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Comparative Analysis of Altman Z-Score and J-UK Model Accuracy in Predicting Financial Distress during the Covid-19 Pandemic (Study on Manufacturing Companies listed on the Indonesia Stock Exchange)

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ABSTRACT

This study aims to analyze the comparison of the predictive ability of Altman Z-Score and J-UK model. There are five financial ratios used in the Altman Z-Score model, namely capital to total assets, retained earnings to total assets, earnings before interest and taxes to total assets, market value equity to book value of total debt, and sales to total assets. Meanwhile, the J-UK model is a modification of the Altman Z-Score model with an additional ratio in the form of cash flow from operations to total liabilities. The research sample used is manufacturing companies listed on the Indonesia Stock Exchange (IDX) in 2020 and 2021. There are 201 non-financial distress companies and 101 financial distress companies. Hypothesis testing used in this study is a classification matrix. From the results of the classification matrix, it was found that the predictive ability of the Altman Z-Score was 78.1% and the ability of the J-UK model was 78.1%. Therefore, the results showed that the Altman Z-Score and J-UK models have the same financial distress prediction ability in manufacturing companies in Indonesia.

Keywords: Financial Distress, Altman Z-Score, J-UK Model, Manufacturing Companies

INTRODUCTION

A Coronavirus Disease 2019 or well known as Covid-19 was confirmed by World Health Organization (WHO) as a pandemic that outbreak globally in 2020. This outbreak is a challenge for people around the world, one of which affects the economic sector. Indonesian government made an official announcement revealing the initial report of the first verified case of Covid-19 in March 2020. To stop the transmission of the Covid-19 outbreak, various policies for restricting social activities were established by the Government of Indonesia, starting from the Large-Scale Social Restrictions (PSBB) transition to the Implementation of Restrictions on Public Activity (PPKM) (Naimah *et al.*, 2023). The impact of these social restrictions has resulted in hampered economic activity and one of them has an impact on the manufacturing sector.

Table 1
Profit (Loss) of Manufacturing Company in 2018-2021

	2018		2019		2020		2021	
	Amount	**%**	**Amount**	**%**	**Amount**	**%**	**Amount**	**%**
Loss	96	25.67%	105	26.45%	166	41.09%	117.00	28.89%
Profit	278	74.33%	292	73.55%	238	58.91%	288.00	71.11%
Total	**374**	**100%**	**397**	**100%**	**404**	**100%**	**405**	**100%**

Source : www.idx.co.id (data processed)

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As can be seen on table 1, during the Covid-19 pandemic in 2020-2021, there was a phenomenon of increasing losses for manufacturing companies compared to before the pandemic. This information of manufacturing companies was retrieved from the financial statements that published on the Indonesia Stock Exchange (IDX) over a four years period from 2018 to 2021 by comparing the net income in two years before pandemic and two years during pandemic. Before the pandemic, there were 25.67% losses of a total of 374 companies in 2018 and increased to 26.45% losses of a total of 397 companies in 2019. At the beginning of the pandemic, there was an increase in losses reaching 41.09% of a total of 404 companies in 2020 and then decreased to 28.89% of the total 405 companies in the following year.

Several bankruptcy prediction models that have been developed include Altman Z Score (1968), Zmijewski Model (1983), Springate Model (1978), J-UK Model (2016), Ohlson O Score (1980), and so on. This study limiting the scope to mainly focus on analyze and compare two models only, Altman Z-Score and J-UK Model. Altman Z Score used a Multiple Discriminant Analysis (MDA) approach to develop its prediction model. By using this approach, the model established a set of ratios in assessing the company's financial performance. A previous research by Altman (1968), reported that Altman Z-Score able to correctly classify up to 94% in estimating bankrupt and non-bankrupt companies. Meanwhile, according to Almamy et al (2016), the J-UK model has an accuracy rate of 82.9%. It is a modified model of the Altman Z-Score with an additional ratio, namely cash flow from operations/total liabilities.

