APPLICATION OF THE ALTMAN Z-SCORE MODEL IN ASSESSING FINANCIAL STABILITY: EVIDENCE FROM A CASE STUDY

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Abstract: This paper examines the application of the Altman Z-score model as a tool for assessing financial stability and identifying potential risks of financial distress and bankruptcy. In conditions of increased economic uncertainty and market competition, the use of quantitative models for financial analysis has become an important instrument for evaluating the performance and sustainability of business entities. The analysis is based on financial data for the period 2022–2024, derived from the balance sheet and income statement of a selected company. The selected time frame enables the observation of changes in financial performance and the identification of trends reflected through the model. The paper presents the theoretical background of the Altman Z-score model, with emphasis on its structure and the role of key financial indicators included in its calculation. The model combines several financial ratios related to liquidity, profitability, leverage, and efficiency in order to generate a single composite indicator of financial stability. The empirical part of the paper includes the calculation of the individual components of the model and the corresponding Z-score values for each year of analysis. This allows for a detailed examination of the contribution of specific financial indicators to the overall result and their influence on the movement of the Z-score over time. The results show a continuous increase in the Z-score values during the analyzed period, indicating a movement within the zone of financial stability. The improvement in the overall score is mainly associated with the growth of selected financial indicators, particularly retained earnings, sales efficiency, and the market value of capital, which has a significant impact on the dynamics of the model. The findings suggest that the Altman Z-score model provides useful insight into financial stability and can support financial analysis by identifying trends in key indicators and changes in business performance. The results are shaped by the behavior of the financial variables included in the model, which determine the final Z-score value and its interpretation.
Keywords: Altman Z-score model, case-based analysis, financial analysis, financial performance, financial stability

1. INTRODUCTION

In modern conditions of economic instability, global competition, and dynamic market changes, the financial stability of enterprises represents a key prerequisite for their survival and long-term development. Companies are increasingly facing financial difficulties caused by high indebtedness, reduced liquidity, inefficient management, inflation, economic crises, and changes in the business environment. Under such conditions, the timely identification of the risk of financial instability and bankruptcy is of particular importance for management, investors, creditors, and other stakeholders. Periods of economic crisis and post-crisis adjustment are associated with weaker business performance, lower productivity growth, and increased economic uncertainty (Trpeski & Cvetanoska, 2017).

Financial distress is most commonly defined as a situation in which a company is unable to meet its current financial obligations on time, representing a phase that may lead to bankruptcy or liquidation. The analysis of financial statements plays an important role in assessing the financial condition of enterprises and evaluating potential risks. Financial indicators provide information on liquidity, profitability, indebtedness, and operational efficiency, while their analysis enables the timely identification of possible problems in the company's operations. In modern economies characterized by uncertainty and rapid structural changes, the ability of companies and institutions to adapt to changing economic conditions has become increasingly important for maintaining long-term stability and sustainable development (Cvetanoska & Trpeski, 2020).

Research related to the prediction of financial distress and bankruptcy began in the first half of the twentieth century, when researchers started examining the relationship between financial indicators and business failure. The most significant contribution in this field was made by Edward Altman, who developed one of the most influential bankruptcy prediction models based on the combination of several financial indicators into a single composite index (Altman, 1968). Altman emphasized that the analysis of individual financial ratios alone is insufficient for a realistic assessment of a company's financial condition, which led to the development of the Altman Z-score model as an instrument for evaluating financial stability and bankruptcy risk. Over time, the Altman Z-score model became one of the most widely applied models for assessing financial stability and bankruptcy risk. According to Altman (2018), even more than fifty years after its development, the model remains one of the most commonly used instruments for the early warning of financial distress worldwide. The author emphasizes that the model is widely applied by banks, investors, auditors, regulators, and financial analysts, particularly in the assessment of credit risk and financial stability.

The literature contains numerous studies confirming the applicability of Altman model across different economies and industries. Existing research generally emphasizes that Altman Z-score model represents an effective instrument for identifying financial distress, assessing financial stability, and predicting bankruptcy risk through the analysis of key financial indicators such as liquidity, profitability, and indebtedness. Studies conducted in different sectors, including the chemical and fertilizer industry, plastic and packaging industry, construction sector, and agriculture, confirm the practical usefulness of the model in evaluating companies' financial condition and identifying financially risky firms (Priyanto, 2023; Nurasik et al., 2023; Vavrek et al., 2021; Srebro et al., 2021).

