

Comparison of the Accuracy of the Altman, Springate, Zmijewski, Grover, Ohlson, Fulmer, and Taffler Models in Predicting Bankruptcy Potential in Companies Delisted from the Indonesia Stock Exchange in 2025

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Abstract: The increasing number of companies delisted from the Indonesia Stock Exchange (IDX) in 2025 highlights the importance of early detection of potential corporate bankruptcy. This study aims to analyze the accuracy levels of the Altman, Springate, Zmijewski, Grover, Ohlson, Fulmer, and Taffler models in predicting corporate bankruptcy prior to delisting from the IDX in 2025. This research employs a quantitative approach using secondary data in the form of corporate financial statements obtained from the official IDX website and other supporting sources. The sampling technique used is purposive sampling, with the criterion that companies must have complete financial statements for the 2021–2024 period. Based on these criteria, four sample companies were obtained, namely PT Smartfren Telecom Tbk (FREN), PT Panasia Indo Resources Tbk (HDTX), PT Jakarta Kyoei Steel Works Tbk (JKSW), and PT Multistrada Arah Sarana Tbk (MASA). The data were analyzed using Microsoft Excel to calculate the financial ratios for each bankruptcy prediction model. The results show differences in the accuracy levels of each bankruptcy prediction model. The Altman and Springate models achieved the highest accuracy rate of 75 percent. Furthermore, the Zmijewski, Grover, and Fulmer models each achieved an accuracy rate of 50 percent, while the Ohlson and Taffler models had the lowest accuracy rate of 37.5 percent. These findings indicate that the Altman and Springate models are more capable of providing early predictions of potential corporate bankruptcy prior to delisting compared to the other models. This study is expected to serve as a consideration for investors, companies, and researchers in assessing corporate financial distress conditions.

Keywords: Bankruptcy Prediction, financial distress, delisting

INTRODUCTION

In recent years, Indonesia’s economy has faced increasingly challenging conditions. As one of the largest economies in Southeast Asia, population growth and urbanization have driven structural changes across various sectors. A World Bank report indicates that the Covid-19 pandemic, inflationary pressures, rising social inequality, and the impacts of climate change are among the factors contributing to these economic challenges (World Bank, 2020).

The impact can be observed in the business continuity of companies in Indonesia. One observable indicator is the increasing number of companies delisted from the Indonesia Stock Exchange (IDX). Based on data compiled from the IDX website, in 2025 the IDX delisted 12 (twelve) companies. This figure is significantly higher compared to the 2021–2024 period, during which the IDX delisted only 3 (three) companies. .

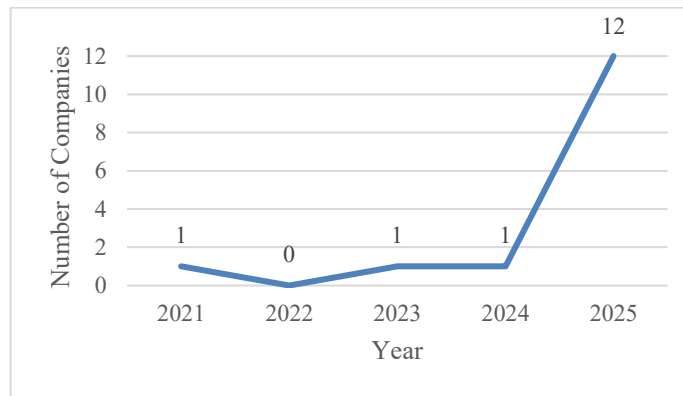


FIGURE 1. Number of Companies Delisted from the IDX in 2021–2025

The details of the 12 companies delisted from the IDX in 2025 are as follows:

TABLE 1. List of 12 Companies Delisted in 2025

No.	Company Name	Stock Code	Sector
1	Jakarta Kyoei Steel Works Tbk	JKSW	B – Basic Materials
2	PT Steadfast Marine Tbk	KPAL	C – Industrials
3	PT Grand Kartech Tbk	KRAH	C – Industrials
4	PT Cottonindo Ariesta Tbk	KPAS	D – Consumer Non-Cyclicals
5	Panasia Indo Resources Tbk	HDTX	E – Consumer Cyclicals
6	Multistrada Arah Sarana Tbk	MASA	E – Consumer Cyclicals
7	Nipress Tbk	NIPS	E – Consumer Cyclicals
8	Prima Alloy Steel Universal Tbk	PRAS	E – Consumer Cyclicals
9	PT Forza Land Indonesia Tbk	FORZ	H – Properties & Real Estate
10	Mas Murni Indonesia Tbk	MAMI	H – Properties & Real Estate
11	Hanson International Tbk	MYRX	H – Properties & Real Estate
12	PT Smartfren Telecom Tbk	FREN	J – Infrastructures

Source: Processed from the IDX Website

One of the reasons companies may be delisted is that they continuously incur losses and/or become involved in legal disputes, or are even declared bankrupt by a court. When a company is delisted, shareholders or investors become among the parties most affected, as they may face difficulties in obtaining returns and may suffer losses. This condition indicates the need for early detection of potential bankruptcy so that signs of declining performance can be identified before a company experiences failure (Wahdania et al., 2023).

