number of cost of goods sold, operating expenses, an increase in raw material prices and a decrease in selling prices and also the result of Covid - 19. In addition, in the year the company's asset value in 2017 – 2021 experienced fluctuations, especially in 2020 and 2021 decreased while total debt in that year increased.

Based on the hypothesis testing that has been carried out using the Mann Whitney test, it is known that H_1 , H_2 , H_3 are rejected so it can be concluded that there is no difference in predicting the potential bankruptcy of timber sub-sector companies and their management using the Altman model with Springate, Altman with Zmijewski, and Springate. with Zmijewski. This is in line with research conducted by Putera et al., (2016) which concluded that there was no difference in the prediction of financial distress with the Altman, Springate and Ohlson models in coal mining companies listed on the Indonesia Stock Exchange in the 2008 – 2014 period. conducted by Rohma & Danny, (2021) is not in line with the results of this study. His research shows that there are differences in scores in predicting financial distress between the Altman model, the Springate model, and the Zmijewski model.

4. CONCLUSION

The results of the study show that SULI and TIRT are predicted to experience potential bankruptcy in 2017-2021 using the Altman and Zmijewski model. 2018-2021 for SULI and 2020-2021 for TIRT using the Springate model, 2018-2021 for SULI and 2019-2021 for TIRT. The Mann Whitney test results show that there is no difference in predicting the potential for bankruptcy of SULI and TIRT using the Altman model with Springate, Altman with Zmijewski, Springate with Zmijewski.

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COMPARATIVE ANALYSIS OF ALTMAN, SPRINGATE AND ZMIJEWSKI MODELS IN PREDICTING BANKRUPTCY

Anwar¹, Reni Restriani Utami²

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