DOI: 10.15649/2346030X.3788
Aibi revista de investigación, administración e ingeniería. Volume 12, Number 1, Pág 195-203, January - April 2024, ISSN 2346-030X

Signaling theory vis a vis bankruptcy prediction model in islamic bank industry in Indonesia

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Received: August 21, 2023.
Accepted: November 15, 2023.
Published: January 01, 2024.

***Abstract*—** This study aims to analyze the difference in the results of bankruptcy predictions in Islamic banking in Indonesia with the research period of 2018-2022. This study uses a quantitative approach, with a sample number of 11 Islamic banking companies. The bankruptcy prediction results compared in this study include Zmijewski, Grover, and Altman Z-Score Modified. Furthermore, the results of this study show that the three calculation models have differences in predicting the bankruptcy of Islamic banks. (1) The Zmijewski model analyzes five samples to be on the criteria of potentially bankrupt and six on the criteria of safe or healthy. (2) Grover's model analyzed 11 samples on safe or healthy criteria. (3) The Altman z-score Model Modification analyzes five samples on the safe or healthy criteria, five on the gray area criteria, and one on the potentially bankrupt criteria. The implication of this study is as a reference and information to stakeholders who focus on measuring the performance of Islamic companies and banks specifically. In addition, the novelty of this research is to compare the results of bankruptcy prediction models in Islamic banks that have never been done in the period 2018 to 2022.

Keywords: bankruptcy prediction; sharia bank; zmijewski model; grover model; altman z-score model modified; signal theory.

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Peer reviewing is a responsability of the Universidad de Santander.

How to cite this article: R. Kurnia, L. Nugroho and A. Janee-Ali, "Signaling theory vis a vis bankruptcy prediction model in islamic bank industry in Indonesia", *Aibi research, management and engineering journal*, vol. 12, no. 1, pp. 195-203 2024, doi: 10.15649/2346030X.3788

I. INTRODUCTION

The level of banking stability is essential in maintaining public confidence and ensuring sustainable growth in the banking sector. Banking stability indicates the ability of a bank to maintain its financial health and face possible economic and financial challenges [1] - [4]. As for maintaining such stability, according to [5]- [7], several risks need to be monitored by banks: credit and investment risk, liquidity risk, market risk, operational risk, legal risk, compliance risk, strategic risk, and reputation risk. Furthermore, customer and public trust is essential for the banking sector's stability. Funds deposited in banks are funds collected from the public, and public trust in banks is a critical factor in ensuring the smooth operation of banks and the sustainability of the banking industry as a whole. Furthermore, if the public loses confidence in the bank, they will withdraw their funds en masse from the bank (rush), which can cause significant liquidity pressures, even threatening the bank's ability to fulfil its financial obligations [8] - [11]. In addition, the loss of trust will have an impact on significantly declining the bank's reputation so that it can affect the bank's image in front of customers, investors, and regulators, as well as reduce the bank's attractiveness as a business partner and depository of funds [10], [12]-[13]. On the other hand, the banking sector does play a vital role in the economy. Banks provide essential financial services to individuals, businesses, and governments, including financing, risk management, and transaction facilitation. Furthermore, the bankruptcy of several large banks can shake the foundation of a country's economy and cause a severe monetary crisis, as happened in the Asian financial crisis in the period 1997-1998 [14] - [16].

During the monetary crisis, there is an alternative that Islamic banks can be a solution for the Islamic banking (Sharia bank) industry to mitigate the crisis caused by greed and the application of interest rates that can potentially harm bank customers [17], [18]. Islamic banks can be a strong alternative in overcoming monetary crises because their principles differ from conventional ones. According to previous researcher [19] - [21], some reasons Islamic banks are considered a potential solution are: (i) Islamic banks operate based on principles that prioritize risk sharing between banks and customers. This approach ensures that the risk is not only borne by the customer but also by the bank so that in the context of a monetary crisis, it can help reduce the burden of risk for customers and prevent mass bankruptcies from occurring. (ii) Transactions in Islamic banks are based on tangible assets or productive economic activity. This means that Islamic banks focus more on sustainable and productive investments than speculation or finance-based transactions alone. The underlying assets approach can help maintain the financial system's stability in monetary crises. (iii) One of the main principles in Islamic banks is the rejection of riba (interest rate) where in a monetary crisis, the absence of riba in Islamic bank financial transactions makes the stability of Islamic banks better and is not affected by high fluctuations in market interest rates, which is the leading cause of the financial crisis.

