



## ANALYSIS OF BANKRUPTCY PREDICTION WITH COMPARISON OF SPRINGATE AND ZMIJEWSKI MODELS ON STATE-OWNED COMPANIES IN THE INFRASTRUCTURE SECTOR LISTED ON THE IDX

Dea Selvani<sup>1</sup>, Afrah Junita<sup>2</sup>, Tuti Meutia<sup>3\*</sup>

<sup>1, 2, 3</sup> Universitas Samudra, Langsa, Indonesia

Corresponding E-mail: <sup>1</sup>[deaselvani@gmail.com](mailto:deaselvani@gmail.com), <sup>2</sup>[afrah@unsam.ac.id](mailto:afrah@unsam.ac.id), <sup>3\*</sup>[tuti\\_meutia@unsam.ac.id](mailto:tuti_meutia@unsam.ac.id)

### Abstract

This study aims to determine the prediction of potential bankruptcy in State-Owned Enterprise companies in the Infrastructure sector listed on the Indonesia Stock Exchange using the Springate and Zmijewski models. The data used in this study are the company's financial statements published on the Indonesia Stock Exchange. Populasi in this study is all 9 companies of State-Owned Enterprises in the Infrastructure sector listed on the Indonesia Stock Exchange. Sampling technique using purposive sampling, so that 7 companies can be used as research samples. The data analysis method uses bankruptcy prediction models including Springate and Zmijewski and uses different tests on both prediction models with normality test and Kruskal-Wallis H test. The results showed that the springate prediction model predicts more companies that have the potential to go bankrupt while the zmijewski model does not, the springate model has an accuracy rate of 67% in predicting bankruptcy, while the zmijewski model is only 29%, so in this study the springate model is the most appropriate model to predict company bankruptcy..

Keywords: *bankruptcy, springate, zmijewski, infrastructure.*

### 1. INTRODUCTION

One of the most important sectors in development in Indonesia is infrastructure. At present, the government's infrastructure development has increased drastically. Infrastructure development carried out must have an impact on local industries, so that it will increase domestic production and economy. In addition to increasing equitable distribution of development, production and the national economy, infrastructure development is also a factor that encourages state companies, namely State-Owned Enterprises (SOEs), especially SOEs in the Infrastructure Sector. SOEs definitely need large capital to be involved in infrastructure projects. Therefore, debt is one of the ways SOEs get funds. As revealed by Finance Minister Sri Mulyani Indrawati in *kompas.com* news (2021) that 55% of SOEs receiving capital injections in 2020 have debt above the industry average, 9% of SOEs receiving PMN have negative or eroded equity and only 2% of SOEs receiving PMN have debt comparable to the industry average, only 2% of SOEs receiving PMN whose debt is comparable to the industry average and the other 34% have debt below the industry average.

Bankruptcy is a very important issue and must be watched out for by companies (Chess, 2020). Things that can be done by companies to avoid bankruptcy are by analyzing bankruptcy predictions. The bankruptcy of an enterprise can be predicted long before it occurs. Therefore, the bankruptcy of the company can be detected quickly. To detect the possibility of bankruptcy in a company is usually seen from its financial statements. However, not all company financial statements can be seen, but only the financial statements of companies that go public or that have been listed on the Indonesia Stock Exchange. In Indonesia, there are 7 state-owned companies in



the infrastructure sector that have been listed on the Indonesia Stock Exchange, namely PT Adhi Karya (Persero) Tbk, PT Waskita Karya, (Persero) Tbk, PT Wijaya Karya (Persero), PT Pembangunan Perumahan (Persero) Tbk, PT Jasa Marga (Persero) Tbk, PT Semen Indonesia (Persero) Tbk, and PT Semen Baturaja.

Debt and equity are part of the gauge of bankruptcy conditions. The debt condition of the seven companies continues to increase from 2019-2021, while the equity condition for the last 3 years is unstable, this shows that increasing debt and declining equity can cause companies to experience financial difficulties. This can cause the company to go bankrupt.

There are several bankruptcy prediction analysis models, including the Altman Z-Score, Springate, Zmijewski, and Grover models, each of which has a high degree of accuracy, but there are inconsistencies in the results in some studies that analyze which model is best. Kiki Fatimah A and Sriwardany, (2021) conducted research on bankruptcy prediction analysis with Springate and Zmijewski models in measuring the Company's health level at PT. Star Persada Satellite. The results showed a marked difference between the Springate and Zmijewski models, Springate models using the *Wallis H Kruskal* Test. The most accurate predictive model in predicting the bankruptcy of PT. Bintang Persada Satellite is Zmijewski with 100% accuracy rate while Springate model with 50% accuracy rate. The research is not in line with research conducted by Permana et al (2017) on *predictions of financial distress* in Manufacturing Companies on the Indonesia Stock Exchange with Grover, Springate and Zmijewski models. The results showed that, compared to Grover and Zmijewski's model, Springate's model was the best predictive model. The results showed that, compared to Grover and Zmijewski's model, Springate's model was the best predictive model.

