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## A comparative Analysis Altman (Z-Score) Revision and Springate (S-Score) Model in Predicting Financial Distress in the Manufacturing Company - Indonesia Stock Exchange

Emmelia Tan\* & Tri Aji Wibisana

Universitas Pelita Bangsa  
\*e-mail: Emmelia.tan@pelitabangsa.ac.id

### Abstract

This study aims to examine the effect of the Altman (Z-Score) Revision model and the Springate (S-Score) model and determine the better and more precision model in predicting financial distress in the manufacturing company on the Indonesia Stock Exchange. The data analysis technique used is logistic regression to prove the study hypothesis. Based on the results testing, can be concluded: 1) Altman Model (Z-Score) Revision : Working Capital to Total Asset, Retained Earning to Total Asset, and EBIT to Total Aset no effect on the Z-Score, while Book Value of Equity to Book Value of Debt and Sales to Total Asset affect the Z-Score. Overall variable factors model at Altman model revision simultaneously affect the Z-Score. 2) Springate Model (S-Score): Working Capital to Total Asset and EBIT to Total Aset affect S-Score, while Earning Before Tax to Current Liabilities and Sales to Total Asset have no effect on the S-Score. All variables factors at Springate model simultaneously affect the S-Score. The conclusion, the better and more precision model in predicting financial distress based on the Nagelkerke R Square testing, is the Revised Altman (Z-Score) model with a value of 82.5%.

*Keywords: Financial Distress, Altman Model (Z-Score) Revision, Springate Model (S-Score)*

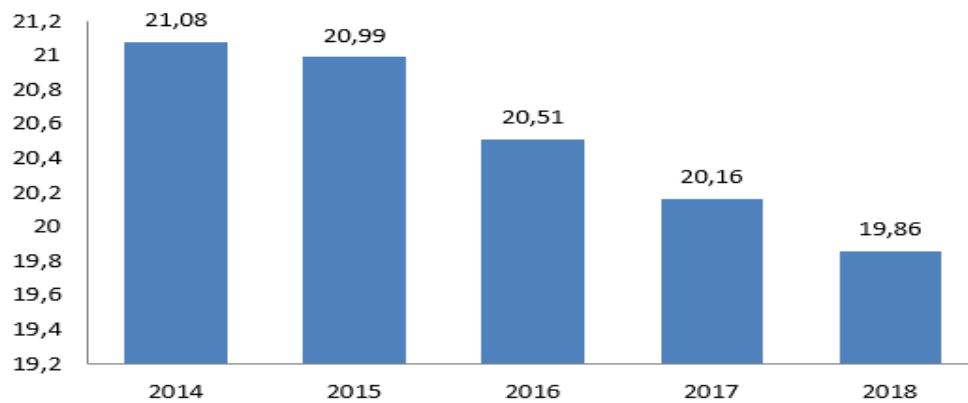
### 1. Introduction

The economy of a country can be seen in the Gross Domestic Product which can be produced and be counted during certain period of time (Konchitchki 2014). Indonesia's economic growth according to business sectors is still dominated by three main business industrial origin. The largest contributor to the Indonesian economy was still contributed by the manufacturing industry amounting to Rp 2,947.3 trillion of total employment GDP of Rp 14,837.4 trillion or a ratio of 19.86% in 2018. GDP according to industrial origin contributed by the manufacturing industry has increased from 2014 to 2018. Recorded GDP in 2018 was Rp 2,947.3 trillion, the highest compared to the previous year.

**Table 1. Total GDP**

Year	GDP Manufacturing	Total GDP (Industrial origin)
2014	2.227,6 trillion	10.569,7 trillion
2015	2.418,4 trillion	11.531,7 trillion
2016	2.545,2 trillion	12.401,7 trillion
2017	2.739,7 trillion	13.587,2 trillion
2018	2.947,3 trillion	14.837,4 trillion

The contribution of the manufacturing industry on the GDP based on industrial origin turned out to decrease trend year on year from 2014 to 2018 as shown in below figure. The lowest decline occurred in 2018 of 19.86% of the GDP industrial origin at Rp14,837.4, smaller than the previous year accounted for 20.16% of the GDP industrial origin at Rp13.587.2 trillion. The decline occurred due to increasingly fierce competition with businesses in the Asian region, lack of innovation through technology utilization and lack of efficiency in the production process.