However, the phenomenon of the existence of Islamic banks can be said to be a new player in the banking industry, marked by the establishment of Bank Muamalat Indonesia (BMI) in 1992, while the banking industry in Indonesia has existed since 1896 which is the year Bank Rakyat Indonesia (BRI) was founded 1895 [22] - [24]. Therefore, historically, the conventional banking industry existed long before Islamic banks emerged as new players and conventional banks have existed for several centuries. Nevertheless, although Islamic banks are classified as new players in the banking industry compared to conventional banks, their development has been significant in recent decades due to the increasing public awareness and interest in financial products and services that comply with Sharia principles [25] - [27]. On the other hand, there is also a phenomenon that Islamic banks have experienced a decline in performance, such as that experienced by Bank Syariah Mandiri (BSM) in 2014, where there was an issue of poor financing quality from BSM which resulted in a change in the Board of Directors of BSM which aims to improve performance and improve asset quality through improving the quality of non-performing financing and suppressing the growth rate of non-performing financing [28]. In 2016, several BMI networks were closed in the North Sumatra region with the aim of efficiency [29]. Another phenomenon is that BMI, in the fourth quarter of 2019, experienced a spike in non-performing financing, reaching 5.22%, which has the potential to erode BMI's revenue [30].

Based on the description above, the analysis to determine the performance of Islamic banking, which has a strategic function and is one of the pillars of the national economy, is fundamental and needed. Furthermore, knowing the performance of Islamic banking, whether it is in a healthy state or a potentially bankrupt state, is very important because, if the condition of a bank can be detected early, it will make it easier for the bank's internal parties and the government to save the bank's condition from the worst risk of bankruptcy [31]. In addition, Islamic bankruptcy prediction is also useful for banks because it can be used to assess stability so that it can be a basis for consideration in decision making for customers, creditors, and bank investors [32], [33]. Furthermore, several models are used to predict bankruptcy, including the Zmijewski, Grover, and Altman Z-Score Modified models whereare, one of the main advantages of the Altman Z-Score Modified is its ability to provide reasonably accurate predictions in various economic and industry conditions [34], [35]. The Modified Altman Z-Score is one of the most adequate and widely used models in general bankruptcy prediction for banks and companies [36].

Following the above phenomenon where there is a potential decline in performance, and there are also differences in measuring instruments in predicting bankruptcy, the problem formulation in this study is whether there are differences in the results of the bankruptcy prediction model of Islamic banks using Zmijewski, Grover, Altman Z-Score. Therefore, this study aims to determine the difference in the results of the bankruptcy prediction model from Zmijewski, Grover, and Altman Z-Score Modified. The research implications provide information and references related to the application of bankruptcy prediction models in Islamic banks and add to the scientific treasures in Islamic banking. In addition, the novelty of this research is that it compares the results of bankruptcy prediction models in Islamic banks that have never been done from 2018 to 2022.

II. THEORETICAL FRAMEWORK

Signal or signaling theory is an essential concept in various disciplines, especially management, economics, and accounting. According to some previous research [37] - [39], there are several vital points in signal theory, which include:

- Signal theory highlights the importance of communication in situations where there is an incompleteness of information or an asymmetry of information between the parties involved.
- Signal theory explains how individuals and organizations use visible signals to communicate specific information to signal receivers. These signals can be actions, policies, announcements, or other attributes observable by the signal receiver.

- Entities use signals for a variety of purposes, including gaining good standing, improving status, gaining trust, or influencing the receiver's perception of the signal so that by using the signal, the entity may seek to reduce any uncertainty or information asymmetry that may exist between them and the receiver.
- In strategic management and financial accounting, the signal theory is vital in understanding how companies use signals to influence decision-makers interpretations and responses. Companies can use signals to create desired perceptions about their financial performance, growth prospects, or management capabilities.

Thus, signaling theory has significant implications in financial accounting in predicting bankruptcy, where companies use signals to influence stakeholders' perceptions and decisions about their financial health [40], [41]. Therefore, a good understanding of signal theory can assist companies in designing effective financial reporting strategies and building positive relationships with external stakeholders [42], [43].

