
BANKRUPTCY PREDICTION MODELS FOR LARGE AGRIBUSINESS COMPANIES IN AP VOJVODINA

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ABSTRACT

The aim of this paper is to present application of different methods used for predicting bankruptcy of large agricultural and food companies in AP Vojvodina, as well as to determine which model is the most suitable for analyzing the companies from the observed sectors. The following three models were applied in the paper: Altman's Z'-score model, Kralicek DF indicators and Kralicek Quick test. The analysis included five companies from the agricultural sector and five companies from the food sector operating on the territory of AP Vojvodina in the period from 2015 to 2019. The results of the research based on the applied models showed that different conclusions can be made about the financial stability of the observed companies. Altman's Z'-score model provided the most rigorous forecast in terms of the bankruptcy risk, while the results of Kralicek DF indicators and Quick test are relatively similar.

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Introduction

Agriculture, together with the food industry, is of strategic importance in the economic development strategy of the Serbian economy (Stošić & Domazet, 2014). In the period from 2002 to 2015, agriculture accounted for 11.1% of the total GVA in the Republic of Serbia (Novaković, 2019). The share of the food industry in the structure of GVA of the Republic of Serbia is about 4% (Domanović et al., 2018). The Republic of Serbia has favorable natural conditions for development of agriculture and thus also for food industry, which is inseparable from agriculture. For AP Vojvodina, which is dominantly agricultural area, the connection between these two industries is even more important. The common feature of these two sectors is duality of their structure, as they comprise a large number of micro and small companies, as well as a smaller number of medium and large companies, which are the backbone of these sectors. One of the key business issues of the companies in the agricultural and food sectors is related to awareness of the management about their financial position. In order to survive on the market and be competitive, every company must be able to assess the risk of insolvency, i.e. bankruptcy (Didenko, et al., 2012). There are a number of models for evaluating successiveness of a company's business. All of the models use different financial indicators, which are compared with the past or expected indicators for a specific company. The goal of financial indicators analysis is to timely detect the risk of a crisis in the functioning of the company (Jakovčević, 2011). Over time, various methods for assessing financial position have been developed, while the most commonly used and well-known methods include: Altman's Z-score model, Ohlson model, Zmijevski model, Kralicek DF and Quick test (Alihodžić, 2013; Barbut, a-Mis, and Madaleno, 2020).

The paper analyzes five large companies from the agricultural sector and five large companies from the food sector operating on the territory of AP Vojvodina in the period from 2015 to 2019. The aim of this paper is to determine the financial position of the observed companies using Altman's Z score model and Kralicek DF indicators and Quick test.

Literature review

A number of authors from our country and the region have dealt with assessment of the bankruptcy risk, i.e. assessment of the financial position of agricultural and food companies.

Burja & Burja (2013) applied Altman's Z'-score model to assess the financial position of 12 agricultural companies operating on the Romanian Stock Exchange in the period from 2007 to 2012. The results of the research showed that most of the observed companies operated in the gray zone, i.e. at risk of bankruptcy.

Rajin et al. (2016) applied Altman's Z'-score model, Kralicek DF model and Quick test to forecast the likelihood of initiating bankruptcy proceedings of agricultural companies from the Republic of Serbia. The analysis included five companies and the results of the applied models indicated that Kralicek DF model is more suitable for the observed market.

Stojanović & Drinić (2017) tested the application of Altman's Z-score models on a sample of 270 agricultural companies from the Republic of Srpska. The companies were analyzed in the period from 2011 to 2015 and it was concluded that none of Altman's models is suitable for assessing the creditworthiness of the observed agricultural companies, but that these models can be useful in detecting certain long-term financial difficulties.

Apan et al. (2018) applied Altman's Z-score model and VIKOR method to determine the financial position of 18 food companies operating in the Turkish market in the period from 2008 to 2014. By comparing the observed models, it was concluded that VIKOR method shows better results.