Several studies also highlight the importance of bankruptcy prediction models for improving financial analysis, investment decision-making, and risk management. In this context, Rosihana et al. (2025) conducted a comparative analysis of the Altman, Springate, and Zmijewski models and emphasized that financial statements represent an essential basis for identifying potential bankruptcy risks and assessing financial stability. Similarly, Toudas et al. (2024), analyzing companies from the construction sector in Greece, pointed out that although the Altman model is among the most widely used bankruptcy prediction models worldwide, its predictive accuracy may vary depending on industry characteristics and economic conditions.

In addition, empirical evidence from Slovenia and Serbia confirms the practical value of Altman model in distinguishing financially stable companies from firms exposed to higher bankruptcy risk. Dolinsek & Kovac (2024) concluded that companies with lower Z-score values demonstrate significantly greater exposure to financial distress and bankruptcy, while Srebro et al. (2021) emphasized that maintaining financial sustainability depends largely on liquidity, profitability, and the company's ability to cope with long-term financial risks.

Although numerous studies have examined the application of the Altman model in different countries and industries, domestic literature still contains a limited number of papers analyzing its practical applicability through specific companies and real financial indicators. Furthermore, some existing studies mainly focus on the theoretical aspects of the model without a more detailed analysis of its usefulness in a concrete business context. This represents a gap in the literature and indicates the need for additional research examining the application of Altman Z-score model in practical conditions and providing a deeper understanding of companies' financial conditions.

Therefore, the aim of this paper is to analyze the financial condition of a selected company through the application of the Altman Z-score model and to assess the risk of financial distress and potential bankruptcy. Through the analysis of financial indicators, the paper seeks to provide insight into the company's financial stability, liquidity, indebtedness, and profitability. In addition, the paper contributes to the existing literature by demonstrating the practical applicability of the Altman model in a real business context.

The contribution of this paper lies in the practical application of the Altman Z-score model to a specific case, providing additional insight into the model's usefulness as an instrument for financial analysis and early detection of financial risks. Furthermore, the paper contributes to the domestic literature by linking theoretical concepts with the practical implementation of the model through a case-based financial analysis.

The paper is structured as follows. After the introductory section and the literature review, the paper presents the methodological framework and the applied research approach. The next section provides the analysis and discussion of the obtained results based on the application of the Altman Z-score model. Finally, the paper concludes with the main findings, limitations of the study, and recommendations for future research and practical application.

2. METHODOLOGY

The methodological framework of this paper is based on the collection, systematization, and analysis of relevant data related to the assessment of the financial condition of a selected company through the application of the Altman Z-score model. The research is based on a scientifically grounded and logically structured approach, using data obtained from the company's financial statements for the period 2022–2024. At the request of the company, and due

to the confidentiality of financial and business information, the identity of the analyzed company is not disclosed in the paper. Therefore, the company is presented anonymously throughout the analysis.

The analysis is based on data from the balance sheet and income statement necessary for the calculation of the Altman coefficient. For this purpose, indicators related to sales, earnings before interest and taxes, current assets, total assets, current liabilities, total liabilities, retained earnings, and market value of capital are analyzed.

The paper applies the original Altman Z-score model developed by Altman (1968), expressed through the following equation:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

where:

X_1= Net Working Capital / Total Assets

X_2= Retained Earnings / Total Assets

X_3= Earnings Before Interest and Taxes / Total Assets

X_4= Market Value of Equity / Total Liabilities

X_5= Sales / Total Assets

Based on the obtained coefficients, the Altman Z-score is calculated for each analyzed year, followed by an analysis of the movement of the individual components of the model and their impact on the overall financial stability of the company. According to the Altman model, companies with a Z-score below 1.81 are considered to be in the bankruptcy risk zone, values between 1.81 and 2.99 represent the so-called "grey zone," while companies with a Z-score above 2.99 are considered financially stable and outside the bankruptcy risk zone.

Several scientific methods were applied in the preparation of the paper. The analytical method is used throughout the paper in the analysis of the financial indicators and the obtained results. The comparative, quantitative, and statistical methods are applied in the examination and comparison of the financial data and changes in the company's financial condition over the analyzed period. In addition, the descriptive method is used in the explanation and interpretation of the research process and the obtained results.