Going concern is based on the assumption that the entity will continue to operate for the foreseeable future without any intention or plan to liquidate or shut down activities. With this assumption, financial statements are prepared considering that the entity will continue to operate for a long time to provide welfare to stakeholders [44], [45]. Therefore, going concerned is a fundamental principle that is very important in preparing financial statements because it provides a solid basis for users of financial statements to make the right decisions. Going concern becomes a critical consideration in developing bankruptcy prediction models because these models assume that the entity will continue to operate for the foreseeable future [46], [47]. Therefore, such models must consider the likelihood of a company's business continuity in assessing its financial health and predicting potential bankruptcy. Bankruptcy prediction models incorporate a variety of variables, including financial ratios such as liquidity, solvency, and profitability ratios, as well as other factors that can affect a company's ability to survive over the long term. In the context of the going concern concept, these models may also consider additional indicators that demonstrate the company's ability to continue operations sustainably. Furthermore, the information generated by bankruptcy prediction models can help stakeholders, such as investors, creditors, and management, in making informed decisions because by understanding the financial risks that the company may face, stakeholders can take the necessary steps to mitigate risks or anticipate the potential impact of possible bankruptcy [48]–[50]. Some of the bankruptcy prediction models used in the study are as follows:

- Zmijewski Model

  It is a method that, in its calculation, prioritizes several ratios in measuring company performance, such as leverage and liquidity, with instruments for calculating return on assets, debt ratio, and current ratio. This method can be used to predict a company's future bankruptcy. The formula of the Zmijeswski model is as follows:

$$\text{Zmijewski} = -4{,}3 - 4{,}5XI + 5{,}7\ X2 + 0{,}004X3$$

Information:
X1: Net Income to Total Aset.
X2: Total Debt to Total Aset.
X3: Current Assets to Current Debt.
The interpretation of the results of Zmijewski's bankruptcy prediction model is Z>0. Then, the company is said to be in the category of financial difficulties leading to bankruptcy. In contrast, if Z<0, the company is said to be in the category of healthy companies with no problems in financial difficulties.

- Grover Model

  The Grover model was created to assess and improve the Z-Score model by adding 13 financial ratios and sample adjustments. Where according to previous research, the formula of Grover's transportation prediction model was as follows:

$$\text{G-Score} = 1{,}650\ X1 = 3{,}404\ X2 - 0{,}016(\text{ROA})$$

Information:
X1: Working capital to total assets.
X2: Earning before interest and taxes (EBIT) to total assets.
ROA: Return on assets.
The interpretation of the bankruptcy prediction results with the Groverl model is that the company is categorized as bankrupt if the score value is obtained less than equal to -0.02 (G≤0.0), while the score for the company is categorized as not bankrupt the score value obtained is more than or equal to 0.01 (G≥0.01).

- Model Altman Z-Score Modifikasi

  This model is used to predict the bankruptcy of non-manufacturing companies such as small businesses, retail, sales, wholesale, and service deposits with the following formula:

$$\text{Z Altman} = 6{,}56X1 + 3{,}26\ X2 + 6{,}72X3 + 1{,}05X4$$

Information:
Z: Analysis Results of Altman Method.
X1: Working Capital to Total Assets.
X2: Retained Earnings to Total Assets.
X3: Earning Before Interest and Taxes (EBIT) to Total Aset.
X4: Book Value of Equity to Total Liabilities.
The interpretation of Altman's bankruptcy prediction model Z-Score Modification is Z>2.6, categorized as a company in good health or not experiencing financial difficulties. If the score is 1.1<Z<2.6, it is categorized in the gray area because it still has potential financial difficulties. In contrast, the score Z<1.1 is categorized as a company in financial difficulties.

III. METHODOLOGY

The method used in this study is quantitative, and the results of the quantitative method are descriptive or explained further, which aims to solve the problem using data in the form of numbers or quantitative data [51]. The data used are secondary and provided from Islamic banks' financial statements. Furthermore, the sampling in this study is a deliberate sample based on specific criteria relevant to the research objectives consisting of 11 Islamic banks during the period 2018 to 2022 with the following list of Islamic banks:

Table 1: Number of Samples.

No	Bank Name	No	Bank Name	No	Bank Name
1	Bank Aceh Syariah	**6**	Bank Mega Syariah	**11**	Bank Aladin Syariah
2	BPD NTB Sharia	**7**	Panin Dubai Sharia Bank		
3	Bank Muamalat	**8**	Bank Syariah Bukopin		
4	Bank Victoria Sharia	**9**	Bank BCA Syariah		
5	Bank BJB Syariah	**10**	Bank BTPN Syariah		

Source: Own elaboration.