From several studies that have been conducted, the comparison of the bankruptcy prediction models yields various outcomes. According to Almamy *et. al* (2016), as an improved model of Altman Z-Score, J-UK model has greater prediction ability percentage compared to the former. In the study by Harjans (2018), Altman Z-Score has the worst prediction compared to the other models, such as L Model and J-UK model in predicting bankruptcy of US companies. However, according to Nelissen (2018), J-UK model unable to outperforms the ability of Altman Z-Score in estimating bankruptcy of US companies. According to Fadhli & Arifin (2022), Altman Z-Score model has better accuracy when measured against the empiric model that constructed from activity, liquidity, cash flow, leverage, profitability, growth, and size variables. Furthermore, study by Marsono (2014) found that Altman model outperforms the cash flow based model in forecasting the financial distress among manufacturing companies in Indonesia.

The purpose of this research is to compare the outcome of Altman Z-Score and J-UK Model in predicting distress in financial of a company. This study examines the manufacturing company's annual report that issued on the IDX to forecast its financial state during the period of Covid-19 from 2020 to 2021 by utillizing the data obtained from the previous year. The research gap arises as a result of the lack of studies in Indonesia as there has been no research that has examined and applied the J-UK model in Indonesia. Therefore, this study emphasize the need for the first research to fill the knowledge void by conducting a research on the application of the J-UK model to the manufacturing companies in Indonesia, to determine whether the findings of this study align with the outcomes of the initial research carried out by Almamy *et. al* in 2016, that only applied to UK companies.

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Altman Z-Score

Altman (1968) introduced a model known as "Altman Z-Score" with the objective of forecasting the likelihood of bankruptcy. Altman formed this model by applying Multiple Discriminant Analysis (MDA). This analysis technique was chosen because it can classify the most influential financial ratios by considering the general characteristics of the company to get a linear combination. Altman conducted a study encompassing a total of 66 manufacturing companies over a span of five years ranging from 1960 to 1965. As reported by this research, the model had an impressive accuracy rate of 94% in forecasting a bankruptcy in companies.

The results of the formulation of the Altman Z-Score model function are as follows:

$$Z = 0.012X1 + 0.014X2 + 0.033X3 + 0.006X4 + 0.999X5$$

Where :

X1 = Working Capital/Total Assets

X2 = Retained Earnings/Total Assets

X3 = Earnings Before Interest and Taxes/Total Assets

X4 = Market Value Equity/Book Value of Total Debt

X5 = Sales/Total Assets

Z = Z-Score Index

J-UK Model

Almamy *et al.* (2016) created a bankruptcy prediction model referred to as J-UK model. This model is a modification of the original Altman Z-Score model (1968) with an insertion of new variable called Cash Flow ratio into the existing equation. The combination of the original variables of Altman model and cash flow ratio variable can significantly enhance the ability of the model in forecasting the financial state of companies in the UK (Almamy *et. al.*, 2016). The original Altman Z-Score model consists of five specific ratios to compute the Z-Score. Meanwhile, in J-UK model, there is an additional ratio, that is Cash Flow from Operations divided by Total Liabilities. Then, the formula for J-UK model is as follows:

$$ZJ = 1.484X1 + 0.043X2 + 0.390X3 + 0.004X4 - 0.424X5 + 0.75X6$$

Where:

X1 = Working Capital/Total Assets

X2 = Retained Earnings/Total Assets

X3 = Earnings Before Interest and Taxes/Total Assets

X4 = Market Value Equity/Total Liabilities

X5 = Sales/Total Assets

X6 = Cash Flow from Operations/Total Liabilities

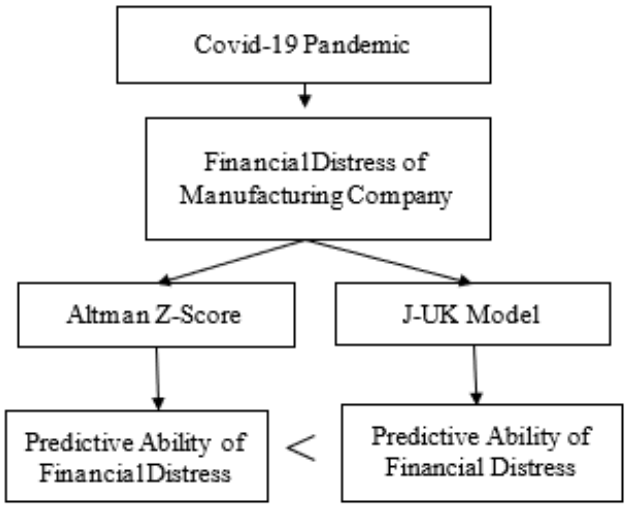
ZJ = Z-Score Index

Almamy *et al.* (2016) conducted a study to compares J-UK model and Altman Z-Score in order to assess their ability in forecasting a bankruptcy among both failed and non-failed companies in the UK across various time periods includes pre-, during, and post-financial crisis. Derived from the findings in the study, before the crisis, the J-UK model got 64.1% correctly classified, while the Altman Z-Score could only get 51.5% correctly classified. During the crisis, the J-UK model again excelled with 79.2% accuracy points compared to the Altman Z-Score which only obtained 67.4% accuracy. After the crisis, the Altman Z-Score only got a 71.5% accuracy rate, while the J-UK model could predict as much as 81.2% accuracy. Overall, the J-UK model can be more accurate than the Altman Z-Score with an average of 11.37% accuracy. It can be concluded that J-UK model outperforms Altman Z-Score in the ability of predicting the likelihood of financial distress in UK companies prior to, during, and after the financial crisis.

Theoretical Framework

In this study will analyze and compare two financial distress prediction models, including both J-UK model and Altman Z-Score. To illustrate the relationship between the variables, a framework model has been developed that is shown in the figure below:

Figure 1
Research Framework



Hypothesis Development

J-UK model is a financial distress model which has been modified from Altman model. Output of this modification comes in the form of an additional variable, that is the Cash Flow from Operations to Total Liabilities ratio. According to Almamy *et al.* (2016), cash flow from operations serves to measure the capability to generate cash from the company's activities. Thus, this additional variable is expected to improve the model to be more accurate in assess whether the financial state of a company is in distress or not.

Based on study by Almamy *et al.* (2016), states that the J-UK model has more accurate ability in estimating company bankruptcy in the UK compared to the Altman Z-Score. Harjans (2018) also conducted research by comparing the J-UK model and Altman model with research samples of companies in the US. From the observations of this study, J-UK model is proven to have a higher accuracy than the former model in predicting bankruptcy in US companies. Contrary to previous studies, Nelissen (2018) found that J-UK model is slightly less accurate than Altman Z-Score in forecasting bankruptcy. However, the former also found that the relationship between the additional cash flow from operations to total liabilities ratio with company bankruptcy has a significant effect. Based on the information collected from previous research, the formulation of hypothesis is set as follows:

H_1 : J-UK model has better predictive ability than Altman Z-Score in predicting financial distress in manufacturing companies listed on the IDX.

RESEARCH METHODOLOGY

Population and Sample

The population sampled in this study comprised of all companies in manufacturing sector that are published through Indonesia Stock Exchange (IDX). The sample selection within this research used a purposive sampling approach. This method ensured that the sample chosen have met specific characteristics. According to Whitaker (1999), defining a financial of a company is in distress under the circumstances when a company experiences negative net income for several years. Based on the study by Luciana (2006), companies that experience negative net income for a continuous two years period are classified as financial distress. Thus, it is essential to meet the sample selection criteria outlined below:

1. The company is a manufacturing sector listed on the Indonesia Stock Exchange (IDX)
2. The company published complete financial reports from 2019-2021.
3. The net income of the company has been negative for two consecutive years.

Data Analysis Method

Discriminant Function

The following procedures are used for data analysis are as follows:

1. Altman Z-Score

Altman (1968) set five specific ratios to compute the Z-Score. The equation this model is outlined as follows:

$$Z = 0.012X1 + 0.014X2 + 0.033X3 + 0.006X4 + 0.999X5$$

However, due to differences in writing formats, it is necessary to calculate variables of X1 to X4 as absolute percentage. The coefficient of each variable must be multiplied by 100 to obtain the absolute percent value. Meanwhile, variable X5 is calculated in the number of series and rounding the coefficient equal to one (Heine, 2002). Thus, the final equation of the model applied in this study is expressed as follows:

$$Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5$$

Where :

