TRANSPUBLIKA
Precise. Resilience. Felicitous.

Transekonomika: Akuntansi, Bisnis dan Keuangan
https://transpublika.co.id/ojs/index.php/Transekonomika
Online ISSN 2809-6851 | Print ISSN 2809-7866

https://doi.org/10.55047/transekonomika.v5i2.872

Original Article

The Use of Altman Z-Score, Springate, and Zmijewski in Detecting Financial Distress in the Transportation and Logistics Sector Companies

Tyus Krisyuanto[1], Gideon Setyo Budiwitjaksono[2*]

[1,2]Universitas Pembangunan Nasional "Veteran" Jawa Timur, Indonesia
Email: [1)] tyuskrisyuan@gmail.com, [2)] gideon.ak@upnjatim.ac.id

Received : 31 December - 2024
Accepted : 04 February - 2025
Published online : 06 February - 2025

Abstract

This research aims to explore how the Altman model (Variable X1), the Springate model (Variable X2), and the Zmijewski model (Variable X3) affect financial distress. A quantitative approach is used, with information gathered from secondary sources, specifically financial statements of transportation and logistics firms on the Indonesia Stock Exchange. The analysis includes systematic compilation, tabulation, and examination of data. The findings from the discriminant analysis indicate that only the Springate model (X2) demonstrates statistical significance, whereas both the Altman (X1) and Zmijewski (X3) do not achieve significance. In terms of predictive accuracy for each model, Altman yields 54.16%, Springate provides 58.33%, and Zmijewski records 16.66%. In summary, within companies operating in the transportation and logistics sector, it is evident that Springate model (X2) possesses a substantial influence in forecasting instances of financial distress, while neither the Altman (X1) nor Zmijewski (X3) models exhibit a comparable level of influence. The findings indicate that the Springate model is the most effective tool for predicting financial distress in this sector.

Keywords: Altman Z-Score, Springate, Zmijewski, Financial Distress.

1. Introduction

Every company wants to make a profit and make a profit. This is intended so that the company can continue to grow and maintain its business. When changes in economic conditions fluctuate, company management must have the right strategy in making decisions. Decision makers also need to pay attention to competing factors so as not to be left behind by other companies (Sidabutar, 2021). Through company strategy, challenges and demands must be taken in order to survive and continue to grow (Hadi et al., 2020).

The company must maintain good performance in order to maintain and advance the company. However, this is also not free from mistakes. Many factors affect the performance of a company, whether it is an error within the company such as wrong decision making, or external factors such as natural disasters. If the company cannot maintain its performance, the company's financial condition will deteriorate. This decline in performance is called financial distress (Febinda et al., 2023). In theory, financial distress is the company's difficulty in dealing with poor financial conditions that can result in decreased performance (Rahayuningsih et al., 2022). Financial distress conditions can continue to worsen and if they cannot be handled properly the company can go bankrupt and go out of business. For this reason, every company needs an early warning system so that it can identify potential financial distress and avoid bankruptcy (Indira & Dilasari, 2023). The level of sensitivity and

productivity is an indicator of company performance is a factor of concern in assessing financial distress (Pitaloka & Budiwitjaksono, 2022). Furthermore, financial distress is a factor for management to conduct tax avoidance (Wulandari et al., 2024).

Financial reports are very helpful for the company, especially management in making decisions. Company performance is one of the indicators of assessing management using financial ratios (Maulidinah & Budiwitjaksono, 2021). In addition, financial reports can be a consideration for management to take certain actions to present financial conditions that can show good performance (Aulia et al., 2023). Financial statements are typically utilised to assess the company's status and aid in making informed decisions. In addition, financial reports have the disadvantage that they only emphasise one financial aspect. To complement these financial reports, a financial analysis tool is needed that can bring together all financial aspects. This financial analysis tool is called financial distress analysis. This analysis provides company management with insight into the financial status of the company as well as indicating whether the company is facing any financial difficulties. If necessary, the company can immediately change its actions when knowing the results of this financial distress analysis.