The authors are interested in analyzing Springate and Zmijewski's model further to measure the health level of companies with state-owned infrastructure sector companies listed on the Indonesia Stock Exchange because there are differences in accuracy in the models used in previous studies. In addition, the Springate and Zmijewski models have advantages, namely being able to combine various financial ratios together and being easy to apply which makes the author interested in using this bankruptcy prediction model in a study entitled "Analysis of Bankruptcy Prediction with Comparison of Springate and Zmijewski Models on State-Owned Companies in the Infrastructure Sector Listed on the IDX".

## 2. IMPLEMENTATION METHOD

This research is a quantitative descriptive research with approach. The type of data used is in the form of quantitative data. Data sources used in this study include secondary data in the form of financial statements obtained from the official website of the Indonesia Stock Exchange. The population in this study is all state-owned companies in the infrastructure sector listed on the IDX in the period 2012-2021, which is as many as 9 companies. Sampling uses the *purposive sampling* method where the method determines the sample based on certain criteria. The data analysis technique uses 2 prediction models, each of which has differences in its calculations, namely the Springate and Zmijewski models, then uses different tests on both prediction models with normality tests and Kruskal-Wallis H tests, he continued Compare the two bankruptcy prediction



models to find out the percentage accuracy rate of each model, with the accuracy test of each prediction model.

$$\text{Accuracy Rate} = \frac{\text{Number of Correct Predictions}}{\text{Number of Sampel}}$$

### 3. RESULTS AND DISCUSSION

#### Research Results

#### Bankruptcy Analysis With Springate Model

The Springate model is formulated in a formula as follows:

$$S = 1.03A + 3.07B + 0.66C + 0.4D$$

Information:

A = Working Capital/Total Assets

B = Earnings before Interest and Taxes/Total Assets

C = Profit before Tax/Total Liabilities

D = Sales/Total Assets

**Table 1. Bankruptcy Prediction Index Using Springate Model**

Code	Year	A	B	C	D	S - Score
ADHI	2012	0.18	0.07	0.07	0.97	0.8
	2013	0.34	0.08	0.12	1.01	1.07
	2014	0.20	0.07	0.09	0.83	0.81
	2015	0.32	0.04	0.08	0.56	0.72
	2016	0.21	0.04	0.05	0.55	0.58
	2017	0.21	0.05	0.03	0.53	0.59
	2018	0.23	0.06	0.03	0.52	0.64
	2019	0.19	0.04	0.03	0.42	0.5
	2020	0.02	0.03	0.01	0.28	0.42
	2021	0.02	0.03	0.03	0.29	0.44
WSKT	2012	0.31	0.08	0.09	1.17	1.05
	2013	0.31	0.08	0.11	1.35	1.17
	2014	0.21	0.08	0.10	0.99	0.89
	2015	-0.03	0.08	0.06	0.69	0.53
	2016	0.14	0.05	0.07	0.26	0.45
	2017	0.01	0.07	0.09	0.27	0.39
	2018	0.08	0.06	0.10	0.25	0.43
	2019	-0.01	0.04	0.03	0.23	0.22
	2020	-0.21	-0.03	-0.20	0.16	-0.37
	2021	0.15	0.04	-0.00	0.17	0.08
WIKA	2012	0.06	0.08	0.13	0.90	0.75
	2013	0.05	0.10	0.14	0.94	0.81
	2014	0.06	0.09	0.14	0.78	0.75
	2015	0.10	0.08	0.07	0.69	0.67
	2016	0.29	0.07	0.09	0.50	0.76
	2017	0.21	0.05	0.06	0.57	0.63
	2018	0.27	0.06	0.08	0.53	0.72