Vukadinović et al. (2018) applied Altman Z'-score model, Kralicek Quick test and the balanced growth model in order to determine the financial position of three companies from the agricultural sector. The research included companies which are in the process of privatization and concluded that all of the observed companies are not stable in the market and are at risk of bankruptcy.

In the paper by Stošić (2019), Altman's Z'-score model was applied in order to assess the financial success of medium-sized companies in the Republic of Serbia. The research included companies from the manufacturing, trade, agricultural and construction industry sectors. The analysis of the obtained results showed that agricultural companies are in the gray zone and that, compared to the companies from other observed sectors, agricultural companies have the highest level of financial stability and liquidity as well as the lowest level of marketability.

Kovács et al. (2020) analyzed the risk of bankruptcy for three agricultural companies operating in Hungary in the period from 2014 to 2018. The bankruptcy risk was assessed using the following four models: Altman Z-score model, Springate model, Comerford model, and Fulmer model. The results demonstrated that all four models provide the same results and that all three observed companies have a high risk of bankruptcy.

Materials and methods

The research analyzed the financial stability of 5 agricultural companies and 5 food companies, all of which are characterized as large companies, operating in the territory of AP Vojvodina in the period from 2015 to 2019. The data were taken from the annual reports of the companies (Business Registers Agency) in order to calculate the financial indicators used for analyzing the companies' financial stability. The financial stability of the observed companies was analyzed using the following three methods:

Altman's Z-score model

In 1968 Altman I. Edward (Altman, 1968) investigated the influence of various financial indicators on a company's risk of bankruptcy in the United States, and the result of this research is the model known as Altman's Z-score model. The research was performed on

a sample of 66 manufacturing companies, including 33 companies that went bankrupt and 33 companies that operated successfully. Altman used the method of multivariate discriminant analysis to test the impact of 22 business indicators on the likelihood of bankruptcy and obtained the model in which the initial number of indicators was reduced to 5 indicators proven to have the greatest impact on bankruptcy prediction. Depending on its impact on the company's operations, each indicator was assigned an appropriate ponder. As a final result of the analysis, the following discriminant function was obtained:

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

The indicators in the discriminatory function are calculated as follows:

X = Z-score,

X_1 = working capital/ total assets,

X_2 = retained earnings/ total assets,

X_3 = EBIT/ total assets,

X_4 = market value of equity/ book value of total liabilities,

X_5 = sales/ total assets.

Indicator X_1 is an indicator of the company's liquidity, and the value of this indicator is obtained as the ratio of working capital and total assets of the company. Working capital of the company is defined as current assets fewer current liabilities. Indicator X_2 is obtained as the ratio of retained earnings and total assets and shows the cumulative profitability of the company. Indicator X_3 is calculated as the ratio of earnings before interest and taxes (EBIT) and total assets, and this indicator shows the company's profitability. Indicator X_4 , which is obtained as the ratio of the market value of equity and total liabilities, shows how much the company's assets can decrease in value before its liabilities exceed the assets and the company enters the zone of insolvency. Indicator X_5 is an indicator of the turnover of fixed assets, and it shows the ability of the asset to generate sales.

Based on the obtained Z values, the companies are classified into three groups. The companies with Z-score value above 2.67 are considered financially stable and are classified in the safe zone. If the value of Z-score is between 1.81 and 2.67, it is considered that the business is financially unstable, but there is a chance of recovery, so the companies are classified in the gray zone. The companies with Z-score value below 1.81 are the companies that will go bankrupt and they are in the distress zone.

The disadvantage of the 1968 Z-score model was that it was not applicable to companies whose shares are not traded on the stock exchange. In 1983, Altman modified the

original model and formed Z'-score model (Altman, 1983). The difference between the original model and Z'-score model is in indicator X_4 , in which the market value of equity is replaced by the book value. New ponders were assigned to the indicators, obtaining the model with the following form:

$$Z' = 0.717 \cdot X_1 + 0.847 \cdot X_2 + 3.107 \cdot X_3 + 0.420 \cdot X_4 + 0.998 \cdot X_5$$

Based on the modified model, the company is considered successful if the value of Z' is above 2.9. The value of Z' between 1.23 and 2.9 indicates that the company operates in the gray zone, while the value below 1.23 indicates high risk of bankruptcy, i.e., these companies are in the distress zone.