Several researchers have developed financial distress analysis models that are useful for management and investors. According to the investor's view, financial statements are used to see the company's potential. Financial ratios are comparisons that investors use as a comparison of companies with other companies (Dewi et al., 2022). To detect financial distress using financial statements and existing ratios, several researchers have developed models. The most widely used models include Altman (1968), Springate (1978), and Zmijewski (1984).

The transportation and logistics industry is considered a key sector within the infrastructure category of companies listed on the Indonesia Stock Exchange. Its significance lies in facilitating the movement and distribution of products, particularly in supporting the growth of online retail (Tohir & Satritama, 2023). Indonesia is an archipelago, this makes the transportation and logistics sector much needed by the community.

Research conducted by Seto and Trisnaningsih (2021) shows that the accuracy of Altman Z-Score has the highest accuracy of 84.48% and it is written that Altman Z-Score is an accurate analysis model. Meanwhile, Bandi et al. (2023) uses the Springate method in its research calculations because this approach has proven to be the most precise in identifying financial difficulties. While research conducted by Mulyani et al. (2019) shows that the Zmijewski model is a suitable model and has an accuracy rate of calculating potential financial distress of 70.83%. the results show that the Zmijewski model can be a financial distress prediction model that companies can use.

2. Literature Review

The Indonesian Accounting Association states that financial statements provide a framework for outlining the financial status and achievements of a business. By creating financial statements, companies aim to benefit the public by revealing details about their financial health, accomplishments, and cash flow. This information will later be used and useful for decision makers to make future decisions.

The purpose of analysing financial statement is to find out how the level of profitability, risk, or even the health of the company (Hanafi & Halim, 2016). Financial statement analysis assists companies in viewing and evaluating the company's financial condition, past operating results, and future plans. So that the purpose of this report analysis is to assess the company's past, present and future performance (Sujarweni, 2017).

Financial distress is a decline in performance in a company caused by poor financial conditions, with negative net operating income (Rahayuningsih et al., 2022). This financial distress condition is a big problem for the company's business continuity. Fluctuations in financial conditions are normal, but it will still cause concern for stakeholders. Therefore, financial distress is one of the causes of corporate bankruptcy.

In 1968, Edward I. Altman created an analysis model that can be used to assess the quality of the ratios used in the analysis technique. This analysis model is the Altman Z-Score model. This model analyses a series of financial ratios in the context of bankruptcy prediction. This model was developed using double discriminant statistical methodology on manufacturing companies (Altman, 1968).

Introduced by Gordon L.V. Springate in 1978. This model produces a bankruptcy prediction model using financial ratios. After that, it is analysed using discriminant statistics made by following the Altman model procedure but with a different structure (Springate, 1978).

The Zmijewski model was produced in 1984 by Mark E. Zmijewski. This model examines two biases that can occur in the calculation of financial distress. The two biases are oversampling which is included in the choice-based sample and full data which is included in the topic of sample selection (Zmijewski, 1984).

2.1. Hypothesis Development

Seto and Trisnaningsih (2021) with the results of his study indicated that the Altman Z-Score analysis model had the highest level of accuracy, reaching 84.48%. Research conducted by Panigrahi (2019) states that the Altman Z-Score model has been used in companies in India and recommends this model to predict financial distress. The findings indicate that the Altman Z-Score model plays a crucial role in identifying financial difficulties. Hence, we formulated the hypothesis that:

H1: The Altman Z-Score model has a significant effect in predicting financial distress.

According to a study carried out by Rahayuningsih et al. (2022), the Springate Method has been found to be 80% accurate in predicting potential bankruptcy. Bandi et al. (2023) also stated that the Springate model has demonstrated superior accuracy in tests using standard deviation. The findings indicate that the Springate model is reliable for predicting financial distress. Therefore, we proposed that:

H2: Springate model has a significant effect in predicting financial distress.

During its development in 20 years and has been repeated, 1983 was the year of refinement of the Zmijewski model. Zmijewski (1984) examines a company's liquidity ratios, leverage, and performance metrics. From 1972 to 1978 Zmijewski continued to develop his research by examining 75 companies indicated as bankrupt and 73 companies indicated as healthy. In making a comparison, Zmijewski uses the F-Test indicator on the group of stock return volatility, firm size, trends, fixed payment coverage, leverage turnover, liquidity, and rate of return (Sari, 2015). According to a study by Mulyani, et al. (2018), the Zmijewski Method has been found to be effective with a 70.83% accuracy rate in determining potential bankruptcy. The research indicates that the Zmijewski model could serve as a valuable tool for companies in predicting financial distress. Therefore, we predicted that:

H3: Zmijewski model has a significant effect in predicting financial distress.