	2019	0.20	0.06	0.09	0.44	0.62
	2020	0.05	0.02	0.01	0.24	0.22
	2021	0.01	0.02	0.01	0.26	0.18
PTPP	2012	0.26	0.08	0.09	0.94	0.94
	2013	0.25	0.09	0.09	0.94	0.96
	2014	0.29	0.09	0.10	0.85	0.97
	2015	0.25	0.08	0.12	0.74	0.87
	2016	0.29	0.06	0.07	0.53	0.73
	2017	0.23	0.06	0.09	0.51	0.67
	2018	0.19	0.06	0.08	0.50	0.62
	2019	0.14	0.03	0.04	0.42	0.43
	2020	0.07	0.02	0.01	0.30	0.26
	2021	0.06	0.03	0.01	0.30	0.28
	JSMR	2012	-0.09	0.12	0.31	0.37
2013		-0.04	0.09	0.35	0.37	0.63
2014		-0.02	0.10	0.43	0.29	0.67
2015		-0.11	0.09	0.27	0.27	0.47
2016		-0.11	0.08	0.14	0.31	0.35
2017		-0.08	0.06	0.13	0.44	0.37
2018		-0.24	0.07	0.10	0.45	0.21
2019		-0.31	0.06	0.07	0.26	0.03
2020		-0.04	0.04	0.05	0.13	0.17
2021		-0.02	0.07	0.17	0.15	0.36
TLKM	2012	0.04	0.23	1.01	0.69	1.68
	2013	0.04	0.22	0.95	0.65	1.59
	2014	0.01	0.21	0.89	0.63	1.48
	2015	0.08	0.20	0.89	0.62	1.51
	2016	0.05	2.18	0.96	0.65	7.64
	2017	0.01	0.22	0.94	0.65	1.57
	2018	-0.01	0.19	0.79	0.63	1.34
	2019	-0.08	0.19	0.65	0.61	1.18
	2020	-0.09	0.18	0.56	0.55	1.04
	2021	-0.03	0.17	0.63	0.52	1.12
PPLN	2012	0.01	0.06	0.07	3.14	1.50
	2013	-0.01	0.07	-0.40	2.93	1.12
	2014	-0.01	0.07	0.17	2.21	1.22
	2015	-0.03	0.04	-0.10	1.81	0.72
	2016	-0.02	0.02	0.11	1.83	0.85
	2017	-0.03	0.02	0.06	1.84	0.80
	2018	-0.03	0.02	0.13	1.73	0.82
	2019	-0.01	0.03	0.16	2.26	1.09
	2020	-0.34	0.03	0.08	2.31	0.72
2021	-0.04	0.03	0.16	2.51	1.16	

Source: Primary data, processed (2023)

### Analysis with the Zmijewski model

The Springate model is formulated in a formula as follows:

$$X = -4.3 - 4.5X_1 + 5.7 X_2 - 0.004 X_3$$



Information:

$X_1$  = Net income/ total assets

$X_2$  = Total liabilities/total assets

$X_3$  = Current assets/current liabilities

**Table 2. Bankruptcy Prediction Index Using Zmijewski Model**

Code	Year	$X_1$	$X_2$	$X_3$	Z – Score
ADHI	2012	0.03	0.85	1.24	0.42
	2013	0.04	0.84	1.55	0.30
	2014	0.03	0.84	1.30	0.36
	2015	0.03	0.69	1.56	-0.49
	2016	0.02	0.73	1.29	-0.22
	2017	0.02	0.79	1.41	0.13
	2018	0.02	0.79	1.34	0.11
	2019	0.02	0.81	1.23	0.25
	2020	0.00	0.85	1.11	0.56
	2021	0.00	0.86	1.02	0.58
WSKT	2012	0.03	0.68	1.47	-0.57
	2013	0.04	0.70	1.43	-0.52
	2014	0.04	0.76	1.31	-0.13
	2015	0.04	1.04	0.96	1.46
	2016	0.03	0.79	1.27	0.05
	2017	0.04	1.00	1.00	1.19
	2018	0.04	0.85	1.18	0.36
	2019	0.01	1.01	0.99	1.40
	2020	-0.10	1.69	0.59	5.73
	2021	-0.00	0.64	1.56	-0.57
WIKA	2012	0.05	0.74	1.10	-0.28
	2013	0.05	0.74	1.10	-0.29
	2014	0.05	0.69	1.12	-0.60
	2015	0.04	0.72	1.19	-0.35
	2016	0.04	0.59	1.59	-1.10
	2017	0.03	0.68	1.34	-0.56
	2018	0.04	0.71	1.54	-0.42
	2019	0.04	0.69	1.39	-0.56
	2020	0.00	0.76	1.09	-0.02
	2021	0.00	0.75	1.01	-0.05
PTPP	2012	0.04	0.81	1.36	0.13
	2013	0.03	0.84	1.34	0.35
	2014	0.04	0.84	1.43	0.32
	2015	0.04	0.73	1.43	-0.33
	2016	0.04	0.65	1.55	-0.74
	2017	0.04	0.66	1.45	-0.73
	2018	0.04	0.72	1.34	-0.39
	2019	0.02	0.73	1.28	-0.20
	2020	0.01	0.74	1.14	-0.11
	2021	0.01	0.74	1.12	-0.10
JSMR	2012	0.06	0.60	0.68	-1.14