Kralicek DF model

Following the example of Altman's model, Kralicek applied the discriminant analysis on a sample of European companies and defined the following function (Alihodžić, 2013):

$$DF = 1.5 \cdot X_1 + 0.08 \cdot X_2 + 10 \cdot X_3 + 5 \cdot X_4 + 0.3 \cdot X_5 + 0.1 \cdot X_6$$

The indicators in the discriminatory function are calculated as follows:

X_1 = value of DF indicator,

X_2 = net cash flow/total liabilities,

X_3 = total assets/ total liabilities,

X_4 = EBIT/total assets,

X_5 = EBIT/operating income,

X_6 = inventories/operating income,

X_7 = operating income/total assets.

Indicator X_1 shows the degree to which net cash flow covers liabilities. Indicator X_2 is obtained as the ratio of total assets and total liabilities, and it shows the share of liabilities in total assets (Vučković, 2014). X_3 indicator is the same as in Altman's Z-score model, showing the company's profitability. Indicator X_4 is an indicator of profitability of total income, X_5 shows how many units of income are engaged in reserve funds and X_6 shows how much income is generated per unit of assets (Šverko-Grdić et al., 2017).

The value of DF can be both positive and negative, while a negative value indicates insolvency of the company and a positive value indicates solvency. The following table shows the critical values of DF indicator with the corresponding assessment of financial stability:

Table 1. DF indicator values

DF indicator value	Financial stability
>3.0	Excellent
>2.2	Very good
>1.5	Good
>1.0	Average
>0.3	Poor
≤0.3	Beginning of insolvency
≤0.0	Moderate insolvency
≤-1.0	Extreme insolvency

Source: Alihodžić, 2013

Kralicek Quick test

Quick test was created in 1990s with the purpose of examining the financial performance of companies using four indicators, including two indicators related to financial stability and two profitability indicators. Each indicator is assigned a score within the range from 1 to 5, where 1 represents the best and 5 the worst result (Vukadinović et al., 2018). The final result is obtained as the average of previously calculated average values of the indicators, expressed in points (Table 2).

Table 2. Kralicek Quick test methodology

Indicators	1 Excellent	2 Very good	3 Good	4 Bad	5 Risk of Insolvency
X ₁	>0.3	0.2-0.3	0.10-0.2	0.0-0.1	Negative
X ₂	< 3	3-5	5-12	12-30	>30
S1=(X ₁ + X ₂)/2 Financial stability					
X ₃	>0.1	>0.08-0.10	0.05-0.08	0.00-0.05	Negative
X ₄	>0.15	0.12-0.15	0.08-0.12	0.00-0.08	Negative
S2=(X ₃ + X ₄)/2 Total performance and profitability					
T=[(X ₁ + X ₂)/2+(X ₃ + X ₄)/2]/2 Total rating					

Source: http://www.kralicek.at/pdf/qr_druck.pdf, adapted by the authors

The indicators used in Kralicek Quick test model are calculated as follows (Alihodžić, 2013):

X₁= equity/total liabilities

X₂ = total liabilities - cash/ net profit + amortization

X₃ = EBIT/ total assets

X_4 = net profit + amortization/ business earnings

Indicator X_1 shows the share of capital in total financing sources. The recommended value of this indicator is 10% or higher. Indicator X_2 shows debt repayment period, and if the value of this indicator is above 30 years, it is considered that the company has certain difficulties with solvency, while the recommended value of this indicator is 12 years or less. Indicator X_3 shows profitability of total assets relative to operating profit. If the value of this indicator is negative, it is considered that the company has difficulties with solvency, while the recommended value is 8% or higher. Indicator X_4 shows the share of cash flow in operating income. The recommended value of this indicator is 5% or higher (Vukadinović et al., 2018).