Information regarding bankruptcy prediction or financial distress is important for investors in assessing a company's financial condition before making investment decisions. Financial distress analysis provides early signals regarding the possibility of financial difficulties that may lead to corporate bankruptcy, thereby enabling investors to assess investment risk more accurately. With such information, investors can consider whether to continue, increase, or discontinue their investment in a company in order to minimize potential losses. Therefore, financial distress prediction analysis serves as an important tool in providing information for economic decision-making in the capital market (Hayat et al., 2025).

Accordingly, it is important to conduct further analysis of bankruptcy prediction models to assess a company's ability to maintain its business continuity in the future. Bankruptcy prediction models based on financial ratios and statistical calculations can serve as evaluation tools to identify potential failure at an early stage. These prediction models can help assess a company's financial stability based on financial indicators without waiting until the company reaches a critical condition. Several bankruptcy prediction models that are frequently used include Altman, Springate, Zmijewski, Grover, Ohlson, Fulmer, and Taffler. These seven models assess a company's financial health using different indicators. The existence of various bankruptcy prediction models often creates uncertainty for investors in determining the most accurate model to assess a company's financial condition. Therefore, research on the accuracy level of each bankruptcy prediction model is important to conduct.

This study faces variations in the publication periods of financial statements. Not all companies delisted in 2025 have complete financial statements for the 2021 to 2024 period. Some companies no longer published their financial statements because they had entered a period of financial difficulty prior to delisting. Therefore, the most recent financial statements available consecutively for four years were used as the basis for analysis.

The main problem of this study is to determine the most accurate bankruptcy prediction model in providing early warning of financial distress conditions in companies that experienced delisting. A comparative analysis of the Altman, Springate, Zmijewski, Grover, Ohlson, Fulmer, and Taffler models is expected to identify the best model for detecting signs of declining performance long before a company is no longer able to survive in the capital market.

LITERATURE REVIEW

Signaling Theory

According to Goh (2023), signaling theory explains why companies disclose financial information to the capital market. The disclosure of such information serves as a form of corporate communication to the market regarding the company's condition and performance. Signaling theory explains that investment decisions are also influenced by such conditions and performance. Through financial reporting and financial notes, companies generally seek to demonstrate better prospects compared to other companies. For investors and stakeholders, this information serves as an important basis for decision-making, as it helps assess the company's condition in previous periods while also estimating its future prospects (Goh, 2023).

Bankruptcy

Bankruptcy, commonly referred to as “insolvency,” originates from the French word *faillite*, which means failure to make payments. According to Law Number 37 of 2004 concerning Bankruptcy and Suspension of Debt Payment Obligations, Article 1 paragraph (1) defines bankruptcy as a general confiscation of all assets of a bankrupt debtor, the management and settlement of which are carried out by a curator under the supervision of a supervisory judge, as regulated in this Law (Undang-Undang (UU) No. 37 Tahun 2004 Kepailitan Dan Penundaan Kewajiban Pembayaran Utang, 2004).

Altman Model

Altman (1968) was one of the earliest researchers to apply Multiple Discriminant Analysis to predict corporate bankruptcy. This approach assesses a company's condition by combining several

financial ratios considered to be the most relevant, rather than evaluating each ratio separately. The combination of these ratios produces an index value known as Z, which functions as an indicator of a company's condition, both in assessing its current financial health and in identifying potential bankruptcy in the future. Altman developed a bankruptcy prediction model using 22 financial ratios grouped into five categories, namely liquidity, profitability, leverage, market test ratios, and activity ratios (Altman, 1968).

Over time, Altman (1995) adjusted the model to make it relevant for various types of companies. The model was subsequently modified so that it could be applied to manufacturing companies, non-manufacturing companies, and bond issuers in emerging markets. In the modified version, the X5 variable, namely sales to total assets, was removed because its value tends to differ across industries and is influenced by differences in asset scale. The following is the modified Z-Score equation (Altman et al., 1995).

$$Z'' = 6,56(X1) + 3,26(X2) + 6,72(X3) + 1,05(X4)$$

Description:

(X1) = Working capital/total asset

(X2) = Retained earning/total asset

(X3) = Earning before interest and taxes/total asset

(X4) = Market value of equity/book value of debt

In the revised model, companies with a Z-score above 2.90 are classified as healthy companies, companies with a Z-score below 2.10 are classified as companies with potential bankruptcy, while scores between 1.20 and 2.90 are placed in the grey area category.

Springate Model

Springate (1978) developed a bankruptcy prediction model using a multiple discriminant analysis approach and employed 40 companies as the sample. This model was reported to have a prediction accuracy rate of 92,5 percent. The Springate model equation is formulated as follows (Springate, 1978).

$$S = 1,03(X1) + 3,07(X2) + 0,66(X3) + 0,4(X4)$$

Description:

(X1) = Working capital / total asset

(X2) = Earning Before Interest and Taxes (EBIT) / total asset

(X3) = Earning Before Taxes (EBT) / current liabilities

(X4) = Sales / total asset

The model establishes a cut-off point in which companies with an S-score greater than 0.862 are categorized as healthy, while companies with an S-score lower than 0.862 are classified as having the potential to experience bankruptcy.