**Figure 1. The contribution of the manufacturing industry on the GDP based on industrial**

The challenges which lead to the weakening contribution by the manufacturing industry towards GDP. The weakening is in line with the declining in earnings of several listed industrial manufacturing companies on the Indonesia Stock Exchange from 2014 to 2018. Low or negative profitability ratio illustrates lack of efficient in the way companies run their operations (Setyawan, 2018). Low profitability ratio and continue happen consecutively is a signal (early warning system) which can trigger financial distress or financial difficulty that might be experienced by companies (Edy and May Tania, 2018). Shalih & Kusumawati (2019) stated financial distress occurs before liquidation can indicate bankruptcy. The company's financial condition can be seen and identified earlier in the financial statements by using some model. The model of financial ratios can be analyzed to determine the financial condition of the company whether experiencing a healthy financial condition or bad condition (financial distress). This study uses two favourite models that developed by the Altman model (Z-Score) and the Springate model (S-Score) to analyze financial distress.

This study aims to predict financial distress using the model ratios using the Altman model (Z-Score) and the Springate model (S-Score) and determine the most accurate model in predicting financial distress in the manufacturing industry listed on the Indonesia Stock Exchange in 2014-2018.

## **2. Literature Review**

### **Financial Distress**

Financial distress is a condition which financial weakening or decreasing of liquidity of cashflow. The inability to fulfill or cover short-term liabilities is an early symptom of financial distress and to can be more serious to being solvable which is a person or entity not capable to pay obligations on time or the condition show amount of liabilities are higher than assets (Edi and May Tania, 2018). According to Primasari (2017), financial distress is a condition in which a company's inability to meet its current liabilities that are due, such as business debt, tax debt, short-term bank debt, etc. But, as long as the company has cash flow that is greater than its debt obligations, the company will have enough funds to pay its creditors. Financial distress is a condition where the company's finances are in a bad or not healthy condition. These conditions interfere with the

company's operations so it must be on the alert by management to avoid worsening situation or bankruptcy.

Research conducted by Susandra (2015) uses the Zmijewski model, the Ohlson model, the Altman model and the Springate model in manufacturing companies with the lowest accuracy is the Altman model by 15% and the highest is the Springate by 25.2%. This study will make a comparative analysis between two model Altman Model (Z-Score) Revision and Springate Model (S-Score).

### **Altman Model (Z-Score) Revision**

A number of studies have been conducted to determine the usefulness of financial ratio analysis in predicting corporate financial failures. One model used is the Alman Z-Score using Multiple Discriminant Analysis (MDA) by Edward I. Altman in his research. This model uses several financial ratios (Sondakh, 2014) which include Working Capital to Total Assets, Retained Earning to Total Assets, Earning Before Interest and Tax to Total Assets, Market Value of Equity to Book Value of Debt, and Sales to Total Assets that used to analyze manufacturing companies that go public.

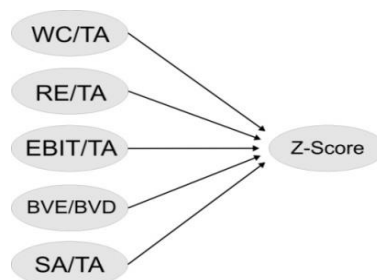
Altman Model (Z-Score) revised and improved the initial model by changing the ratio of Market Value of Equity to Book Value of Debt to Book Value of Equity to Book Value of Debt to be used to analyze in private companies. Private companies are not listed on the exchange so they do not have market value (Bakhtiar, 2018). Widyawati et al (2015) in research with the modified altman model with partial testing there are only two variables that influence, namely RE / TA and EBIT / TA. Simultaneously all variables affect in predicting financial distress.