3. RESULTS AND DISCUSSION

The following table presents the data from the balance sheet and income statement used for the calculation of the Altman Z-score model. For this purpose, financial statement data for the period 2022–2024 were used.

Table 1. Financial Statement Data Used in the Altman Z-score Analysis (2022–2024)

	2022	2023	2024
Sales	7,097,599.00	7,397,836.00	7,860,414.00
Earnings before interest and taxes	715,510.00	775,624.00	780,972.00
Current assets	4,839,171.00	4,936,232.00	4,577,218.00
Total assets	9,481,868.00	9,515,448.00	9,740,805.00
Current liabilities	1,852,229.00	1,769,811.00	1,669,420.00
Total liabilities	1,934,025.00	1,844,626.00	1,720,378.00
Retained earnings	3,216,316.00	3,529,699.00	3,890,742.00
Market value of capital	6,415,663.19	7,287,270.68	7,779,798.90

Source: Financial statements of the company

**Data are expressed in 000 denars*

Sales increased continuously during the analyzed period, from 7,097,599,000 denars in 2022 to 7,860,414,000 denars in 2024. This represents an absolute increase of 762,815,000 denars, or 10.75% over the three-year period, with an average annual increase of 5.24%. The growth in sales indicates an improvement in the company's market performance and business activity. At the same time, earnings before interest and taxes also increased, indicating positive operating performance.

Total assets recorded an increase of 2.73% in 2024 compared to 2022, while current assets showed a slight average decrease of 2.74%. This indicates an increase in the share of fixed assets relative to current assets, suggesting greater investment activity within the company. In addition, working capital decreased due to a reduction in receivables from customers, which indicates faster collection of receivables and improved liquidity.

Current liabilities decreased by 182,809,000 denars during the analyzed period, representing a decline of 9.87%, while total liabilities decreased by 213,647,000 denars, or 11.05%. The reduction in liabilities indicates more timely settlement of obligations and a decrease in the company's overall indebtedness.

Retained earnings also showed continuous growth during the analyzed period. In 2022, retained earnings amounted to 3,216,316,000 denars, while in 2024 they reached 3,890,742,000 denars, representing an increase of 20.97%. At the same time, although the total number of shares remained unchanged, the market value of capital increased continuously, with a total increase of 21.26% between 2022 and 2024. This reflects increased investor confidence and improved market valuation of the company.

The calculated coefficients of the Altman model are presented in the following table.

Table 2. Altman Z-score Model Coefficients (2022–2024)

	2022	**2023**	**2024**
Net working capital/Total assets	0.32	0.33	0.30
Retained earnings/Total assets	0.34	0.37	0.40
Earnings before interest and taxes/Total assets	0.08	0.08	0.08
Market value of capital/Total liabilities	3.32	3.95	4.52
Sales/Total assets	0.75	0.78	0.81

Source: Authors' calculations

The ratio of net working capital to total assets remained relatively stable throughout the analyzed period, with a slight decrease from 0.32 in 2022 to 0.30 in 2024. Despite this decline, the company maintained satisfactory liquidity and the ability to meet its short-term financial obligations.

The retained earnings to total assets ratio increased from 0.34 to 0.40, reflecting stronger internal financing capacity and improved financial stability. This indicates a greater reliance on internally generated funds and lower dependence on external financing sources.

The ratio of earnings before interest and taxes to total assets remained stable at 0.08 during all three years, indicating consistent operating profitability and the company's ability to generate earnings from its regular business activities.

A significant increase was observed in the ratio of market value of capital to total liabilities, which increased from 3.32 in 2022 to 4.52 in 2024. This movement reflects growth in the company's market valuation and stronger investor confidence, indicating lower exposure to bankruptcy risk.

The sales to total assets ratio also increased during the analyzed period, from 0.75 in 2022 to 0.81 in 2024, indicating that sales grew at a faster pace than total assets and suggesting improved efficiency in asset utilization.