Zmijewski Model

In 1984, Zmijewski criticized the sample selection techniques used in previous studies. He argued that the matched-pair sampling model had the potential to create bias in research results. Therefore, Zmijewski applied a random sampling technique in his study, consistent with the approach used in Ohlson's research. Zmijewski also emphasized the importance of determining the proportion of the sample and population from the outset, so that bankruptcy frequency could be calculated accurately by comparing the number of bankrupt firms with the total sample. The Zmijewski model was then formulated as presented in the referenced study (Zmijewski, 1984).

$$X = -4,3 - 4,5(X1) + 5,7(X2) - 0,004(X3)$$

Description:

(X1) = ROA (net income/total asset)

(X2) = Leverage (total liabilities/total asset)

(X3) = Liquidity (current asset/current liabilities)

Zmijewski states that a company is considered to be in distress if its probability value is greater than 0.

Grover Model

The Grover model was developed through a process of redesigning and re-evaluating the Altman Z-Score model. Jeffrey S. Grover used the 1968 Altman Z-Score model as the basis and added thirteen new financial ratios. The study used 70 companies as the sample, consisting of 35 bankrupt companies and 35 non-bankrupt companies during the period from 1982 to 1996 (Grover, 2001). Grover then formulated the model function as follows.

$$G = 1,650(X1) + 3,404(X2) - 0,016ROA + 0,057$$

Description:

(X1) = Working capital/total asset

(X2) = Earning before interest and taxes / total asset

ROA = Return on Asset (net income / total asset)

The Grover model establishes that a company is classified as bankrupt if its Z-score is less than or equal to -0,02. Conversely, a company is categorized as non-bankrupt if its Z-score is greater than or equal to 0,01.

Ohlson Model

This model was developed by James A. Ohlson in 1980. Ohlson used sample data from the 1970 to 1976 period, covering 150 manufacturing industries, with 105 companies experiencing financial distress and 1,058 companies in healthy condition. Ohlson applied the Multiple Logistic Regression model, which was considered capable of addressing the weaknesses of the multiple discriminant analysis model previously used by Altman (1968) and Springate (1978) (Ohlson, 1980). The Ohlson model formula is as follows.

$$O = -1,32 - 0,407 (X1) + 6,03 (X2) - 1,43 (X3) + 0,0757 (X4) - 2,37 (X5) - 1,83 (X6) + 0,285 (X7) - 1,72 (X8) - 0,521 (X9)$$

Description:

(X1) = Log (total assets / GNP price-level index)

(X2) = Total liabilities / total asset

(X3) = Working capital / total asset

(X4) = Current liabilities / current asset

(X5) = 1 if total liabilities > total assets; 0 otherwise

(X6) = Net income / total asset

(X7) = Operating cash flow / total liabilities

(X8) = 1 if net income is negative; 0 otherwise

(X9) = (Nlt - Nlt-1) / (Nlt + Nlt-1)

The Ohlson model has a specific cut-off value as the basis for classifying a company's condition. If the O-value is less than 0,38, the company is categorized as healthy. Conversely, if the O-value is greater than 0,38, the company is categorized as bankrupt.

Fulmer Model

The Fulmer prediction model is reported to have an accuracy rate of approximately 98 percent in classifying companies with potential bankruptcy within a one-year horizon, and approximately 81 percent within a two-year horizon. Fulmer also stated that this model can serve as a reference for managers of small companies, be used by investors as one basis for assessing investment feasibility, and be utilized by auditors as a consideration in evaluating small companies (Fulmer et al., 1984). The Fulmer prediction model equation is as follows.

$$H = 5,528(X1) + 0,212(X2) + 0,073(X3) + 1,270(X4) - 0,120(X5) + 2,335(X6) + 0,575(X7) + 1,083(X8) + 0,894(X9) - 6,075$$

Description:

- (X1) = Retained earnings / total assets
- (X2) = Sales / total assets
- (X3) = Earnings before taxes / total equity
- (X4) = Cash flow from operations / total liabilities
- (X5) = Total liabilities / total assets
- (X6) = Current liabilities / total assets
- (X7) = Log (fixed assets)
- (X8) = Working capital / total liabilities
- (X9) = Log (EBIT / interest expense)

The bankruptcy index classification in the Fulmer model is determined based on the H-Score obtained from the calculation results. If the H-Score is less than 0, the company is predicted to experience bankruptcy. Conversely, if the H-Score is greater than or equal to 0, the company is predicted not to experience bankruptcy.

Taffler Model

Taffler (1983) developed a bankruptcy prediction model for manufacturing companies listed on the London Stock Exchange during the period from 1969 to 1976. The study used four variables and applied the Multiple Discriminant Analysis technique, with a prediction accuracy rate of 95,7 percent for bankrupt companies and 100 percent for non-bankrupt companies (Taffler, 1983).

$$Z = 3,20 + 12,18(X1) + 2,50(X2) - 10,68(X3) + 0,0289(X4)$$

Description:

- (X1) = Earning before interest and tax / current liabilities
- (X2) = Current assets / current liabilities
- (X3) = Current liabilities / total assets
- (X4) = Net Income / total asset

The discriminant Z-Score index classifies companies into certain zones. If the Z-value is greater than 0,3, the company is in a low bankruptcy-risk zone. Conversely, if the Z-value is less than 0,2, the company is in a high bankruptcy-risk zone.

Deslisted Shares

PT Bursa Efek Indonesia (Indonesia Stock Exchange or IDX) is one of the regulators and organizers of capital market trading in Indonesia. Through the Decree of the Board of Directors of the IDX No. Kep-00101/BEI/12-2021, the IDX may carry out listing, which refers to the inclusion of a security in the list of securities listed on the Exchange so that it can be traded on the Exchange. In addition, the IDX may also carry out delisting, which refers to the removal of a security from the list of securities listed on the Exchange, so that the security can no longer be traded on the Exchange (Surat Keputusan Direktur BEI Nomor Kep-00101/BEI/12-2021 Tentang Perubahan Peraturan Nomor I-A Tentang Pencatatan Saham Dan Efek Bersifat Ekuitas Selain Saham Yang Diterbitkan Oleh Perusahaan Terdaftar, 2021).