### **Springate Model (S-Score)**

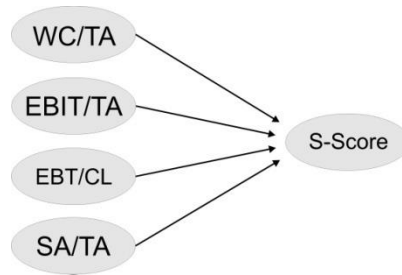
The Springate Model is a development of the Altman model in 1968. The Springate model uses 19 financial ratios, after retesting, Springate finally chose 4 ratios used in determining the criteria for companies included the category of healthy companies or potentially bankrupt companies (Edi and May Tania, 2018).

Research conducted by Gordon L.V. Springate in 1978 to find a model that can be used in predicting the potential (indication) of bankruptcy. After going through the statistical tests of multiple discriminant analysis similar to what Altman did in 1968, which distinguishes between companies that went bankrupt and those that did not go bankrupt. Ben et al (2015) conducted a study on the springate model with partial test results that EBIT / TA, EBT / CL and SA / TA influenced financial distress and simultaneously all variables influenced financial distress.

### **Framework & Hypothesis**



**Figure 2. Altman (Z-Score) Revision model**



**Figure 3. Springate (S-Score) model**

Hypothesis are as follows :

Hypothesis 1: Working Capital / Total Asset (WC/TA), Retained Earning/Total Asset (RE/TA), Earning Before Interest and Tax to Total Asset (EBIT/TA), Book Value of Equity to Book Value of Debt (BVE/BVD) and Sales to Total Asset (SA/TA), Altman Model (Z-Score) Revision, has partially and simultaneous effect on Z-Score.

Hypothesis 2: Working Capital to Total Asset (WC / TA), Earning Before Interest and Tax to Total Asset (EBIT/TA), Earning Before Tax to Current Liabilities (EBT/CL) and Sales to Total Asset (SA / TA), Springate Model (S-Score), partially and simultaneously influence the S-Score.

Hypothesis 3: Determine the better and more precision model for Predicting Financial Distress

### 3. Methods

This type of research is a quantitative research, the data taken from listed company manufacturing industry sector during 2014-2018. The population in this study amounted to 173 manufacturing listed companies. The sample uses purposive sampling model and meet the predetermined criteria such as companies that had issued financial statements during 2014-2018 can provided data regarding Altman and Springate model and the important criteria is the companies showed the decreased earnings for minimum consecutive 2 years. Therefore, the sample of this study are 24 companies.

This study uses SPSS version 25 statistical data processing software. The method analysis uses logistic regression methods and does not require testing the assumption of normality on the independent variables (Ghozali, 2017). Logistic regression is used because financial distress on the dependent variable is a dichotomous variable which has two criteria, namely financial distress (FD) and Non-financial distress (Non FD). The criteria in logistic regression testing consist of 0 and 1, for companies that experience financial distress are categorized as 1 and companies that do not experience financial distress are categorized as 0.

The Altman (Z-Score) Revision Logistic Regression Assumption equation model is as follows:

$$Ln \frac{FD}{1-FD} = \beta_0 + \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 + \beta X_5 \quad (1)$$

The variables are defined as:

- $Ln \frac{FD}{1-FD}$  = Financial Distress
- $\beta$  = Regression Coefficients
- $X_1$  = Working Capital / Total Asset
- $X_2$  = Retained Earning / Total Asset
- $X_3$  = Earning Before Interest and Tax / Total Asset

- X4 = Book Value of Equity / Total Asset
- X5 = Sales / Total Asset

The Springate model (S-Score) logistic regression equation model is as follows:

$$\ln \frac{FD}{1-FD} = \beta_0 + \beta X_1 + \beta X_2 + \beta X_3 + \beta X_4 \tag{2}$$