3. Methods

In this research, a quantitative method is applied, incorporating the Altman Z-Score (X1), Springate (X2), and Zmijewski (X3) Models as variables independent of financial distress (Y1) as the variable dependent on them. The target group for the study consists of all transportation and logistics firms listed on the Indonesia Stock Exchange (IDX) between 2021 and 2023, comprising a total of 37 companies. A purposive sampling approach was employed to select the samples according to specific criteria: a) Listed on the IDX in the 2021-2023 period. b) Included in the development board category on the IDX. c) Published complete financial reports for three consecutive years (2021-2023). d) Experienced a decrease in net profit in that period.

Following the completion of the sample selection process, 16 companies were found to align with the requirements, resulting in a total of 48 research samples spanning three years (2021-2023). The research in question utilises secondary data taken from financial reports and annual reports of transportation and logistics sector companies that are publicly traded on the IDX. The data collection process involved the use of documentation methods and literature reviews.

Seto and Trisnaningsih (2021) have classified the findings of identifying financial troubles in a business into numerical terms. They assign a value of 0 to companies facing financial difficulties, and a value of 1 to those that are not. Variable Y is assessed by applying three different financial distress prediction models - Altman Z-Score, Springate, and Zmijewski, to the financial data of 16 companies. After the calculation, the companies were grouped based on their financial distress condition. The grouping of companies experiencing financial distress is given the number 0, and the grouping of non-financial distress companies is given the number one. The measurement of each independent variable in this study is as follows:

3.1. Altman Z-Score Model

$$Z= 1{,}2X1 + 1{,}4X2 + 3{,}3X3 + 0{,}6X4 + 1.0X5$$

X1 = Working Capital / Total Asset
= (Current assets - current liabilities)/(Current assets + Non-current assets)
X2 = Retained Earnings / Total Asset
= (Retained earnings)/(Current assets + Non-current assets)
X3 = Earnings Before Interest and Taxes / Total Asset
= (Assets Before Interest and Taxes)/(Current assets + Non-current assets)
X4 = Market Value of Equity / Book Value of Total Debt
= (Share price outstanding x Number of shares outstanding)/(Book value of total debt)
X5 = Sales / Total Asset
= Sales/(Current assets + Non-current assets)

If the calculation results show less than 2.675, the calculated company will be grouped into the financial distress group and given a number 0 (zero). If the formula calculation results in a number greater than 2.675, the companies calculated will be grouped into groups that are not experiencing financial distress and given a number 1 (one).

3.2. Springate Model

$$S= 1{,}03A + 3{,}07B + 0{,}66C + 0{,}4D$$

A = Working Capital / Total Asset
= (Current assets-current liabilities)/(Current assets + Non-current assets)
B = Net Profit Before Interest and Taxes / Total Asset

= (Net income before interest and tax)/(Current assets + Non-current assets)

C = Net Profit Before Taxes / Current Liabilities
= (Net income before interest and tax)/(Current liabilities)

D = Sales / Total Asset
= Sales/(Current assets + Non-current assets)

If the calculation results show a number greater than 0.862, the calculated company will be grouped into the financial distress group and given a number 1 (one). If the formula calculation results in a number less than 0.862, the companies calculated will be grouped into groups that are not experiencing financial distress and given a number 0 (zero).

3.3. Zmijewski Model

$$Z= -4,3 - 4,5X1 + 5,7X2 + 0,004X3$$

X1 = ROA (Return on Asset)
= (Net income)/(Current assets + Non-current assets)

X2 = Leverage (Debt Ratio)
= (Total Liabilities)/(Current assets + Non-current assets)

X3 = Liquidity (Current Ratio)
= (Current assets)/(Current liabilities)

If the calculation results show a number more than 0 (zero), the calculated company will be grouped into the financial distress group and given a number 0 (zero). If the formula calculation results in a number less than 0 (zero), the calculated company will be grouped into a group that is not experiencing financial distress and given a number 1 (one).