Based on Kep-308/BEJ/07-2004, the delisting of a share from the list of securities listed on the Exchange may occur due to a delisting request submitted by the relevant listed company and/or the removal of the company's shares from the listing by the Exchange in accordance with applicable provisions (Keputusan Direksi PT Bursa Efek Jakarta Nomor Kep Kep-308/BEJ/07-2004 Tentang Penghapusan Pencatatan (Delisting) Dan Pencatatan Kembali (Relisitng) Saham Di Bursa, 2004).

METHODS

Sampling Technique

According to Sugiyono (2023), population refers to a generalization consisting of objects or subjects with certain qualities and characteristics determined by the researcher to be studied and from which conclusions are drawn (Sugiyono, 2023). The population in this study consists of all companies listed on the Indonesia Stock Exchange (IDX) in 2025 that experienced delisting during

the period relevant to this study. The number of companies that meet these population criteria is twelve companies.

The sampling technique used in this study is purposive sampling, which means that the sample is selected deliberately based on certain considerations in order to obtain samples that meet the predetermined criteria (Sugiyono, 2023). The sample criterion used in this study is companies that have complete financial statements for the period from 2021 to 2024. The availability of complete financial statements is required because such data serve as the basis for calculating financial ratios in the Altman, Zmijewski, Grover, Springate, Fulmer, Ohlson, and Taffler models. The recapitulation of the twelve companies included in the population is presented as follows:

TABLE 2. Recapitulation of the Availability of Financial Statements of Companies Delisted from the IDX in 2025

Stock Code	Availability of Financial Statements										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
FORZ			V	V	V	V					
FREN								V	V	V	V
HDTX								V	V	V	V
JKSW								V	V	V	V
KPAL				V	V	V	V				
KPAS				V	V	V	V				
KRAH		V	V	V	V						
MAMI					V	V	V	V			
MASA								V	V	V	V
MYRX		V	V	V	V						
NIPS	V	V	V	V							
PRAS						V	V	V	V		

Source: Author

Based on the sample selection process, out of the twelve companies included in the population, four companies met the criterion of having complete financial statements for the period from 2021 to 2024. These companies are Pania Asia Indo Resources Tbk (HDTX), Multistrada Arah Sarana Tbk (MASA), Jakarta Kyoei Steel Works Tbk (JKSW), and Smartfren Telecom Tbk (FREN). These four companies were used as the research sample to examine the accuracy level of each bankruptcy prediction model in predicting the condition of companies that experienced delisting.

Data Collection Technique

The data source used in this study is secondary data; therefore, the data were obtained from the financial statements of the companies serving as the research objects, which were published on the IDX website or other sources. The secondary data collection method used is documentation, conducted by reviewing books, journals, and the financial statements of each company included as the research object.

Data Analysis Technique

After collecting the data, the next step was data processing, namely identifying and compiling relevant financial data required for each model, including the Altman, Springate, Zmijewski, Grover, Ohlson, Fulmer, and Taffler models. These data were then entered into Microsoft Excel, which was used to calculate the financial ratios applied in each model.

The financial data were then calculated for each bankruptcy prediction model. The calculation of the bankruptcy prediction models was carried out using Microsoft Excel, as each model has a different combination of financial data in accordance with the formulas established in the theory.

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The calculation results of each model produce a bankruptcy prediction ratio score. This score can be converted into the category of bankrupt or non-bankrupt according to the classification criteria established in the theory. The results of the bankrupt or non-bankrupt classification were then further calculated to determine the accuracy level of each model.

Accuracy was calculated by comparing the prediction results with the actual condition of the company, namely its delisting or bankruptcy status, against the total number of predictions. The accuracy formula used is: $(\text{number of correct predictions} / \text{total predictions}) \times 100$ percent. The calculation of the accuracy of the bankruptcy prediction models was carried out using Microsoft Excel.

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RESULT AND DISCUSSION

Results of the Altman Model Analysis

Based on the formula developed by Altman, the results of the bankruptcy prediction calculation for the sample companies are presented in the following table:

TABLE 3. Results of the Altman Model Calculation for Companies Delisted from the IDX in 2025