The variables are defined as:

- $\ln \frac{FD}{1-FD}$  = Financial Distress
- $\beta$  = Regression Coefficients
- X1 = Working Capital / Total Asset
- X2 = Earning Before Interest and Tax / Total Asset
- X3 = Earning Before Tax / Current Liabilities
- X4 = Sales / Total Asset

#### 4. Results and Discussion

##### Assessing the Fit Model

Using Hosmer and Lemeshow’s Goodness of fit test to know the model fit or not. To determine whether the model is feasible or not to predict the hypothesis, if the sig. statistic result show the sig greater than the coefficient 0.05, it means that the model can predict the hypothesis or observation data or the model is acceptable to use.

Based on the results of data processing, here are the results of the assessing the fit model.

**Table 2. Hosmer and Lemeshow’s Test**  
**Hosmer and Lemeshow Test**

<i>Model</i>	<i>Step</i>	<i>Chi-square</i>	<i>df</i>	<i>Sig.</i>
<b>Altman</b>	1	5.138	8	0.743
<b>Springate</b>	1	7.735	8	0.460

The results of the model assessing the fit model in table 1 use the Hosmer and Lemeshow Test on the Altman Model (Z-Score) Revision and the Springate Model (S-Score). Based on table 2, the Chi-square value of 5.138 and sig was obtained. 0.743 For the Altman model, the value of sig. 0.743 > 0.05 which means the model is suitable to be used. Springate value has a Chi-square value of 7,735 and sig. 0.460, sig. 0460 > 0.05 which means the model is suitable to be used

**Table 3. Model Feasibility Test Results**  
**Overall Model Fit Test**

<i>Model</i>	<i>Iteration</i>	<i>-2 Log likelihood</i>	<i>Coefficients Constant</i>
<b>Altman</b>	<i>Block 0</i>	164.216	0.268
	<i>Block 1</i>	49.703	9.222
<b>Springate</b>	<i>Block 0</i>	86.455	2.024
	<i>Block 1</i>	65.723	4.481

Based on the results of the Feasibility Test Results table 2, the results were good. This is known from the decline in the value of the Altman Log-likelihood model (Z-Score) Revision 164,216 in block

0 to 49,703 in block 1. The Springate Model (S-Score) decreased the -2 Log likelihood value by 86,455 in block 0 to 65,723 in block block 1. Decrease -2 Log likelihood of the two models can be concluded that the logistic regression model is feasible to use. The Altman and Springate models can be concluded to be able to predict the value of their observations data.

**Hypothesis Testing and Results**

**Wald test & Logistic regression**

Based on Wald test results in table 3 a & 3 b produce significant values for the Revised Altman (Z-Score) model and the Springate Model (S-Score). If Sig. value lower than 0.05 means that there is an influence significantly of the independent variables to the dependent variable in the logistic regression model.

**Table 4. Wald Test Results Model Altman (Z-Score)**

		Variables in the Equation					95% C.I.for EXP(B)		
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1 <sup>a</sup>	WC/TA	-2,543	3,688	0,476	1	0,490	0,079	0,000	108,286
	RE/TA	2,227	2,099	1,126	1	0,289	9,270	0,152	567,094
	EBIT/TA	-1,621	1,872	0,750	1	0,386	0,198	0,005	7,747
	BVE/BVD	-8,331	2,230	13,958	1	0,000	0,000	0,000	0,019
	SA/TA	-7,117	1,493	22,738	1	0,000	0,001	0,000	0,015
	Constant	9,222	1,902	23,513	1	0,000	10114,424		

a. Variable(s) entered on step 1: WC/TA, RE/TA, EBIT/TA, BVE/BVD, SA/TA.