4. Results and Discussion

4.1. Research Results

4.1.1. Normality Test Results

Table 1. Normality Test Results

One-Sample Kolmogorov-Smirnov Test			
			Unstandardized Residual
N			48
Normal Parameters[a,b]	Mean		.0000000
	Std. Deviation		.30695814
Most Extreme Differences	Absolute		.124
	Positive		.124
	Negative		-.097
Test Statistic			.124
Asymp. Sig. (2-tailed)[c]			.063
Monte Carlo Sig. (2-tailed)[d]	Sig.		.061
	99% Confidence Interval	Lower Bound	.055
		Upper Bound	.067

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. Lilliefors' method based on 10000 Monte Carlo samples with starting seed 334431365.

Source: Processed by researchers (2024)

4.1.2. Multicollinearity Test

Table 2. Multicollinearity Test Results

Coefficients[a]							
	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model	B	Std. Error	Beta	T	Sig.	Tolerance	VIF
1(Constant)	.101	.068		1.482	.145		
X1	.011	.007	.167	1.469	.149	.710	1.409
X2	.312	.052	.715	5.958	.000	.637	1.570
X3	.005	.034	.020	.148	.883	.507	1.972

a. Dependent Variable: Y

Source: Processed by researchers (2024)

In table 2, it can be seen that the Altman variable (X1) has a tolerance value of 0.710, exceeding the threshold of 0.10, suggesting significant multicollinearity. Similarly, the Springate variable (X2) and Zmijewski variable (X3) also exhibit tolerance values of 0.637, which surpass the threshold of 0.10, pointing towards significant multicollinearity.

4.1.3. Homogeneity Test

Table 3. Homogeneity Test Results

Test Results		
Box's M		.892
F	Approx.	.870
	df1	1
	df2	4918.076
	Sig.	.061
Tests null hypothesis of equal population covariance matrices.		

Source: Processed by researchers (2024)

The Homogeneity Test yielded a p-value of 0.061, indicating that the variance and covariance of the matrix demonstrate homogeneity as opposed to heterogeneity typically seen in a significance value of 0.05.

4.1.4. Test of Equality of Group Means Result

Table 4. Test of Equality of Group Means Result

	Wilks' Lambda	F	df1	df2	Sig.
X1	.847	8.301	1	46	.006
X2	.426	61.929	1	46	.000
X3	.750	15.371	1	46	.000

Source: Processed by researchers (2024)

According to the information provided in the table, the Altman variable (X1) has a wilks' lambda value of 0.847, which is near 1, and a significance value of 0.006, lower than 0.05, indicating its ability to differentiate between financially distressed and stable companies.

Similarly, the Springate variable (X2) has a wilks' lambda value of 0.426, close to 1, and a significance value of 0.000, less than 0.05, demonstrating its effectiveness in distinguishing financially distressed from stable companies. Likewise, the Zmijewski variable (X3) has a wilks' lambda value of 0.750, close to 1, and a significance value of 0.000, below 0.05, suggesting its capability in identifying financially distressed versus stable companies.

4.1.5. Wilks Lambda Test Results

Table 5. Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.426	38.804	3	.000

Source: Processed by researchers (2024)

Judging from the wilks‘ lambda table above, the wilks’ lambda value shows 0.426 which is close to 0. This proves that there is a significant difference between groups of variables.

4.1.6. Eigenvalues

Table 6. Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.346[a]	100.0	100.0	.757

a. First 1 canonical discriminant functions were used in the analysis.
Source: Processed by researchers (2024)

Based on the Eigenvalues table above, there is a cannonocal correlation value that shows the number 0.757 close to 1 (the amount of correlation between 0 - 1). This proves that the relationship between the independent variable and the dependent variable is very high.