Stock Code	Year	X1 Working capital/ total asset	X2 Retained earning/ total asset	X3 EBIT / total asset	X4 Market value of equity / book value of debt	Z"	Bankrupt / Non- Bankrupt
FREN	2021	-0.1679	-0.6004	0.0057	0.8028	-2.1778	Bankrupt
	2022	-0.1354	-0.5368	0.0134	0.7203	-1.7917	Bankrupt
	2023	-0.0507	-0.5560	0.0121	0.5709	-1.4644	Bankrupt
	2024	-0.0401	-0.6097	-0.0072	0.5264	-1.7462	Bankrupt
HDTX	2021	-0.6980	-5.6395	-0.1553	1.1782	-22.7698	Bankrupt
	2022	-0.8336	-7.5667	-0.1789	1.2582	-30.0169	Bankrupt
	2023	-0.9183	-8.4636	-0.1679	1.3019	-33.3763	Bankrupt
	2024	-1.0703	-9.5936	-0.1786	1.2917	-38.1401	Bankrupt
JKSW	2021	0.2194	-3.4390	-0.0619	0.0135	-10.1733	Bankrupt
	2022	0.2137	-3.6104	-0.0604	0.0138	-10.7590	Bankrupt
	2023	0.1596	-3.6293	-0.0730	0.0138	-11.2605	Bankrupt
	2024	0.1753	-3.7731	-0.0904	0.0138	-11.7433	Bankrupt
MASA	2021	0.1558	0.0081	0.1261	11.3354	13.7983	Non-Bankrupt
	2022	0.1106	0.1271	0.1500	18.7403	21.8253	Non-Bankrupt
	2023	0.2354	0.2176	0.1859	20.3246	24.8433	Non-Bankrupt
	2024	0.3103	0.2678	0.0930	41.8233	47.4485	Non-Bankrupt

Source: Author

Based on the classification results, 12 predictions were correct out of a total of 16 observational data points; therefore, the accuracy level of the Altman model is calculated as follows:

$$\frac{\text{Number of Correct Predictions}}{\text{Total Predictions}} \times 100\% = \frac{12}{16} \times 100\% = 75,00\%$$

Results of the Springate Model Analysis

Based on the formula developed by Springate, the results of the bankruptcy prediction calculation for the sample companies are presented in the following table:

TABLE 4. Results of the Springate Model Calculation for Companies Delisted from the IDX in 2025

Stock Code	Year	X1 Working capital / total asset	X2 EBIT/ total asset	X3 EBT/ current liabilities	X4 Sales/ total asset	S	Bankrupt / Non- Bankrupt
FREN	2021	-0.1679	0.0057	-0.0590	0.2412	-0.0979	Bankrupt
	2022	-0.1354	0.0134	0.1243	0.2410	0.0801	Bankrupt
	2023	-0.0507	0.0121	0.0129	0.2588	0.0968	Bankrupt
	2024	-0.0401	-0.0072	-0.2112	0.2644	-0.0969	Bankrupt
HDTX	2021	-0.6980	-0.1553	-0.1741	0.0340	-1.2969	Bankrupt
	2022	-0.8336	-0.1789	-0.3272	0.0226	-1.6147	Bankrupt
	2023	-0.9183	-0.1679	-0.0783	0.0001	-1.5128	Bankrupt
	2024	-1.0703	-0.1786	0.1293	0.0000	-1.5653	Bankrupt

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Stock Code	Year	X1 <i>Working capital / total asset</i>	X2 <i>EBIT/ total asset</i>	X3 <i>EBT/ current liabilities</i>	X4 <i>Sales/ total asset</i>	S	Bankrupt / Non-Bankrupt
JKSW	2021	0.2194	-0.0619	-0.0028	0.0087	0.0376	Bankrupt
	2022	0.2137	-0.0604	0.2291	0.0000	0.1860	Bankrupt
	2023	0.1596	-0.0730	-0.0064	0.0000	-0.0639	Bankrupt
	2024	0.1753	-0.0904	-0.3409	0.0000	-0.3220	Bankrupt
MASA	2021	0.1558	0.1261	0.4446	0.8867	1.1958	Non-Bankrupt
	2022	0.1106	0.1500	0.5431	1.0037	1.3343	Non-Bankrupt
	2023	0.2354	0.1859	0.7627	0.9338	1.6899	Non-Bankrupt
	2024	0.3103	0.0930	0.6508	0.8790	1.3863	Non-Bankrupt

Source: Author

Based on the classification results, 12 predictions were correct out of a total of 16 observational data points; therefore, the accuracy level of the Springate model is calculated as follows:

$$\frac{\text{Number of Correct Predictions}}{\text{Total Predictions}} \times 100\% = \frac{12}{16} \times 100\% = 75,00\%$$

Results of the Zmijewski Model Analysis

Based on the formula developed by Zmijewski, the results of the bankruptcy prediction calculation for the sample companies are presented in the following table:

TABLE 5. Results of the Zmijewski Model Calculation for Companies Delisted from the IDX in 2025

Stock Code	Year	X1 <i>net income/ total asset</i>	X2 <i>total liabilities/ total asset</i>	X3 <i>current asset/ current liabilities</i>	S	Bankrupt / Non-Bankrupt
FREN	2021	-0.0100	0.7082	0.2418	-0.2193	Non-Bankrupt
	2022	0.0229	0.6610	0.2731	-0.6362	Non-Bankrupt
	2023	-0.0024	0.6521	0.6550	-0.5750	Non-Bankrupt
	2024	-0.0300	0.5033	0.7156	-1.2989	Non-Bankrupt
HDTX	2021	-0.1212	1.0590	0.0587	2.2813	Bankrupt
	2022	-0.2159	1.2928	0.0515	4.0400	Bankrupt
	2023	-0.0626	1.3877	0.0389	3.8915	Bankrupt
	2024	-0.1307	1.5644	0.0175	5.2054	Bankrupt
JKSW	2021	-0.0003	3.9544	2.9272	18.2296	Bankrupt
	2022	0.0200	4.0988	3.4449	18.9593	Bankrupt
	2023	-0.0005	4.1153	2.9225	19.1478	Bankrupt
	2024	-0.0276	4.2425	3.1660	19.9936	Bankrupt
MASA	2021	0.0963	0.4791	1.5596	-2.0089	Non-Bankrupt
	2022	0.1143	0.2983	1.4099	-3.1196	Non-Bankrupt
	2023	0.1439	0.2723	1.9776	-3.4035	Non-Bankrupt
	2024	0.0728	0.1763	3.1769	-3.6354	Non-Bankrupt