The results of the Altman (Z-Score) revised model are as follows:

- 1) WC / TA with sig. 0.490 > 0.05 which means not significant effect the Z-Score
- 2) RE / TA with sig. 0.289 > 0.05 which means no significant effect on the Z-Score
- 3) EBIT / TA with sig. 0.386 > 0.05 which means no significant effect on the Z-Score
- 4) BVE / BVD has sig. 0.000 < 0.05 which means there is an sig effect on the Z-Score
- 5) SA / TA influences Z-Score with sig. 0.000 < 0.05.

**Table 5. Wald Test Results Model Springate (S-Score)**

		Variables in the Equation					95% C.I.for EXP(B)		
		B	S.E.	Wald	df	Sig.	Exp (B)	Lower	Upper
Step 1 <sup>a</sup>	WC/TA	-5.318	1.766	9.070	1	0.003	0.005	0.000	0.156
	EBIT/TA	-3.310	1.341	6.097	1	0.014	0.036	0.003	0.505
	EBT/CL	0.265	0.649	0.166	1	0.166	1.303	0.365	4.648
	SA/TA	-1.284	0.976	1.731	1	0.188	0.277	0.041	1.875
	Constant	4.481	0.866	26.789	1	0.000	88.334		

a. Variable(s) entered on step 1: WC/TA, EBIT/TA, EBT/CL, SA/TA.

The Springate Model (S-Score) test results are as follows:

- 1) WC / TA with sig. 0.003 < 0.05 which means significant effects the Z-Score
- 2) EBIT / TA with sig. 0.014 < 0.05 which means significant influence on the Z-Score
- 3) EBT / CL with sig. 0.166 > 0.05 which means no significant effect on the Z-Score
- 4) SA / TA has no effect on Z-Score with sig. 0.188 > 0.05

**Overall Model Fit Test**

**Table 6. Results of Omnibus Tests of Model Coefficients**  
**Omnibus Tests of Model Coefficients**

			<i>Chi-square</i>	<i>df</i>	<i>Sig.</i>
<b>Step 1</b>	Altman	Step	114.512	5	0.000
		Block	114.512	5	0.000
		Model	114.512	5	0.000
	Springate	Step	20.733	4	0.000
		Block	20.733	4	0.000
		Model	20.733	4	0.000

The test results in table 4 of the overall model fit test Altman model (Z-Score) Revision shows sig values. 0.000 is smaller than 0.05, which means the variables WC / TA, RE / TA, EBIT / TA, BVE / BVD and SA / TA simultaneously affect the Z-Score. In the same way, the Springate Model (S-Score) in table 4 testing produces a value of 0,000 less than 0.05 which means that WC / TA, EBIT / TA, EBT / CL and SA / TA simultaneously influence the S-Score.

**Coefficient of Determination (R2)**

**Table 7. Coefficient of Determination**  
**Model Summary**

<i>Model</i>	<i>Step</i>	<i>-2 Log likelihood</i>	<i>Cox &amp; Snell R Square</i>	<i>Nagelkerke R Square</i>
<b>Altman</b>	1	49.703 <sup>a</sup>	0.615	0.825
<b>Springate</b>	1	65.723 <sup>a</sup>	0.159	0.309

The results testing of the coefficient of determination of the summary model in table 5 show the Altman model (Z-score) Revision Nagelkerke R Square of 0.825 or 82.5%, which means that the variability of the dependent variable that can be explained by the dependent variable is 82.5%. In the second row The Springate Model (S-Score) produces R square of 0.309 or 30.9%, which means the variability of the dependent variable that can be explained by the independent variable is 30.9%. Therefore, the better and more precision model in predicting financial distress based on this study results of testing the coefficient of negativity determination R square in table 5 is the Altman model (Z-Score) Revision of 82.5%.

## **Discussion**

### *Altman Model (Z-Score) Revision*

The result of Hypothesis 1 indicate that there is no influence partially between working capital to total assets, retained earnings to total assets and earnings before interest and tax to total assets to the Z-Score.