X1 = Working Capital/Total Assets

X2 = Retained Earnings /Total Assets

X3 = Earnings Before Interest and Taxes/Total Assets

X4 = Market Value Equity/Total Liabilities

X5 = Sales/Total Assets

Z = Z-Score Index

2. J-UK Model

Almamy (2016) added one ratio to Altman's original 1968 formula to calculate the Z-Score value of J-UK model. The calculation of the model is outlined below:

$$ZJ = 1.484X1 + 0.043X2 + 0.390X3 + 0.004X4 + 0.424X5 + 0.75X6$$

Since the J-UK model is a modification of Altman model formed before the format adjustment, it is necessary to adjust the variables of X1 to X4 as absolute percentage and variables of X5 to X6 as the numbers of series. Thus, the final equation expressed as follows,

$$ZJ = 148.4X1 + 4.3X2 + 39.0X3 + 0.4X4 + 0.424X5 + 0.75X6$$

Where,

X1 = Working Capital/Total Assets

X2 = Retained Earnings/Total Assets

X3 = Earnings Before Interest and Taxes/Total Assets

X4 = Market Value Equity/Total Liabilities

X5 = Sales/Total Assets

X6 = Cash Flow from Operations/Total Liabilities

ZJ = Z-Score Index

3. Descriptive Statistics

Descriptive statistics present a concise summary of characteristics of the research sample in mean, standard deviation, and sample size. According to Narimawati (2008), the existence of a distinct difference in the mean value of the variables may suggest that there is a possibility of a significant difference, but a deeper analysis is needed to ensure that there is a significant difference. Ghozali (2021) states that the mean value of financial ratios can assess whether there is a clear

distinction between companies in good financial health and companies facing bankruptcy with further testing such as F-test and Wilks Lambda.

4. F-test

F test is applied to assess the importance of financial ratios and compare the significance of each variables in both models, J-UK model and Altman Z-Score. It is necessary to examine if there is a disparity between before and after the insertion of the cash flow ratio in the equation.

a. If the significance of F > 0.05, then there is no significant difference within groups.
b. If the significance of F < 0.05, then there is a significant difference within groups.

5. Wilks Lambda

The Wilks' lambda is determined on a 0 to 1 scale, with smaller values implies the data is clearly distinguished. In contrast, if the Wilks Lambda value is close to 1, the data tends to be similar. Therefore, the lower the value, it intensifies the significance of the financial ratios variable towards the discriminant function.

6. Z-Score Index

Z-Score Index interpretation is based on the cutoff points of the discriminant function. Altman (1968) set the cutoff points of Altman Z-score to classify the company's financial state. Z-score lower than 1.8 is categorized as financial distress. Z-score greater than 1.8 and below 2.99 is categorized as gray areas. If the company is in a non-distress financial state, the Z-score will exceed 2.99.

J-UK model is the modification of Altman Z-Score, but there are only two classifications in J-UK model, namely financial distress and non-financial distress. Within this research, there is an adjustment in group classification to fit both models. The companies that are classified as gray areas will be adjusted into groups according to the original classification.

Therefore, the company is assigned to either financial distress or non-financial distress based on the results of the Z-Score index towards the predetermined cutoff point.

7. Classification Matrix

Classification matrix is used for the testing of the hypothesis to determine the predictive ability of Altman Z-Score and J-UK model. According to Hair et al. (2010), classification matrix is utilized to analyze the ability of the discriminant function. Classification matrix summarized the performance of the discriminant function by comparing the predicted gorup and the actual group The predicted group is obtained from the classification results based on the Z-Score Index value. After established the classification matrix, the next step is to determine the performance of the discriminant function by calculating the percentage of correct classification. The formula used is shown below:

$$\text{Percent correctly classified} = \left(\frac{\text{Number correctly classified}}{\text{Total number of observations}}\right) \times 100$$

RESULTS AND DISCUSSION

Description of Research Object

In this study, the sample chosen was a manufacturing company that registered on Indonesia Stock Exchange (IDX) during 2019 to 2021. The data is obtained through financial statements on the Bloomberg and IDX website. In table 2 show the selected samples in this study.

Table 2
Sample Selection

No	Description	Total
1.	The company is a manufacturing sector listed on IDX.	421
2.	Absence of financial reports published in 2019-2021.	119
3.	Total sample	302
	- The net income of company has been negative for two consecutive years (financial distress).	101
	- - The net income of company has not been negative for two consecutive years (non financial distress).	201

Descriptive Statistics Analysis

Descriptive statistics is used to shows overview and information of the sample data used in this study.