Source: Author

Based on the classification results, 8 predictions were correct out of a total of 16 observational data points; therefore, the accuracy level of the Zmijewski model is calculated as follows:

$$\frac{\text{Number of Correct Predictions}}{\text{Total Predictions}} \times 100\% = \frac{8}{16} \times 100\% = 50,00\%$$

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Results of the Grover Model Analysis

Based on the formula developed by Grover, the results of the bankruptcy prediction calculation for the sample companies are presented in the following table:

TABLE 6. Results of the Grover Model Calculation for Companies Delisted from the IDX in 2025

Stock Code	Year	X1 Working capital / total asset	X2 EBIT/ total asset	X3 Net Income / total asset	G	Bankrupt / Non- Bankrupt
FREN	2021	-0.1679	0.0057	-0.0100	-0.2005	Bankrupt
	2022	-0.1354	0.0134	0.0229	-0.1211	Bankrupt
	2023	-0.0507	0.0121	-0.0024	0.0145	Bankrupt
	2024	-0.0401	-0.0072	-0.0300	-0.0331	Bankrupt
HDTX	2021	-0.6980	-0.1553	-0.1212	-1.6213	Bankrupt
	2022	-0.8336	-0.1789	-0.2159	-1.9240	Bankrupt
	2023	-0.9183	-0.1679	-0.0626	-2.0286	Bankrupt
	2024	-1.0703	-0.1786	-0.1307	-2.3148	Bankrupt
JKSW	2021	0.2194	-0.0619	-0.0003	0.2084	Non-Bankrupt
	2022	0.2137	-0.0604	0.0200	0.2038	Non-Bankrupt
	2023	0.1596	-0.0730	-0.0005	0.0719	Non-Bankrupt
	2024	0.1753	-0.0904	-0.0276	0.0389	Non-Bankrupt
MASA	2021	0.1558	0.1261	0.0963	0.7419	Non-Bankrupt
	2022	0.1106	0.1500	0.1143	0.7482	Non-Bankrupt
	2023	0.2354	0.1859	0.1439	1.0757	Non-Bankrupt
	2024	0.3103	0.0930	0.0728	0.8845	Non-Bankrupt

Source: Author

Based on the classification results, 8 predictions were correct out of a total of 16 observational data points; therefore, the accuracy level of the Grover model is calculated as follows:

$$\frac{\text{Number of Correct Predictions}}{\text{Total Predictions}} \times 100\% = \frac{8}{16} \times 100\% = 50,00\%$$

Results of the Ohlson Model Analysis

Based on the formula developed by Ohlson, the results of the bankruptcy prediction calculation for the sample companies are presented in the following table:

TABLE 7. Results of the Ohlson Model Calculation for Companies Delisted from the IDX in 2025

Stock Code	Year	X1 Log (total assets / GNP price- level index)	X2 Total liabilities / total asset	X3 Working capital / total asset	X4 Current liabilities / current asset	X5 1 if total liabilities > total assets; 0 otherwise	X6 Net income / total asset	X7 Operating cash flow / total liabilities	X8 1 if net income is negative; 0 otherwise	X9 (Nlt – Nlt-1) / (Nlt + Nlt-1)	O	Bankrupt / Non- Bankrupt
FREN	2021	19.4643	0.7082	-0.1679	4.1349	0.0000	-0.0100	0.0935	1.0000	-0.5555	-5.8041	Non- Bankrupt
	2022	19.4428	0.6610	-0.1354	3.6618	0.0000	0.0229	0.0858	0.0000	2.3842	-6.0360	Non- Bankrupt
	2023	19.3963	0.6521	-0.0507	1.5266	0.0000	-0.0024	0.0897	1.0000	-1.2281	-6.1444	Non- Bankrupt
	2024	19.3447	0.5033	-0.0401	1.3974	0.0000	-0.0300	0.1088	1.0000	0.8448	-8.0693	Non- Bankrupt
HDTX	2021	14.6346	1.0590	-0.6980	17.0304	1.0000	-0.1212	-0.0128	1.0000	-0.0597	-2.4441	Non- Bankrupt