Retained earnings to total asset do not have impact on the prediction of financial distress in the manufacturing industry. Retained earnings in the manufacturing industry on average experienced a negative value for 5 years, which means the company suffered the loss. Despite that, the decline in retained earnings has no impact on financial distress predictions in Altman model.

Empirical results of this study found that the Book value of equity to book value of debt (BVE / BVD) has an influence in predicting financial distress. These results are consistent with findings study by (Ardian, 2014). The ratio of equity to debt significantly contribute to financial distress in manufacturing company.

Sales of total assets affect the Z-Score which means it has an impact on predicting financial distress. Sales describe the productivity of assets or sales capacity towards investment in one particular asset (Edi and May Tania, 2018). The manufacturing industry in the last 5 years had shown the declining sales.

Based on the results of simultaneously testing of all variables of the Altman model (Z-Score) Revision together have influence on the Z-Score financial distress, so the study hypothesis 1 joint testing variables is accepted.

### *Springate Model (S-Score)*

The result of hypothesis 2 EBT/TA and SA/TA has no significant effect on S-Score, while WC/TA and EBIT/TA have significant effect on financial distress S-Score.

Working capital is the difference of current assets and current liabilities to finance short term operation costs. Working capital / total assets has influence on the S-Score in the manufacturing industry, still relevant factor to financial distress

Earnings before interest and tax on the use of all of its assets. Revenue obtained based on data tends to decrease. Declining profits will affect liquidity and dividends for shareholders. the declining earnings before interest and taxes has effect in predicting financial distress S-Score model in the manufacturing industry.

The Springate model (S-Score) has formulas and criteria as the Altman model and other classical models in predicting financial distress. Based on the results of testing all factors of Springate model (S-Score) simultaneously have influences on the S-Score, therefore the hypothesis is accepted.

### *Determination coefficient*

The logistic regression test results based on the summary coefficient of the Nagelkerke R Square determination coefficient showed that the Altman model (Z-Score) had the highest value compared to the Springate model (S-Score), which amounted to 82.5%. In accordance with the research hypothesis, that in predicting financial distress in manufacturing industries listed on the Indonesia Stock Exchange in 2014-2018 using the revised Altman (Z-Score) model.

## **5. Conclusion**

Financial ratios model in this study are important in predicting financial distress, it is a good signal to get better prevention and to get better improvement from management if can detect early



signal of financial distress. The results of the hypothesis test and the discussion carried out in this study supported the previous research conducted by Ardian (2014) with the BVE / BVD and SA / TA variables in the Revised Altman (Z-Score) model that affects the Z-Score. Overall the WC / TA, RE / TA, EBIT / TA, BVE / BVD and SA / TA variables influence the Z-Score. These results are in line with other researchs conducted by Husein (2014), Fredy (2018), Primasari (2017), Nilasari (2018), Edy and May Tania (2018), Nisa (2014), Widyawati (2015), Ardian (2014) ) and Adi (2014) and Susandra (2015).

The Springate Model (S-Score) with WC / TA and EBIT / TA variables influences the S-Score according to the results of research by Ben et al (2015). Together the Springate Model (S-Score) variables WC / TA, EBIT / TA, EBT / CL and SA / TA affect the S-Score. These results are in accordance with research by Husein (2014), Fredy (2018), Primasari (2017), Nilasari (2018), Edy and May Tania (2018) and Susandra (2015) and Ben (2015).

The results of the study using logistic regression show that the better and more precision model is the Altman (Z-Score) revision, especially more attention to ratio of book value of equity to book value of debt (BE/BVD) and sales to total assets (SA/TA). In other word, short and long term debt needs to be managed properly. Sales performance is a priority and get used to overcome any challenges faced by company, such as innovations and better strategies by management.

The suggestion for future study to develop in specific sector during economy crisis especially now pandemic covid some sectors are more vulnerable such as tourism industry, property and construction. Future study also encourage to compare other financial distress model such Ohlson, Grover, Zmijewski and others or the latest models using Artificial Intelligence (AI) and Neural Network (NN) models.

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