Following Table 1 above, the sample used in this study consisted of eleven Sharia Commercial Banks (BUS). Furthermore, the stage of this research is to calculate the score of each model to predict bankruptcy and then analyze the results so that it can be known which bankruptcy model is more sensitive in predicting bankruptcy in the Islamic banking sector from 2018 to 2022.

IV. RESULTS AND DISCUSSION

a. Calculation of bankruptcy prediction using the Zmijewski Model

Referring to the formula of the Zmijewski model bankruptcy prediction, below are the following data:

Table 2: Data from the Zmijewski Model.

NO	SHARIA COMMERCIAL BANKS	X1					X3					ROA				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
1	Bank Aceh Syariah	0,01	0,1	0,1	0,1	1,2	0,00	0,02	0,01	0,09	0,14	3,5	2,9	0,8	0.8	0.8
2	BPD NTB Sharia	0,00	1,88	0,01	1,23	1,39	5,41	5,48	1,61	1,49	1,36	1,11	5,13	4,39	2.23	2,35
3	Bank Muamalat	0,1	0,2	0,2	0,49	0,52	0,1	0,1	0	0	0	0,08	0,03	0,02	0,02	0,04
4	Bank Victoria Sharia	0,00	0,00	0,00	0,00	0,00	0,13	0,10	0,23	0,04	0,12	2,56	3,70	1,82	11,1	5,07
5	Bank BJB Syariah	0,00	2,18	5,18	0,00	0,00	0,87	0,89	0,86	0,88	0,89	2,44	1,93	2,76	2,31	2,19
6	Bank Mega Syariah	0,6	0,6	0,8	0,8	0,7	0,00	0,00	0,01	0,04	0,02	0,8	0,8	1	5	2
7	Panin Dubai Sharia Bank	0,20	0,16	0,08	0,33	0,13	0,00	0,00	0,00	-0,01	0,02	0,00	0,00	1,13	-0,05	0,16
8	Bank Syariah Bukopin	0,00	0,05	-0,27	0,11	0,02	0,00	0,01	-0,05	-0,03	-0,06	0,00	0,03	-0,04	-0,25	-0,06
9	Bank BCA Syariah	0,02	0,01	0,01	0,01	0,01	0,82	0,73	0,72	0,73	0,77	2,51	1,71	2,28	2,22	1,64
10	Bank BTPN Syariah	0,82	0,83	0,83	0,84	0,88	0,11	0,12	0,07	0,10	0,03	0,08	0,09	0,05	0,08	0,02
11	Bank Aladin Syariah	0,9	0,9	0,09	0,94	0,7	-0,09	0,1	0,06	-0,05	-0,05	-9	0,1	0,06	-5	-5

Source: Own elaboration.

Based on data from the Zmijewski model in Table 2 above and calculations from the bankruptcy prediction formula using the Zmijewski model at Sharia Commercial Banks for the 2018-2022 period, the score or results are obtained in the table below:

Table 3: Results of Bankruptcy Prediction Calculation with Zmijewski Model.

NO	BANK NAME	ZMIJEWSKI VALUE					AVERAGE	INFORMATION
		2018	2019	2020	2021	2022		
1	Bank Aceh Syariah	-3,54	-3,67	-3,82	-3,82	-3,54	-3,68	Safe
2	BPD NTB Sharia	-4,02	-4,09	-3,45	-3,51	-3,59	-3,73	Safe
3	Bank Muamalat	-3,16	-3,2	-3,23	-3,16	-3,29	-3,2	Safe
4	Bank Victoria Sharia	-3,55	-3,73	-2,96	-4,03	-3,6	-3,57	Safe
5	**Bank BJB Syariah**	**-0,01**	**0,83**	**-0,03**	**-0,5**	**-0,22**	**0,07**	**Bankrupt prediction**
6	**Bank Mega Syariah**	**-4,22**	**-3,48**	**-1,59**	**-3,79**	**-3,69**	**0,35**	**Bankrupt prediction**
7	**Panin Dubai Sharia Bank**	**0,26**	**0,65**	**-0,18**	**0,26**	**0,37**	**0,27**	**Bankrupt prediction**
8	**Bank Syariah Bukopin**	**0,85**	**0,86**	**0,96**	**0,62**	**0,91**	**0,84**	**Bankrupt prediction**
9	Bank BCA Syariah	0,1	-0,38	-0,33	-0,52	-0,38	-0,3	Safe
10	Bank BTPN Syariah	-3,66	-3,78	-3,59	-3,84	-3,86	-3,75	Safe
11	**Bank Aladin Syariah**	**-8,01**	**3,01**	**-3,87**	**-4,07**	**-3,44**	**3,28**	**Bankrupt prediction**
AVERAGE							-1,22	Safe

Source: Own elaboration.