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Stock Code	Year	X1 Log (total assets / GNP price- level index)	X2 Total liabilities / total asset	X3 Working capital / total asset	X4 Current liabilities / current asset	X5 1 if total liabilities > total assets; 0 otherwise	X6 Net income / total asset	X7 Operating cash flow / total liabilities	X8 1 if net income is negative; 0 otherwise	X9 (Nlt – Nlt-1) / (Nlt + Nlt-1)	O	Bankrupt / Non- Bankrupt
JKSW	2022	14.2781	1.2928	-0.8336	19.4095	1.0000	-0.2159	-0.0071	1.0000	0.1550	-0.4522	Non-Bankrupt
	2023	14.1583	1.3877	-0.9183	25.7086	1.0000	-0.0626	0.0241	1.0000	-0.5859	0.8814	Bankrupt
	2024	14.0369	1.5644	-1.0703	57.2233	1.0000	-0.1307	-0.0107	1.0000	0.3023	4.2513	Bankrupt
	2021	13.9122	3.9544	0.2194	0.3416	1.0000	-0.0003	0.0114	1.0000	-0.9069	12.9609	Bankrupt
	2022	13.7668	4.0988	0.2137	0.2903	1.0000	0.0200	0.0050	0.0000	-1.0343	14.5650	Bankrupt
	2023	13.7469	4.1153	0.1596	0.3422	1.0000	-0.0005	-0.0057	1.0000	-1.0540	14.1563	Bankrupt
MASA	2024	13.7060	4.2425	0.1753	0.3159	1.0000	-0.0276	0.0058	1.0000	0.9612	13.9183	Bankrupt
	2021	17.7036	0.4791	0.1558	0.6412	0.0000	0.0963	0.2515	0.0000	-0.0958	-5.8655	Non-Bankrupt
	2022	17.5787	0.2983	0.1106	0.7093	0.0000	0.1143	0.7667	0.0000	0.0688	-6.8067	Non-Bankrupt
	2023	17.6759	0.2723	0.2354	0.5057	0.0000	0.1439	0.5285	0.0000	0.1696	-7.3716	Non-Bankrupt
	2024	17.6252	0.1763	0.3103	0.3148	0.0000	0.0728	0.4129	0.0000	-0.3465	-7.6854	Non-Bankrupt

Source: Author

Based on the classification results, 6 predictions were correct out of a total of 16 observational data points; therefore, the accuracy level of the Ohlson model is calculated as follows:

$$\frac{\text{Number of Correct Predictions}}{\text{Total Predictions}} \times 100\% = \frac{6}{16} \times 100\% = 37,50\%$$

Results of the Fulmer Model Analysis

Based on the formula developed by Fulmer, the results of the bankruptcy prediction calculation for the sample companies are presented in the following table:

TABLE 8. Results of the Fulmer Model Calculation for Companies Delisted from the IDX in 2025

Stock Code	Year	X1 Retained earnings / total assets	X2 Sales / total assets	X3 EBT / total equity	X4 Cash flow from operations / total liabilities	X5 Total liabilities / total assets	X6 Current liabilities / total assets	X7 Log (fixed assets)	X8 Working capital / total liabilities	X9 Log (EBIT / interest expense)	H	Bankrupt / Non- Bankrupt
FREN	2021	-0.6004	0.2412	-0.0448	0.0935	0.7082	0.2215	24.4377	-0.2371	-1.3596	3.7515	Non-Bankrupt
	2022	-0.5368	0.2410	0.0683	0.0858	0.6610	0.1862	24.5104	-0.2048	-0.5201	4.8560	Non-Bankrupt
	2023	-0.5560	0.2588	0.0054	0.0897	0.6521	0.1470	24.4297	-0.0778	-0.8548	4.4544	Non-Bankrupt
	2024	-0.6097	0.2644	-0.0600	0.1088	0.5033	0.1410	24.3824	-0.0797	-1.4494	3.6181	Non-Bankrupt
HDTX	2021	-5.6395	0.0340	2.1880	-0.0128	1.0590	0.7415	19.6185	-0.6591	2.2578	-23.2144	Bankrupt
	2022	-7.5667	0.0226	0.9824	-0.0071	1.2928	0.8789	19.3515	-0.6448	-0.0861	-35.9958	Bankrupt
	2023	-8.4636	0.0001	0.1929	0.0241	1.3877	0.9555	19.2550	-0.6617	2.2223	-38.8677	Bankrupt
	2024	-9.5936	0.0000	-0.2495	-0.0107	1.5644	1.0893	19.1617	-0.6841	1.3211	-45.8444	Bankrupt
JKSW	2021	-3.4390	0.0087	0.0001	0.0114	3.9544	0.1139	18.5352	0.0555	8.2826	-7.3412	Bankrupt
	2022	-3.6104	0.0000	-0.0065	0.0050	4.0988	0.0874	18.5283	0.0521	7.9158	-8.7230	Bankrupt
	2023	-3.6293	0.0000	0.0002	-0.0057	4.1153	0.0830	18.6036	0.0388	8.2599	-8.5175	Bankrupt
	2024	-3.7731	0.0000	0.0085	0.0058	4.2425	0.0809	18.5540	0.0413	8.4439	-9.1863	Bankrupt
MASA	2021	0.0081	0.8867	0.2376	0.2515	0.4791	0.2784	22.1625	0.3252	3.9815	11.7427	Non-Bankrupt
	2022	0.1271	1.0037	0.2089	0.7667	0.2983	0.2699	22.2195	0.3709	3.7905	12.9975	Non-Bankrupt
	2023	0.2176	0.9338	0.2523	0.5285	0.2723	0.2408	22.1640	0.8644	4.4217	14.1905	Non-Bankrupt
	2024	0.2678	0.8790	0.0928	0.4129	0.1763	0.1426	22.1660	1.7604	5.9907	16.4570	Non-Bankrupt

Source: Author

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Based on the classification results, 8 predictions were correct out of a total of 16 observational data points; therefore, the accuracy level of the Fulmer model is calculated as follows:

$$\frac{\text{Number of Correct Predictions}}{\text{Total Predictions}} \times 100\% = \frac{8}{16} \times 100\% = 50,00\%$$

Results of the Taffler Model Analysis

Based on the formula developed by Taffler, the results of the bankruptcy prediction calculation for the sample companies are presented in the following table:

TABLE 9. Results of the Taffler Model Calculation for Companies Delisted from the IDX in 2025