1. Group Statistics of Altman Z-Score

Group statistic of Altman Z-Score is shown in the following figure:

Table 3
Group Statistics of Altman Z-Score

Group Statistics

		Mean	Standard Deviation	Valid N Unweighted	Valid N Weighted
Non Financial Distress	X1	0.2567297	0.26592779	201	201.000
	X2	0.3219311	0.48054235	201	201.000
	X3	0.2036724	0.35261065	201	201.000
	X4	14.4935002	168.45404490	201	201.000
	X5	0.9508790	0.75935650	201	201.000
Financial Distress	X1	-0.4998812	4.29113871	101	101.000
	X2	-2.2776577	16.71941218	101	101.000
	X3	-0.2681254	0.83997599	101	101.000
	X4	2.5308110	9.08758454	101	101.000
	X5	1.0404557	3.02713860	101	101.000

Source : SPSS, 2023

From table 3, the result of descriptive analysis show the mean values in non financial distress group as follows: 0.2567297 for Working Capital to Total Assets (X1), 0.3219311 for Retained Earnings to Total Assets (X2), 0.2036724 for of Earnings Before Interest and Taxes to Total Assets (X3), 14.4935002 for Market Value Equity to Total Liabilities (X4), and 0.9508790 for Sales to Total Assets (X5). Meanwhile the mean values in financial distress group is as follows: (-0.4998812) for Working Capital to Total Assets (X1), -2.2776577 for Retained Earnings to Total Assets (X2), -

0.2681254 for of Earnings Before Interest and Taxes to Total Assets (X3), 2.5308110 for Market Value Equity to Total Liabilities (X4), and 1.0404557 for Sales to Total Assets (X5).

In conclusion, the variables of Working Capital to Total Assets (X1), Retained Earnings to Total Assets (X2), Earnings Before Interest and Taxes to Total Assets (X3) have opposite coefficients of mean value, which in the non-financial distress group has a positive values and has negative values in the financial distress group. Meanwhile, there is no difference in the coefficients of mean values of Market Value Equity to Total Liabilities (X4) and Sales to Total Assets (X5) towards the non-financial distress and financial distress groups.

2. Group Statistics of J-UK Model

Group statistic of J-UK Model is shown in the following figure:

Table 4
Group Statistics of J-UK Model

Group Statistics

		Mean	Standard Deviation	Valid N Unweighted	Valid N Weighted
Non Financial Distress	X1	31.7489100	32.88640276	201	201.000
	X2	0.9887885	1.47595151	201	201.000
	X3	2.4070371	4.16721676	201	201.000
	X4	9.6623335	112.30269655	201	201.000
	X5	-0.4035763	0.32228944	201	201.000
	X6	0.1688055	1.01574992	201	201.000
Financial Distress	X1	-61.8186416	530.67082024	101	101.000
	X2	-6.9956629	51.35248028	101	101.000
	X3	-3.1687545	9.92698901	101	101.000
	X4	1.6872073	6.05838969	101	101.000
	X5	-0.4415948	1.28479156	101	101.000
	X6	0.0141956	0.19892117	101	101.000

Source : SPSS, 2023

From table 4, the result of descriptive analysis show the mean values in non financial distress group as follows: 31.7489100 for Working Capital to Total Assets (X1), 0.9887885 for Retained Earnings to Total Assets (X2), 2.4070371 for of Earnings Before Interest and Taxes to Total Assets (X3), 9.6623335 for Market Value Equity to Total Liabilities (X4), -0.4035763 for Sales to Total Assets (X5), and 0.1688055 for Cash Flow from Operations to Total Liabilities (X6).

Meanwhile the mean values in financial distress group is as follows: -61.8186416 for Working Capital to Total Assets (X1), -6.9956629 for Retained Earnings to Total Assets (X2), 1.6872073 for of Earnings Before Interest and Taxes to Total Assets (X3), 2.5308110 for Market Value Equity to Total Liabilities (X4), -0.4415948 for Sales to Total Assets (X5), and 0.0141956 for Cash Flow from Operations to Total Liabilities (X6).

In table 4.3, it can be seen that variables of Working Capital to Total Assets (X1), Retained Earnings to Total Assets (X2) , Earnings Before Interest and Taxes to Total Assets (X3) have opposite coefficients of mean value, which in the non-financial distress group has a positive values and has negative values in the financial distress group. Meanwhile, there is no difference in the coefficients of mean values of Market Value Equity to Total Liabilities (X4), Sales to Total Assets (X5), and Cash Flow from Operations to Total Liabilities (X6) towards the non-financial distress and financial distress groups.