	2013	0.04	0.64	0.78	-0.87
	2014	0.04	0.65	0.82	-0.75
	2015	0.04	0.66	0.49	-0.69
	2016	0.03	0.69	0.70	-0.50
	2017	0.03	0.77	0.76	-0.05
	2018	0.02	0.75	0.37	-0.12
	2019	0.02	0.77	0.28	-0.03
	2020	-0.00	0.76	0.72	0.04
	2021	0.01	0.75	0.86	-0.08
TLKM	2012	0.16	0.40	1.16	-2.77
	2013	0.16	0.39	1.16	-2.77
	2014	0.15	0.39	1.06	-2.73
	2015	0.14	0.44	1.35	-2.44
	2016	0.16	0.41	1.20	-2.68
	2017	0.16	0.44	1.05	-2.57
	2018	0.13	0.43	0.94	-2.44
	2019	0.12	0.47	0.71	-2.19
	2020	0.12	0.51	0.67	-1.94
	2021	0.12	0.48	0.89	-2.15
PPLN	2012	0.01	0.68	1.02	-0.45
	2013	-0.00	0.75	0.95	0.14
	2014	0.02	0.75	0.98	-0.12
	2015	0.00	0.39	0.66	-2.12
	2016	0.01	0.31	0.81	-2.57
	2017	0.00	0.35	0.67	-2.33
	2018	0.01	0.38	0.72	-2.18
	2019	0.00	0.41	0.95	-1.96
	2020	0.04	4.09	0.65	18.8
	2021	0.01	0.39	0.59	-2.11

Source: Primary data, processed (2023)

### Descriptive Statistical Results

Descriptivestatistical statistics are performed to provide an overview or description of data seen from minimum, maximum and mean values.

**Table 3 Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
S_Score	70	-.37	7.64	.8267	.92397
Z_Score	70	-2.80	18.80	-.2721	2.65974
Valid N (listwise)	70				

Source: Primary data, processed (2023)

### Normality Test Results

In the normality test, the data is assumed to be normal if the probability value is  $> 0.05$ . Conversely, if the probability value is  $< 0.05$  then the data is said to be abnormal because it does not meet the assumption of normality, then the test is carried out using the *Kolmogorof Smirnov Test*.



**Table 4 One-Sample Kolmogorov-Smirnov Test**

		S_Score	Z_Score
N		70	70
Normal Parameters <sup>a,b</sup>	Mean	.8267	-.2721
	Std. Deviation	.92397	2.65974
Most Extreme Differences	Absolute	.223	.303
	Positive	.223	.303
	Negative	-.196	-.171
Test Statistics		.223	.303
Asymp. Sig. (2-tailed)		.000 <sup>c</sup>	.000 <sup>c</sup>

Source : Primary data, processed (2023)

- a. Test distribution is Normal.
- b. Calculated from data.
- c. Lilliefors Significance Correction.

Based on the results of the normality test with the *One-Sample Kolmogorov-Smirnov Test* in table IV-13, the *Asymp. Sig. (2-tailed)* for Springate and Zmijewski's calculation models are 0.000 and 0.000, respectively. Because the significance value of Springate and Zmijewski  $< 0.05$ , the normality assumption is not met, so the test is carried out using the *Kruskal Wallis H Test* or *H-test*.

### **Kruskal Wallis-Test Results (Difference Test)**

The *Kruskal-Wallis* test is a non-parametric statistical technique used as an alternative to the *One Way Anova* test when the normality assumption is not met.

**Table 5 Kruskal Wallis-Test Results**

Ranks			
	model_prediksi_kebangkrutan	N	Mean Rank
Predictions	S_score	70	98.47
	Z_Score	70	42.53
	Total	140	

Source: Primary Data, processed (2023)

### **Test Statistics<sup>a,b</sup>**

	Predictions
Chi-Square	66.607
Df	1
Asymp. Sig.	.000

Source : Primary Data, processed (2023)

- a. Kruskal Wallis Test
- b. Grouping Variable: bankruptcy prediction model

Based on the calculation results in table 4, it is known that the *value of Asymp. Sig.* is 0.000  $< 0.05$ . Thus, it can be concluded that the test is rejected which means that there is a significant difference between Springate and Zmijewski's calculation models.