Based on the calculated coefficients, the Altman Z-score was determined for each analyzed year. The obtained results are as follows:

2022: Z = 1.2*0.32 + 1.4*0.34 + 3.3*0.08 + 0.6*3.32 + 1.0*0.75= 3.87

2023: Z = 1.2*0.33 + 1.4*0.37+ 3.3*0.08 + 0.6*3.95 + 1.0*0.78= 4.33

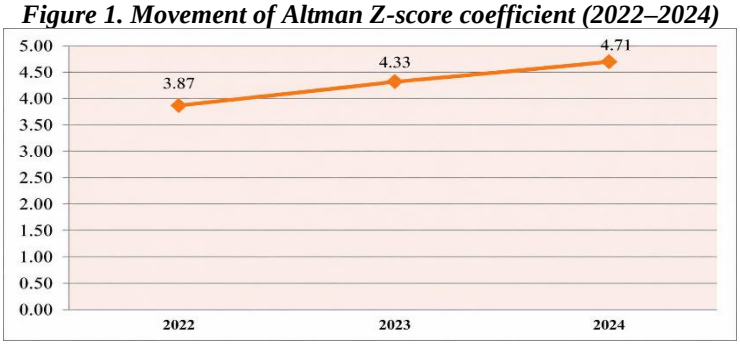
2024: Z = 1.2*0.30 + 1.4*0.40 + 3.3*0.08 + 0.6*4.52 + 1.0*0.81 = 4.71

The results indicate that the company remained outside the bankruptcy risk zone throughout the entire analyzed period, as all calculated Z-score values are significantly above the threshold value of 2.99. Moreover, the continuous increase in the Altman coefficient indicates a gradual improvement in the company's financial stability over time.

The increase in the Altman coefficient is primarily influenced by the growth in the market value of capital, retained earnings, and sales relative to total assets. These movements indicate stronger market valuation, improved internal financing capacity, and more efficient utilization of company assets. At the same time, the stability of the earnings before interest and taxes ratio contributed to maintaining consistent operating profitability throughout the analyzed period. Although the ratio of net working capital to total assets recorded a slight decline, its movement does not significantly affect the overall Altman coefficient or the company's financial stability. The observed trends in the analyzed financial indicators suggest an improvement in the company's financial position and a lower exposure to financial distress risk over time.

The graphical presentation of the Altman coefficient is provided in Figure 1, illustrating the movement of the Z-score values during the analyzed period. Figure 1 provides a clearer overview of the trend and dynamics of the coefficient over time and supports the results obtained from the financial analysis and the interpretation of the calculated Altman values.

Figure 1. Movement of Altman Z-score coefficient (2022–2024)



Source: Authors' calculations

4. CONCLUSION

This paper examined the applicability of the Altman Z-score model as an instrument for assessing financial stability and identifying potential bankruptcy risk through a case-based financial analysis. In conditions of increased economic uncertainty, market competition, and dynamic changes in the business environment, the importance of timely identification of financial difficulties and potential bankruptcy risk has become increasingly significant for companies and other market participants. In this context, bankruptcy prediction models represent important instruments for evaluating financial performance and supporting financial and managerial decision-making processes.

The findings of the study confirm that the Altman Z-score model represents a useful and practical analytical tool for assessing a company's financial condition and monitoring changes in financial performance over time. The analysis demonstrated that the combined observation of liquidity, profitability, indebtedness, retained earnings, market value of capital, and sales efficiency provides a more comprehensive understanding of the company's financial stability and overall business performance compared to the isolated analysis of individual financial indicators. In this regard, the study confirms the practical usefulness of the Altman model in identifying financial trends and assessing potential exposure to financial distress.

The obtained results indicate that the analyzed company maintained a stable financial position throughout the observed period and remained outside the bankruptcy risk zone according to the Altman classification. The continuous increase in the Altman coefficient reflects positive movements in several important financial indicators, particularly retained earnings, market value of capital, and sales efficiency. At the same time, the stability of profitability indicators and the reduction in liabilities contributed to strengthening the company's financial stability and reducing its exposure to financial risk.

The findings of this study are consistent with the conclusions of previous empirical research emphasizing the practical applicability of the Altman model in different industries and economic environments. Similar studies have shown that the model represents an effective instrument for assessing financial stability, distinguishing financially stable companies from financially risky firms, and supporting financial analysis and risk management processes. In this context, the present study additionally confirms the relevance and practical applicability of the Altman model in contemporary business conditions.

The paper contributes to existing domestic literature through the practical implementation of the Altman Z-score model using real financial data and a specific business case. In addition, the study demonstrates the applicability of the model in practical business conditions and highlights the importance of integrating financial ratio analysis into the process of financial assessment and risk evaluation. The paper also contributes to a better understanding of the role of bankruptcy prediction models as instruments for early detection of financial difficulties and support for strategic financial planning.