4.1.7. Determining the Variables that Enter the Discriminant Function

Table 7. Results of Variables that Enter the Discriminant Function

Variables Entered/Removed[a,b,c,d]									
		Wilks' Lambda							
Step	Entered	Statistic	df1	df2	df3	Exact F Statistic	df1	df2	Sig.
1	X2	.426	1	1	46.000	61.929	1	46.000	.000

At each step, the variable that minimizes the overall Wilks' Lambda is entered.
a. Maximum number of steps is 6.
b. Maximum significance of F to enter is .05.
c. Minimum significance of F to remove is .10.
d. F level, tolerance, or VIN insufficient for further computation.
Source: Processed by researchers (2024)

According to the findings presented in the table above, only one variable is considered in the discriminant analysis function. This variable is X2, also known as the Springate variable. The Altman Variable (X1) and the Zmijewski Variable (X3) are not included in the discriminant analysis function. Therefore, the first hypothesis of the study, which suggests that the Altman model (X1) can predict financial distress, is not supported. Conversely, the second hypothesis, which posits that the Springate model can predict financial distress, is

validated. Additionally, the third hypothesis, which proposes that the Zmijewski model can predict financial distress, is not supported.

4.1.8. Accuracy Test of each Prediction Model

a. Altman Model

Table 1. Accuracy of the Altman Model

Year	Financial distress prediction	Sample
2021	8	16
2022	8	16
2023	10	16
Total	26	48
Accuracy Rate	54,16%	

Source: Processed by researchers (2024)

The information provided in the table demonstrates the effectiveness of the Altman Z-Score prediction model in distinguishing between companies facing financial difficulties and those that are not. Out of the 48 samples analysed, 26 companies were identified as experiencing financial distress. Therefore, the accuracy of the Altman Z-Score in predicting financial distress is calculated to be 54.16%.

b. Springate Model

Table 9. Accuracy of the Springate Model

Year	Financial distress prediction	Sample
2021	10	16
2022	9	16
2023	9	16
Total	28	48
Accuracy Rate	58,33%	

Source: Processed by researchers (2024)

The data presented in the table demonstrates the effectiveness of the Springate prediction model on 48 samples belonging to companies that are either facing financial troubles (0) or are financially stable (1). The number of companies that detected financial distress was 28 companies. So based on this table, it has been calculated that Springate has an accuracy of 58.33%.

c. Zmijewski Model

Table 10. Accuracy of the Zmijewski Model

Year	Financial distress prediction	Sample
2021	2	16
2022	4	16
2023	2	16
Total	8	48
Accuracy Rate	16,66%	

Source: Processed by researchers (2024)

The information presented in the table illustrates the effectiveness of the Zmijewski prediction model on 48 samples of companies classified as either facing financial difficulties (0) or not facing financial difficulties (1). The number of companies that detected financial

distress was 8 companies. So that based on this table it has been calculated that Zmijewski has an accuracy of 16.66%.

4.2. Discussion

According to the latest testing findings, it is clear that the Altman variable (X1) is able to differentiate between companies facing financial difficulties and those that are not. The group means table comparison showed no significant difference with a value higher than 0.05. Wilk's lambda test revealed a value of 0.426, suggesting variance between variable groups. The eigenvalues for cannonical correlation indicated a strong relationship between independent and dependent variables, with a value of 0.757 nearing 1. However, the Altman model is considered less influential in detecting financial distress because the entered/removed variable table does not include these two models in the classification of moderately influential models. The accuracy of the Altman model (X1) has a value of 54.16%.

The Springate model (X2) can identify companies undergoing financial difficulties and those that are not. This is evident from the table testing group means equality, showing a significance level above 0.05. The Wilk's lambda test reveals a value of 0.426, indicating a significant difference between variable groups. The cannonical correlation value on eigenvalues stands at 0.757, approaching 1, suggesting a strong link between independent and dependent variables. The Springate model is considered influential in detecting financial distress because the entered/removed variable table shows the Springate model in the classification of models that are quite influential. The accuracy of the Springate model (X2) has the highest value, namely 58.33%.

Zmijewski (X3) is able to differentiate between companies facing financial difficulties and those that are not, as shown by the test table confirming the significance level exceeds 0.05. The Wilk's lambda test reveals a value of 0.426, indicating significant variation between the groups. The correlation between the eigenvalues of canonical variables is strong, with a value of 0.757, indicating a close relationship between the independent and dependent variables. However, the Altman model is considered less influential in detecting financial distress because the entered/removed variable table does not include these two models in the classification of moderately influential models. The accuracy of the Zmijewski model (X3) has a value of 16.66%.