Under Table 3 above, the bankruptcy prediction score of the Islamic banking industry using the Zmijewski method from Sharia Commercial Bank data shows that Bank Aceh Syariah from 2018-2022 has an average value of -3.68<0 with a safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy. BPD NTB Syariah from 2018-2022 has an average value of -3.73<0 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy.

In addition, Bank Muamalat from 2018-2022 has an average value of -3.2<0 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy. Bank Victoria Syariah from 2018-2022 has an average value of -3.57<0 in the safe category, meaning that the bank is not experiencing severe financial problems so that it can

still carry out operational activities properly and is far from bankruptcy. Bank BJB Syariah from 2018-2022 has an average value of 0.07>0 with a bankrupt prediction category, meaning that the bank is experiencing financial problems and has a high potential for bankruptcy.

Bank Mega syariah from 2018-2022 has an average value of 0.35>0 with the category of bankruptcy prediction, meaning that the bank is experiencing financial problems and has a high potential for bankruptcy. Bank Panin Dubai Syariah from 2018-2022 has an average value of 0.27>0 with a bankrupt prediction category, meaning that the bank is experiencing financial problems and has a high potential for bankruptcy. Bank Syariah Bukopin from 2018-2022 has an average value of 0.84>0 with a bankrupt prediction category, meaning that the bank is experiencing financial problems and has a high potential for bankruptcy. Bank BCA Syariah from 2018-2022 has an average value of -0.3<0 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and is far from bankruptcy.

Bank BTPN Syariah from 2018-2022 has an average value of -3.75<0 in the safe category, meaning that the bank is not experiencing severe financial problems so that it can still carry out its operations properly and far from bankruptcy. Bank Aladin Syariah from 2018-2022 has an average value of 3.28>0 with a bankrupt prediction category, meaning that the bank is experiencing financial problems and has a high potential for bankruptcy so that the average value of the calculation results of the Zmijewski method in 2018-2022 at Sharia Commercial Banks is around -1.22<0 with the safe category.

b. Calculation of bankruptcy prediction using Grover's Model

Referring to the formula of Grover's bankruptcy prediction model, below are attached the following data:

Table 4: Data from Grover's Model.

NO	SHARIA COMMERCIAL BANKS	X1					X3					ROA				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
1	Bank Aceh Syariah	0,01	0,1	0,1	0,1	1,2	0,00	0,02	0,01	0,09	0,14	3,5	2,9	0,8	0.8	0.8
2	BPD NTB Sharia	0,00	1,88	0,01	1,23	1,39	5,41	5,48	1,61	1,49	1,36	1,11	5,13	4,39	2.23	2,35
3	Bank Muamalat	0,1	0,2	0,2	0,49	0,52	0,1	0,1	0	0	0	0,08	0,03	0,02	0,02	0,04
4	Bank Victoria Sharia	0,00	0,00	0,00	0,00	0,00	0,13	0,10	0,23	0,04	0,12	2,56	3,70	1,82	11,1	5,07
5	Bank BJB Syariah	0,00	2,18	5,18	0,00	0,00	0,87	0,89	0,86	0,88	0,89	2,44	1,93	2,76	2,31	2,19
6	Bank Mega Syariah	0,6	0,6	0,8	0,8	0,7	0,00	0,00	0,01	0,04	0,02	0,8	0,8	1	5	2
7	Panin Dubai Sharia Bank	0,20	0,16	0,08	0,33	0,13	0,00	0,00	0,00	-0,01	0,02	0,00	0,00	1,13	-0,05	0,16
8	Bank Syariah Bukopin	0,00	0,05	-0,27	0,11	0,02	0,00	0,01	-0,05	-0,03	-0,06	0,00	0,03	-0,04	-0,25	-0,06
9	Bank BCA Syariah	0,02	0,01	0,01	0,01	0,01	0,82	0,73	0,72	0,73	0,77	2,51	1,71	2,28	2,22	1,64
10	Bank BTPN Syariah	0,82	0,83	0,83	0,84	0,88	0,11	0,12	0,07	0,10	0,03	0,08	0,09	0,05	0,08	0,02
11	Bank Aladin Syariah	0,9	0,9	0,09	0,94	0,7	-0,09	0,1	0,06	-0,05	-0,05	-9	0,1	0,06	-5	-5

Source: Own elaboration.