At the same time, the study has certain limitations. The analysis is based on a single company and a limited observation period, which restricts the possibility of broader generalization of the findings. In addition, the research is based on the application of a single bankruptcy prediction model and financial statement data, which may limit the comprehensiveness of the assessment of financial stability and bankruptcy risk. Future research may therefore include comparative analyses of companies from different industries, longer time periods, and the application of additional bankruptcy prediction models in order to obtain more comprehensive insights into financial stability and financial risk assessment.

Based on the findings of the study, several recommendations can be proposed. Companies should continuously monitor key financial indicators related to liquidity, profitability, indebtedness, and market performance in order to identify potential financial risks in a timely manner. In addition, bankruptcy prediction models should be

incorporated into internal financial analysis and strategic decision-making processes as instruments for improving financial planning and risk management. Special attention should also be given to maintaining stable profitability, controlling indebtedness, improving liquidity management, and strengthening the company's financial position in order to reduce potential exposure to financial distress and bankruptcy risk.

REFERENCES

Altman, E.I. (1968). 'Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy', *The Journal of Finance*, 23(4), pp. 589–609.

Altman, E.I. (2018). 'Applications of Distress Prediction Models: What Have We Learned After 50 Years from the Z-Score Models?', *International Journal of Financial Studies*, 6(70), pp. 1–15. doi:10.3390/ijfs6030070

Cvetanoska, M., & Trpeski, P. (2020). Higher education and economic growth in North Macedonia: Evidence from causality testing and COVID-19 challenges. In M. Santa (Ed.), C*onference proceedings of the 1st International Scientific Conference Economic and Business Trends Shaping the Future* (pp.199-208). Faculty of Economics-Skopje, Ss. Cyril and Methodius University in Skopje.

Dolinsek, T., & Kovac, T. (2024). Application of the Altman model for the prediction of financial distress in the case of Slovenian companies. *Organizacija*, *57*(2), pp. 115-126. DOI: 10.2478/orga-2024-0008

Nurasik, Abidin, F. I. N., Hasanah, E., & Rizal, A. (2023). Financial distress prediction models: Altman Z-score approach. In *Proceedings of the International Conference on Intellectuals' Global Responsibility (ICIGR 2022)* (pp. 398-408). Atlantis Press. https://doi.org/10.2991/978-2-38476-052-7_44

Priyanto. (2022). Financial distress analysis by using Altman Z-score methods: A case study of selected fertilizer company in Indonesia year 2016–2020. In *Proceedings of the 19th International Symposium on Management (INSYMA 2022)* (pp. 36-46). Atlantis Press. https://doi.org/10.2991/978-94-6463-008-4_6

Rosihana, A. D., Ridwan, A., Saputra, W., & Madewi, A. (2025). Bankruptcy prediction analysis based on the Altman Z-score, Springate, and Zmijewski methods (Case study on PT. Net Visi Media Tbk). *Journal of Economics and Social Sciences (JESS)*, *4*(1), pp.61-66. https://doi.org/10.59525/jess.v4i1.654,

Srebro, B., Mavrenski, B., Bogojevic Arsic, V., Knezevic, S., Milasinovic, M., & Travica, J. (2021). Bankruptcy risk prediction in ensuring the sustainable operation of agriculture companies. *Sustainability*, *13*(7712), pp. 1-17. https://doi.org/10.3390/su13147712

Toudas, K., Archontakis, S., & Boufounou, P. (2024). Corporate bankruptcy prediction models: A comparative study for the construction sector in Greece. *Computation*, *12*(9), pp.1-20. https://doi.org/10.3390/computation12010009

Trpeski, P., & Cvetanoska, M. (2016). Labor productivity and economic growth in selected SEE countries after the Great Recession of 2008. In V. Stojanović Aleksić (Ed.), *Conference proceedings of the 4th International Scientific Conference Contemporary Issues in Economics, Business and Management* (pp. 175-181). Faculty of Economics, University of Kragujevac.

Vavrek, R., Gundova, P., Kravcakova Vozarova, I., & Kotulic, R. (2021). Altman Model Verification Using a Multi-criteria Approach for Slovakian Agricultural Enterprises. E&M Economics and Management, 24(1), 146–164. https://doi.org/10.15240/tul/001/2021-1-010