Calculation of F-Test

1. F-Test of Altman Z-Score

The F-Test of Altman Z-Score is shown in the following figure:

Table 5
F-Test of Altman Z-Score

	Wilks' Lambda	F	df1	df2	Sig.
X1	0.980	6.222	1	300	0.013
X2	0.984	4.867	1	300	0.028
X3	0.864	47.043	1	300	0.000
X4	0.998	0.508	1	300	0.477
X5	0.999	0.157	1	300	0.692

Source : SPSS, 2023

From table 5, The result of F-test has following significance values: 0.013 for Working Capital to Total Assets (X1), 0.028 for Retained Earnings to Total Assets (X2), 0.000 for Earnings Before Interest and Taxes to Total Assets (X3), 0.477 for Market Value Equity to Total Liabilities (X4), and 0.692 for Sales to Total Assets (X5).

In conclusion, derived from the calculation of the F test on Altman Z-Score, only the ratio of Working Capital to Total Assets (X1), Retained Earnings to Total Assets (X2) , Earnings Before Interest and Taxes to Total Assets (X3) that have a significance value lower than 0.05. It means that these ratios have a significant impact in discriminating financial distress and non-financial distress. In contrast, ratio of Market Value Equity to Total Liabilities (X4) and Sales to Total Assets (X5) do not have a significant impact in discriminating a company into financial distress and non-financial distress.

2. F-Test of J-UK Model

The F-Test of J-UK model is shown in the following figure:

Table 6
F-Test of J-UK Model

	Wilks' Lambda	F	df1	df2	Sig.
X1	0.980	6.222	1	300	0.013
X2	0.984	4.867	1	300	0.028
X3	0.864	47.043	1	300	0.000
X4	0.998	0.508	1	300	0.477
X5	0.999	0.157	1	300	0.692
X6	0.992	2.292	1	300	0.131

Source : SPSS, 2023

From table 6, The result of F-test has following significance values: 0.013 for Working Capital to Total Assets (X1), 0.028 for Retained Earnings to Total Assets (X2), 0.000 for Earnings Before Interest and Taxes to Total Assets (X3), 0.477 for Market Value Equity to Total Liabilities (X4), 0.692 for Sales to Total Assets (X5), and 0.131 for Cash Flow from Operations to Total Liabilities (X6)

In conclusion, derived from the calculation of the F test on J-UK model, only the ratio of Working Capital to Total Assets (X1), Retained Earnings to Total Assets (X2) , Earnings Before Interest and Taxes to Total Assets (X3) ratio that have a significance value

lower than 0.05. It means that these ratios have a notable significance in discriminating financial distress and non-financial distress. In contrast, ratio of Market Value Equity to Total Liabilities (X4), Sales to Total Assets (X5), and Cash Flow from Operations to Total Liabilities (X6) do not have a significant impact in discriminating a company into financial distress and non-financial distress. It also indicates that the addition of Cash Flow from Operation to Total Liabilities (X6) as an individual does not affect the distinction between financial distress and non-financial distress.

Calculation of Wilks Lambda

Table 7
Wilks' Lambda of Altman Z-Score

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.779	74.391	3	0.000

Source : SPSS, 2023

Table 8
Wilks' Lambda of J-UK Model

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.779	74.391	3	0.000

Source : SPSS, 2023

Derived from table 7 and table 8, both Altman Z-Score and J-UK model has Wilks Lambda value of 0.779 and its significance value is 0.000. It means that the discriminant function of J-UK model has significance influence in discriminating financial distress and non-financial distress.

It can be deduced that both models can be used as financial distress prediction model and have the same discriminating ability to distinguish financial distress and non-financial distress. This also indicates that the addition of the ratio of cash flow from operations to total liabilities (X6) in the J-UK model has not been able to differ the discriminating ability between J-UK model and Altman Z-Score.