This research has similar results to research conducted (Rahayuningsih et al., 2022). This study also took the same sector, namely the transportation and logistics sector, and the results showed that the Springate model had the best accuracy in detecting financial distress (80%), followed by the Altman model (58%) and Zmijewski (24%). from this equation it can be proven that Springate is the best financial distress detection model in the transportation and logistics sector.

Yendrawati and Adiwafi's research (2020) shows different results. The research was conducted in a different sector, namely the real estate sector. In this study, the Altman Z-Score detection model is better able to detect financial distress with an accuracy rate of 88.44%, followed by Zmijewski at 83.56% and Springate at 48.44%. This difference proves that each detection model has different results in each company sector.

The impact of the Altman model and the Zmijewski model in identifying financial distress is minimal, unlike the Springate model, which is deemed significant in detecting financial distress. This goes against the findings of Yendrawati & Adiwafi (2020), who argue that the Springate model is not reliable in predicting financial distress in real estate firms, while the Altman and Zmijewski models are considered reliable. On the other hand, the outcomes of various other research studies suggest otherwise (Bandi et al., 2023) which say that the Springate Model is a more accurate and widely used model in determining the

company's financial distress. The results of this study can be used as a reference for transportation and logistics companies, especially companies that are considered to be experiencing financial distress.

5. Conclusion

Based on the test results that have been described, the conclusions obtained from this research are: 1) The Altman model is less influential in distinguishing financial distress companies and non-financial distress companies. So that the Altman Z-Score model is a poor indicator of financial distress for transport and logistics sector companies. 2) The Springate model variable is quite influential in distinguishing financial distress companies and non-financial distress companies. So that the Springate model can be a good financial distress indicator for transport and logistics sector companies. 3) The Zmijewski model is less influential in distinguishing financial distress companies and non-financial distress companies. So that the Zmijewski model is a poor indicator of financial distress for transport and logistics sector companies.

The research uncovers important findings for the transportation and logistics industry. The Springate model's impressive performance indicates that its metrics are more in line with the specific characteristics of the industry. However, the significant difference in model effectiveness between sectors highlights the necessity for industry-specific approaches to predicting financial distress. The overall low accuracy rates (below 60%) for all models suggest that existing prediction tools may require adjustments for this particular sector.

Stakeholders within the transportation and logistics industry should take a well-rounded approach to predicting financial distress, giving preference to the Springate model while incorporating additional industry-specific metrics. It is recommended that companies conduct regular evaluations of their financial well-being using a mix of models, while researchers and financial institutions should concentrate on creating improved prediction tools customized to the industry's unique traits. This could involve developing hybrid models or identifying new variables that better represent the financial dynamics of the sector in order to enhance prediction accuracy beyond current standards.

6. References

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, *23*(4), 589–609.

Aulia, F. N., Millah, N. H., Nurholiza, Alfazriani, R. S., Wahyudin, D., & Caturiasari, J. (2023). Dampak Gerakan Literasi Terhadap Pengembangan Pendidikan Karakter Siswa Sekolah Dasar. *JUDIKDAS: Jurnal Ilmu Pendidikan Dasar Indonesia*, *2*(3), 151–160. https://doi.org/10.51574/judikdas.v2i3.811

Bandi, M. H., Nurmalina, R., & Hayatie, M. N. (2023). Analisis Kebangkrutan Menggunakan Metode Springate (Studi Kasus Pada Pt. Garuda Indonesia, Tbk Tahun 2018-2020). *EconBank: Journal of Economics and Banking*, *5*(1), 75–84.

Febinda, Ruma, Z., Anwar, Amin, A. M., & Ramli, A. (2023). Analysis Of Financial Distress In Broadcasting Sub-Sector Companies Listed On The Indonesia Stock Exchange. *MARGINAL JOURNAL OF MANAGEMENT, ACCOUNTING, GENERAL FINANCE AND INTERNATIONAL ECONOMIC ISSUES*, *2*(3). https://doi.org/10.55047/marginal.v2i3.661

Hadi, S., Putra, A. R., & Mardikaningsih, R. (2020). Pengaruh perilaku inovatif dan keterlibatan kerja terhadap kinerja karyawan. *Jurnal Baruna Horizon*, *3*(1), 186–197.