## Accuracy Test Results

Based on the results of data processing, it can be known which bankruptcy prediction model is the most accurate in predicting bankruptcy in state-owned companies in the infrastructure sector listed on the IDX.

**Table 6 Accuracy Test Results**

Prediction Models	Springate	Zmijewski
Potentially Bankrupt	47	20
Not Potentially Bankrupt	23	50
Total	70	70
% Accuracy	67%	29%
% Error	33%	71%

Source: Primary Data, processed (2023)

## Discussion

The calculation results of the springate model show more financial statements from the 7 companies sampled that have the potential to go bankrupt compared to the zmijewski model. In addition to being able to be seen from the level of accuracy of each model which shows a higher level of accuracy of the springate model, it can also be viewed from the ratio used in each model. The springate model uses more ratios compared to the zmijewski model. Therefore, the springate model is a better model used to predict corporate bankruptcy. Then, when viewed from the results of the difference test, namely, the Kruskal Wallis-Test in table 5 shows that there is a significant difference between the springate and zmijewski models.

Based on table 6 which shows the results of the bankruptcy prediction accuracy test for each model, where the accuracy level of the Springate model is 67% and the error is 33% with details from 70 financial reports, as many as 47 financial reports of state-owned companies in the infrastructure sector are known to have the potential to experience bankruptcy and as many as 23 other financial reports do not have the potential to experience bankruptcy. Meanwhile, the Zmijewski model has an accuracy rate of 29% and an error of 71% with details of 20 financial reports known to have the potential to experience bankruptcy and as many as 50 other financial reports that do not have the potential to experience bankruptcy. The bankruptcy prediction model with the highest level of accuracy is the Springate model with a percentage of 67%. The highest level of accuracy shows that the Springate model has accurate predictions for state-owned companies in the infrastructure sector based on the entire existing sample. This research is in accordance with research by Ilyasa (2018) which uses the Altman Z-Score, Springate, Zmijewski, and Internal Growth Rate models in predicting financial distress in mining companies listed on the IDX with the best model results being the Springate model, the second being the zmijewski model, third is the Altman model, and the last is the internal growth rate model. This research is also in line with research by Melissa and Banjarnahor (2020) regarding bankruptcy prediction analysis using the Altman z-score, springate and zmijewski models which are listed on the Indonesia Stock Exchange, where the results of the research show that the springate model is the bankruptcy prediction model that has the highest level of accuracy. 98%, the Altman Z-Score model has an accuracy rate of 90% and the Zmijewski model has an accuracy rate of 80%. Meanwhile, research conducted by Dewi (2018) which examined retail companies listed on the IDX using the Springate





and Zmijewski models showed that there was no significant difference between the Springate and Zmijewski methods in predicting the bankruptcy of retail companies listed on the Indonesia Stock Exchange (IDX) period. 2015-2016.

#### 4. CONCLUSION

Based on the results and discussion, it can be concluded that the calculation results based on the springate model analysis are known that more companies have the potential to experience bankruptcy, because it is caused by the value of the company's working capital that is unstable and fluctuates, thus affecting the calculation results using the specified formula, especially in the A ratio, which is the ratio between working capital to total assets. The calculation results based on the analysis of the zmijewski model are known that more companies do not have the potential to go bankrupt, because it is caused by the value of current debt which is relatively larger and only a slight difference with the value of current assets, resulting in a value that is far from the *cut-off* value of the zmijewski model. There are significant differences between the springate model and the zmijewski model in predicting the bankruptcy of state-owned companies in the infrastructure sector listed on the Indonesia Stock Exchange. There is a difference in scores assessed by the level of accuracy between Springate and Zmijewski models in predicting bankruptcy. The difference can be seen through accuracy tests, where in this study the Springate model has an accuracy rate of 67% while the Zmijewski model has an accuracy rate of 29%. Therefore, in this study the springate model is the most appropriate model to predict company bankruptcy.

Based on the results and discussion, it can be recommended for several parties, including for companies, the results of this research can be used as material for consideration in taking steps and strategies so that bankruptcy can be prevented. For investors, the results of this research are expected to help investors in making decisions to invest in selected companies by looking at the potential for bankruptcy. Future researchers should add other bankruptcy prediction models such as Altman Z Score, Grover, Fulmer, Ohlson and others, as well as try to research companies in other sectors such as manufacturing, food and beverage and so on.

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