Stock Code	Year	X1 Earning before interest and tax / current liabilities	X2 Current assets / current liabilities	X3 Current liabilities / total assets	X4 Net Income / total asset	S	Bankrupt / Non- Bankrupt
FREN	2021	0.0257	0.2418	0.2215	-0.0100	1.7523	Non-Bankrupt
	2022	0.0720	0.2731	0.1862	0.0229	2.7708	Non-Bankrupt
	2023	0.0821	0.6550	0.1470	-0.0024	4.2682	Non-Bankrupt
	2024	-0.0508	0.7156	0.1410	-0.0300	2.8635	Non-Bankrupt
HDTX	2021	-0.2094	0.0587	0.7415	-0.1212	-7.1265	Bankrupt
	2022	-0.2035	0.0515	0.8789	-0.2159	-8.5432	Bankrupt
	2023	-0.1757	0.0389	0.9555	-0.0626	-9.0488	Bankrupt
	2024	-0.1639	0.0175	1.0893	-0.1307	-10.3909	Bankrupt
JKSW	2021	-0.5436	2.9272	0.1139	-0.0003	2.6805	Non-Bankrupt
	2022	-0.6905	3.4449	0.0874	0.0200	2.4688	Non-Bankrupt
	2023	-0.8791	2.9225	0.0830	-0.0005	-1.0875	Bankrupt
	2024	-1.1171	3.1660	0.0809	-0.0276	-3.3565	Bankrupt
MASA	2021	0.4530	1.5596	0.2784	0.0963	9.6460	Non-Bankrupt
	2022	0.5556	1.4099	0.2699	0.1143	10.6125	Non-Bankrupt
	2023	0.7720	1.9776	0.2408	0.1439	14.9791	Non-Bankrupt
	2024	0.6525	3.1769	0.1426	0.0728	17.5687	Non-Bankrupt

Source: Author

Based on the classification results, 6 predictions were correct out of a total of 16 observational data points; therefore, the accuracy level of the Taffler model is calculated as follows:

$$\frac{\text{Number of Correct Predictions}}{\text{Total Predictions}} \times 100\% = \frac{6}{16} \times 100\% = 37,50\%$$

Results of the Model Accuracy Analysis

After the prediction results from each model were compared with the actual condition of the companies, different accuracy levels were obtained for each model. These differences indicate that each model has a different predictive ability in assessing the potential bankruptcy of companies that experienced delisting. The accuracy results of all bankruptcy prediction models are presented in the following table:

TABLE 10. Accuracy Results of Bankruptcy Prediction Models for
Companies Delisted from the IDX in 2025

Stock Code	Year	Altman	Springate	Zmijewski	Grover	Ohlson	Fulmer	Taffler
FREN	2021	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt

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Stock Code	Year	Altman	Springate	Zmijewski	Grover	Ohlson	Fulmer	Taffler
	2022	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt
	2023	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt
	2024	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt
HDTX	2021	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Bankrupt
	2022	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Bankrupt
	2023	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Bankrupt
	2024	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Bankrupt	Bankrupt
JKSW	2021	Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt
	2022	Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt
	2023	Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Bankrupt	Bankrupt
	2024	Bankrupt	Bankrupt	Bankrupt	Non-Bankrupt	Bankrupt	Bankrupt	Bankrupt
MASA	2021	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt
	2022	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt
	2023	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt
	2024	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt	Non-Bankrupt
Accuracy Level		75.00%	75.00%	50.00%	50.00%	37.50%	50.00%	37.50%

Source: Author

CONCLUSIONS

Based on the calculations that have been conducted, the results show that there are differences in the accuracy levels among the Altman, Springate, Zmijewski, Grover, Ohlson, Fulmer, and Taffler models in predicting corporate bankruptcy prior to delisting from the IDX in 2025. This can be seen from the differences in the accuracy level of each model, where the Altman and Springate models achieved the highest accuracy level of 75 percent, followed by the Zmijewski, Grover, and Fulmer models, each with an accuracy level of 50 percent, while the Ohlson and Taffler models achieved an accuracy level of 37.5 percent. These results indicate that each model has different predictive capabilities in detecting corporate financial distress.

This study has several limitations. First, the observation period, which only covers the years 2021 to 2024, means that the bankruptcy prediction results do not fully reflect the companies' long-term financial condition. Second, out of the 12 companies delisted from the IDX in 2025, only 4 companies had complete financial statements available for the 2021–2024 period; therefore, the research objects were limited and consisted of companies from different industrial sectors. This condition means that the research findings do not fully describe the specific characteristics of companies within a particular industry sector. Third, differences in industry characteristics, corporate financial conditions, and external factors such as macroeconomic conditions and corporate policies are not fully explained in this study, which may affect the accuracy level of each model in predicting corporate bankruptcy prior to delisting.

Based on the research findings, the researcher provides several recommendations. Future researchers are expected to increase the number of company samples and extend the research period so that the results are more representative and better able to describe corporate conditions more comprehensively. Future

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studies are also expected to use more specific industrial sectors so that the accuracy level of each bankruptcy prediction model can be analyzed in greater depth. In addition, future researchers may add other bankruptcy prediction models and non-financial variables to obtain more optimal prediction results. For companies, the results of this study are expected to serve as a consideration in conducting early evaluations of financial conditions in order to reduce the risk of financial distress and potential delisting from the IDX.

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