Hanafi, M. M., & Halim, A. (2016). Analisis laporan keuangan. *Yogyakarta: Upp Stim Ykpn*.

Indira, I., & Dilasari, A. P. (2023). Peran Moderasi Profitabilitas Terhadap Faktor Prediksi Financial Distress. *Jurnal Manajemen Riset Inovasi*, *1*(1), 118–134.

Maulidinah, R., & Budiwitjaksono, G. S. (2021). Analisis Rasio Keuangan Dalam Mengukur Kinerja Keuangan Pt Indocement Tunggal Prakarsa Tbk. *Jurnal Proaksi*, *8*(1), 233–244.

Mulyani, L., Sulindawati, N. L. G. E., & Wahyuni, M. A. (2019). Analisis Perbandingan Ketepatan Prediksi Fi-Nancial Distress Perusahaan Menggunakan Metode Altman, Springate, Zmijewski, Dan Grover (Studi Pada Perusahaan Retail Yang Terdaftar Di Bursa Efek Indonesia Periode 2015-2017). *JIMAT (Jurnal Ilmiah Mahasiswa Akuntansi) Undiksha*, *10*(1).

Panigrahi, C. M. A. (2019). Validity of Altman's 'z'score model in predicting financial distress of pharmaceutical companies. *NMIMS Journal of Economics and Public Policy*, *4*(1).

Pitaloka, G. G., & Budiwitjaksono, G. S. (2022). Analisis Rasio Keuangan Terhadap Financial Distress Saat Pandemi Pada Perusahaan Sub Sektor Transportasi Yang Terdaftar Di Bei Tahun 2017-2020. *Jurnal Ilmiah Manajemen, Ekonomi, & Akuntansi (MEA)*, *6*(2), 648–696.

Rahayuningsih, W., Indrayono, Y., & Surono, S. E. (2022). *Analisis Financial Distress Menggunakan Model Altman, Model Springate, Dan Model Zmijewski Pada Perusahaan Jasa Subsektor Transportasi Yang Listing Di Bursa Efek Indonesia Periode 2016-2020*. Universitas Pakuan.

Seto, B. A., & Trisnaningsih, S. (2021). Penggunaan Model Altman Z-Score, Springate, Zmijewski Dan Grover Dalam Memprediksi Financial Distress. *Seminar Nasional Akuntansi Dan Call for Paper*, *1*(2), 754–769.

Sidabutar, F. Y. (2021). *Analisis Kebangkrutan Dengan Metode Z-Score Altman, Springate Dan Zmijewski Pada Perusahaan Pertanian Di Bursa Efek Indonesia*. STIESIA SURABAYA.

Springate, G. L. V. (1978). *Predicting the possibility of failure in a Canadian firm: A discriminant analysis*. Simon Fraser University.

Sujarweni, V. W. (2017). *Analisis Laporan Keuangan; Teori, Aplikasi, dan Hasil Penelitian*.

Tohir, M., & Satritama, A. (2023). Peranan Logistik Terhadap Perusahaan Untuk Menunjang Kelancaran Dunia Bisnis. *Jurnal Humaniora, Ekonomi Syariah Dan Muamalah*, *1*(4), 201–208.

Wulandari, A., Budiwitjaksono, G. S., & Kirana, N. W. I. (2024). Pengaruh Financial Distress Dan Capital Intensity Terhadap Tax Avoidance Pada Perusahaan Subsektor Food And Beverage Yang Terdaftar Di Bursa Efek Indonesia Tahun 2020-2022. *Journal of Economic, Bussines and Accounting (COSTING)*, *7*(4), 8845–8852.

Yendrawati, R., & Adiwafi, N. (2020). Comparative analysis of Z-score, Springate, and Zmijewski models in predicting financial distress conditions. *Journal of Contemporary Accounting*, 72–80.

Zmijewski, M. E. (1984). Methodological issues related to the estimation of financial distress prediction models. *Journal of Accounting Research*, 59–82.