Based on data from the Groverl model in Table 4 above and calculations from the bankruptcy prediction formula using the Grover model at Sharia Commercial Banks for the 2018-2022 period, the score or results are obtained in the table below:

Table 5: Results of Bankruptcy Prediction Calculation with Grover's Model.

NO	BANK NAME	GROVER VALUE					AVERAGE	INFORMATION
		2018	2019	2020	2021	2022		
1	Bank Aceh Syariah	0,17	0,16	0,27	0,32	0,21	0,23	Safe
2	BPD NTB Sharia	0,09	0,38	1,93	0,4	0,4	0,64	Safe
3	Bank Muamalat	0,29	0,42	0,38	0,87	0,91	0,57	Safe
4	Bank Victoria Sharia	0,39	0,49	0,37	0,73	0,87	0,57	Safe
5	Bank BJB Syariah	0,3	0,27	0,28	0,49	0,53	0,37	Safe
6	Bank Mega Syariah	1,22	1,17	1,48	1,56	1,43	1,37	Safe
7	Panin Dubai Sharia Bank	0,37	0,29	0,26	0,88	0,29	0,42	Safe
8	Bank Syariah Bukopin	0,07	0,02	0,55	0,12	0,11	0,17	Safe
9	Bank BCA Syariah	0,24	0,17	0,32	0,32	0,32	0,27	Safe
10	Bank BTPN Syariah	1,76	1,81	1,66	2,3	1,59	1,82	Safe
11	Bank Aladin Syariah	-1,82	1,91	0,4	1,77	1,52	0,76	Safe
AVERAGE							0,65	Safe

Source: Own elaboration.

Referring to table 5 above, the bankruptcy prediction using the Grover method from Sharia Commercial Bank data shows that Bank Aceh Syariah from 2018-2022 has an average value of 0.23≥0.01 with a safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and is far from bankruptcy, BPD NTB Syariah from 2018-2022 has an average value of 0.64≥0.01 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy, Bank Muamalat from 2018-2022 has an average value of 0.57≥0.01 with a safe

category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy, Bank Muamalat from 2018-2022 has an average value of 0.570.01 with a safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from Bankruptcy.

Bank Victoria Syariah from 2018-2022 has an average value of 0.57≥0.01 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy. Bank BJB Syariah from 2018-2022 has an average value of 0.37≥0.01 in the safe category, meaning that the bank does not experience severe financial problems, so it can still carry out operational activities far away from bankruptcy. Bank Mega Syariah from 2018-2022 has an average value of 1.37≥0.01 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy. Bank Panin Dubai Syariah from 2018-2022 has an average value of 0.42≥0.01 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy. Bank Syariah Bukopin from 2018-2022 has an average value of 0.17≥0.01 with a safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy. Bank BCA Syariah from 2018-2022 has an average value of 0.27≥0.01 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy.

Bank BTPN Syariah from 2018-2022 has an average value of 1.82≥0.01 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy, and Bank Aladin Syariah from 2018-2022 has an average value of 0.76≥0.01 in the safe category, meaning that the bank does not experience severe financial problems so that it can still carry out operational activities properly and far from bankruptcy. So, the average value of Grover's calculation results from all Sharia Commercial Banks from 2018-2022 can range from 0.65≥0.01 with the safe category.

c. Calculation of bankruptcy prediction using the Modified Altman Z-Score Model

Referring to the formula of the bankruptcy prediction of the Altman Z-Score Modified model, the following data are attached below:

Table 6: Data from Altman Z-Score Modified.