Comparison of the Z-Score Index

Table 9
Prediction Model Comparison

Model	Accuracy of FD (Prediction/Total Sample)	Accuracy of NFD (Prediction/Total Sample)	Total Calculation	% of FD	% of NFD
Altman	81/101	155/201	236/302	80%	77%
J-UK	54/101	182/201	236/302	53%	91%

In table 9, represent the prediction outcomes for each models on Financial Distress (FD) sample and Non-Financial Distress (NFD) sample. Altman Z-Score can predict 81 out of 101 financial distress companies or prediction rate of 80%. Meanwhile, only 54 companies are correctly classified with the J-UK model, which only 53% prediction rate. From these outcomes, it can be concluded that Altman Z-Score have higher prediction rate in classifying financial distress companies. Furthermore, out of 201 non-financial distress, Altman Z-Score able to classify 155 companies or about 77% prediction rate of non-financial distress companies. Whereas, J-UK model have bigger prediction rate of 91% with 182 companies classified as non-financial distress. However, based on total calculation, both Altman Z-

Score and the J-UK model have the same amount of total of both sample groups by being able to predict 236 out of 302 manufacturing companies.

Classification Matrix

1. Classification Matrix of Altman Z-Score

Table 10
Classification Matrix of Altman Z-Score

Altman Model		Predicted		Sample Observed
		FD	Non-FD	
Original	FD	81	20	101
	Non-FD	46	155	201

As seen in table 10, there are 101 financial distress (FD) manufacturing companies and 201 non-financial distress (Non-FD) manufacturing companies observed. The results is the Altman Z-Score can correctly predict 81 financial distress companies with a misclassification of 20 identified as non-financial distress in the original category of a total of 101 financial distress manufacturing companies. While in the original category of a total of 201 non-financial distress manufacturing companies, the Altman Z-Score can correctly predict 155 non-financial distress companies with a misclassification of 46 companies as financial distress. Furthermore, the calculation of the model's predictive ability is as follows,

$$Total\ predictive\ ability = \frac{Total\ Correct\ Prediction}{Total\ Sample\ Observed}$$

$$= \frac{(81 + 155)}{(101 + 201)} = 78.1\%$$

From the calculations above, it is found that the Altman Z-Score has a predictive ability rate of 78.1% in predicting Indonesian manufacturing companies in 2020-2021.

2. Classification Matrix of J-UK Model

Table 11
Classification Matrix of J-UK Model

J-UK Model		Predicted		Sample Observed
		FD	Non-FD	
Original	FD	54	47	101
	Non-FD	19	182	201

As seen in table 11, there are 101 financial distress (FD) manufacturing companies and 201 non-financial distress (Non-FD) manufacturing companies observed. J-UK model can correctly predict 54 financial distress companies with a misclassification of 47 identified as non-financial distress out of 101 manufacturing companies in the original classification. Meanwhile, out of 201 originally classified non-financial distress manufacturing companies, the J-UK model can correctly predict 182 non-financial distress companies with a misclassification of 19 companies as financial distress. Furthermore, the calculation of the model's predictive ability is as follows,

$$Total\ predictive\ ability = \frac{Total\ Correct\ Prediction}{Total\ Sample\ Observed}$$

$$= \frac{(54 + 182)}{(101 + 201)} = 78.1\%$$

From the calculations above, it is shows that the predictive ability rate of the J-UK model amounts to 78.1% in predicting Indonesian manufacturing companies in 2020-2021. Based on this result, the J-UK model has similar predictive ability as the Altman Z-Score with 78.1%, therefore hypothesis 1 (H_1) is rejected.

CONCLUSION

This research comparing the predictive ability of Altman Z-Score and J-UK Model in predicting distress of manufacturing companies during the period of Covid-19 from 2020 to 2021. The findings of this study shows that the discriminant function of the Altman Z-Score and the J-UK model have proven to be a competent tools as a financial distress predictor and can be implemented in manufacturing companies in Indonesia. However, there is no distinction between the ability of Altman Z-Score and the J-UK model in estimating financial distress in manufacturing companies. It implies that the J-UK model is not able to outperforms the Altman Z-Score in regards to forecasting the financial distress. Consequently, Altman Z-Score remains as the practical choice to be used as a financial distress prediction model for manufacturing companies in Indonesia as it has similar total predictive ability as J-UK model and offers a simpler equation compared to the J-UK model.

Regardless, there are several limitations in this study that should be noted as it may affect the scope of the findings, which in this research focus on the manufacturing sector during the period of Covid-19 pandemic, the time frame is confined to one year prior the financial distress, and insufficient data needed in financial reports resulted in a limited number of research samples.

Considering the previous limitations, for further research are recommended to broaden the sample size, expand the time span of the research, and develop more accurate financial distress prediction model with various financial ratios than only the addition of the cash flow ratio.

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