NO	SHARIA COMMERCIAL BANKS	X1					X3				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
1	Bank Aceh Syariah	0,01	0,1	0,1	0,1	1,2	0,007	0,02	0,01	0,09	0,14
2	BPD NTB Sharia	0,00	1,88	0,01	1,23	1,39	5,41	5,48	1,61	1,49	1,36
3	Bank Muamalat	0,1	0,2	0,2	0,49	0,52	0,1	0,1	0	0	0
4	Bank Victoria Sharia	0,00	0,00	0,00	0,00	0,00	0,13	0,10	0,23	0,04	0,12
5	Bank BJB Syariah	0,00	2,18	5,18	0,00	0,00	0,87	0,89	0,86	0,88	0,89
6	Bank Mega Syariah	0,6	0,6	0,8	0,8	0,7	0,008	0,008	0,01	0,04	0,02
7	Panin Dubai Sharia Bank	0,00	0,00	1,13	-0,05	0,16	0,00	0,00	1,13	-0,06	0,02
8	Bank Syariah Bukopin	0,002	0,05	-0,27	0,11	0,02	0,002	0,01	-0,05	-0,03	-0,06
9	Bank BCA Syariah	0,02	0,01	0,01	0,01	0,01	0,82	0,73	0,72	0,73	0,77
10	Bank BTPN Syariah	0,82	0,83	0,83	0,84	0,88	0,11	0,12	0,07	0,10	0,03
11	Bank Aladin Syariah	0,9	0,9	0,09	0,94	0,7	-0,09	0,1	0,06	-0,05	-0,05

Source: Own elaboration.

Table 7: Data from Altman Z-Score Modified.

NO	SHARIA COMMERCIAL BANKS	X2					X4				
		2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
1	Bank Aceh Syariah	0,01	0,1	0,1	0,1	1,2	0,64	0,78	1,02	1,04	0,84
2	BPD NTB Sharia	0,00	1,88	0,01	1,23	1,39	3,50	2,95	0,83	0,86	0,87
3	Bank Muamalat	0,1	0,2	0,2	0,49	0,52	0,07	0,4	0,4	0,3	0,5
4	Bank Victoria Sharia	0,00	0,00	0,00	0,00	0,00	1,05	1,60	0,70	5,20	4,15
5	Bank BJB Syariah	0,00	2,18	5,18	0,00	0,00	0,14	0,12	0,15	0,13	0,11
6	Bank Mega Syariah	0,6	0,6	0,8	0,8	0,7	14,6	1,29	0,31	1,53	2,13
7	Panin Dubai Sharia Bank	0,00	0,00	1,13	-0,05	0,16	0,23	0,17	0,38	0,18	0,20
8	Bank Syariah Bukopin	0,002	0,05	-0,27	0,11	0,02	0,10	0,10	0,12	0,15	0,18
9	Bank BCA Syariah	0,02	0,01	0,01	0,01	0,01	0,22	0,37	0,39	0,36	0,30
10	Bank BTPN Syariah	0,82	0,83	0,83	0,84	0,88	8,38	8,88	8,43	9,39	9,78
11	Bank Aladin Syariah	0,9	0,9	0,09	0,94	0,7	4,03	4,96	16	12	3,95

Source: Own elaboration.

Following Tables 6 and 7 above, the calculation of bankruptcy prediction using the Altman Z-Score Modification model for Sharia Commercial Banks for the 2018-2022 period is as follows:

Table 8: Data from Altman Z-Score Modified.

NO	BANK NAME	MODIFIED ALTMAN Z-SCORE					AVERAGE	INFORMATION
		2018	2019	2020	2021	2022		
1	**Bank Aceh Syariah**	**1,05**	**1,17**	**1,28**	**2,09**	**1,43**	**1,40**	***Grey area***
2	BPD NTB Sharia	3,81	4,29	1,72	2,21	2,21	2,85	Safe
3	**Bank Muamalat**	**1,02**	**1,87**	**1,71**	**3,59**	**3,92**	**2,42**	***A grey area***
4	Bank Victoria Sharia	2,45	3,4	7,99	8,13	7,59	5,91	Safe
5	**Bank BJB Syariah**	**0,75**	**1,29**	**1,75**	**2,06**	**2,32**	**1,63**	***Grey area***
6	Bank Mega Syariah	20,1	6	5,7	7,42	7,54	9,35	Safe
7	**Panin Dubai Sharia Bank**	**1,49**	**1,12**	**1,24**	**1,78**	**1,19**	**1,36**	***A grey area***
8	**Bank Syariah Bukopin**	0,15	-0,19	-2,09	1,18	-0,27	-0,24	**Bankrupt prediction**
9	**Bank BCA Syariah**	**1,46**	**1,35**	**2,02**	**1,93**	**1,47**	**1,65**	***A grey area***
10	Bank BTPN Syariah	8,38	8,88	8,43	9,39	9,78	8,97	Safe
11	Bank Aladin Syariah	9,72	12,84	23,41	18,47	9,22	14,73	Safe
AVERAGE							4,55	Safe

Source: Own elaboration.

Under Table 8 above, the calculation of bankruptcy prediction using the Modified Altman Z-Score model shows that Bank Aceh Syariah from 2018-2022 is in a gray area position. This can be seen from the average 1.1<1.40<2.6 value. BPD NTB Syariah from 2018-2022 is in a safe position, as seen from the average value of 2.85>2.6. Bank Muamalat from 2018-2022 is in a gray area position, as seen from the average value of 1.1<2.42<2.6. Bank Victoria Syariah from 2018-2022 is safe, as seen from the average value of 5.91>2.6. Bank BJB Syariah from 2018-2022 is in a gray area position, which can be seen from the average value of 1.1<1.63<2.6. Bank Mega Syariah from 2018-2022 is safe, as seen from the average value of 9.35>2.6. Bank Panin Dubai Syariah from 2018-2022 is in a gray area, as seen from the average value of 1.1<1.36<2.6.

Bank Syariah Bukopin from 2018-2022 is in a position to predict bankruptcy, and this can be seen from the average value of -0.24<1.1. Bank BCA Syariah from 2018-2022 is in a gray area, as seen from the average value of 1.1<1.65<2.6. Bank BTPN Syariah from 2018-2022 is safe, as seen from the average value of 8.97>2.6. Bank Aladin Syariah from 2018-2022 is in a safe position, as seen from the average value of 14.73>2.6. Based on the analysis results from all Sharia Commercial Banks, the average Altman Z-Score Modification is 4.55>2.6, which shows it is safe.

d. Signal Theory Vis a Vis Bankruptcy Prediction Model in the Islamic Bank Industry

Following the calculation results of the bankruptcy prediction model, the following can be informed:

- Model Zmijewski

Under the calculation results, it can be known that five Sharia commercial banks are predicted to experience bankruptcy, namely Bank BJB Syariah, Bank Mega Syariah, Bank Panin Dubai syariah, Bank Syariah Bukopin, and Bank Aladin Syariah. Furthermore, six Sharia commercial banks are included in the safe category, namely Bank Aceh Syariah, BPD NTB Syariah, Bank Muamalat, Bank Victoria Syariah, and Bank BTPN Syariah.

- Model Grover

The results of the calculation of bankruptcy prediction with Grover's model show that all Islamic commercial banks are in safe condition.

- Model Altman Z-Score Modifikasi

Referring to the results of the bankruptcy model calculation with the Altman Z-Score Modification model, six Sharia commercial banks need to be aware of their business continuity, namely Bank Aceh Syariah, Bank Muamalat, Bank BJB Syariah, Bank Panin Dubai Syariah, Bank Syariah Bukopin, and Bank BCA Syariah. The remaining six Sharia commercial banks in the safe category include BPD NTB Syariah, Bank Victoria Syariah, Bank Mega Syariah, Bank BTPN Syariah, and Bank Aladin Syariah.

According to the calculation results of the bankruptcy prediction model, it can be known based on the signaling theory of the bankruptcy prediction model with Altman Z-Score Modification is more sensitive to prediction than the bankruptcy prediction model Zmijewski model and Grover model. However, the advantages of a modified Altman Z-score model compared to other models will depend on a variety of factors, including industry type, company size, and market conditions. In addition, the sensitivity and conservativeness of the model must be tested and compared with other models empirically to ensure its effectiveness.

Furthermore, according to the Altman Z-Score Modified bankruptcy prediction calculation, six Islamic commercial banks are included in the unsafe category. In comparison, in the Zmijewski model bankruptcy prediction, five Islamic commercial banks are included in the unsafe category, and the Grover model bankruptcy prediction is included in the safe category. Nevertheless, it is essential to consider that no model is perfect, and predictive results should always be carefully considered along with other factors in financial decision-making.

V. CONCLUSIONS

In accordance with the results and discussion of this study, it can be concluded that the crucial thing is that the more conservative and sensitive bankruptcy prediction model in this study is the Modified Altman Z-Score Model. However, the results of this study need to be studied further depending on various factors, including industry type, company size, and market conditions. In addition, the sensitivity and conservativeness of the model should be tested by future studies.

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