Results and discussions

The results of the research show the financial position of the selected companies based on Z'-score model, Kralicek DF indicator and Quick test. The data required for calculation of the indicators used for the methods described in the previous chapter were obtained from the companies' financial reports. In order to determine the financial position of the companies, the data were analyzed in a period of five years (from 2015 to 2019). All of the observed companies are classified as large companies according to legally established criteria. The research included five agricultural companies: PIK Bečej (A), Mitrosrem (B), DOO Almex (C), DOO RACA Zrenjanin (D) and Perutnina Ptuj-Topiko (E), and five food companies: Carnex (F), Neoplanta G), Dijamant AD Zrenjanin (H), Jaffa Crvenka (I) and Sunoko (J).

The first step in the research was to calculate Z'-score indicators for the observed agricultural companies. These values indicate the financial position of the company (Table 3).

Table 3. Values of Z' indicators for observed agricultural companies

Company	Value of Z' indicator				
	2015	2016	2017	2018	2019
A	-0.009	5.302	4.692	4.233	4.198
B	-0.031	0.733	0.919	0.814	0.953
C	1.837	1.689	1.945	1.921	1.886
D	2.241	3.021	2.732	2.411	1.999
E	1.329	2.434	2.177	2.699	3.028

Source: Authors' calculations based on data from financial reports, Business Register Agency, <http://www.apr.gov.rs>

Based on the values of Z' indicator for the company A, it can be observed that in 2015 the company was in the distress zone, i.e., at high risk of bankruptcy. Z' indicator had a negative sign, and such a low value of the indicator is accounted for by a negative business result achieved in the observed year. In 2016, the company A improved its financial position, achieved a positive business result and moved into the success zone,

i.e., the safe zone, where it remained during the rest of the observed period ($Z' > 2.9$). The company B also achieved a negative business result in 2015 and it was in the distress zone. In the following years, the company B achieved a positive result, but remained in the distress zone, which indicates that this company had difficulties with liquidity, profitability and solvency and is at risk of bankruptcy, as it was in the distress zone for the entire period (values of Z' indicators < 1.23). The company C was in the gray zone during the entire observed period ($1.23 < Z' < 2.9$), which indicates that the company is at risk of bankruptcy, but there is a possibility of improving its business and moving to the safe zone. Based on the values of Z' indicator for the company D in 2015, it can be concluded that the company operated in the gray zone ($Z' < 2.9$). This result is accounted for by low level of liquidity and low profit rate of the company. In the following year, the company D moved to the safe zone ($Z' > 2.9$), but due to low rate of return, it moved back to the gray zone in 2017 and remained in the gray zone for the rest of the observed period (values of Z' indicator < 2.9). The company E was in the gray zone ($Z' < 2.9$) in the period from 2015 to 2018 due to low liquidity rate and low profit rate, but in 2019 it moved to the safe business zone ($Z' = 3.028$).

Assessment of the financial stability of the observed agricultural companies was performed also by calculating the values of Kralicek DF indicator (Table 4).

Table 4. Values of Kralicek DF indicators for observed agricultural companies

Company	Values of Kralicek DF indicator				
	2015	2016	2017	2018	2019
A	-0.810	6.227	4.208	2.897	2.565
Financial stability	Moderate insolvency	Excellent	Excellent	Very good	Very good
B	-1.474	0.957	0.894	0.115	1.139
Financial stability	Extreme insolvency	Poor	Poor	Beginning of insolvency	Average
C	1.313	1.318	1.855	2.258	1.640
Financial stability	Average	Average	Good	Very good	Good
D	1.647	3.306	4.992	1.029	1.029
Financial stability	Good	Excellent	Excellent	Average	Average
E	1.064	1.907	1.021	1.289	1.537
Financial stability	Average	Good	Average	Average	Good

Source: Authors' calculations based on data from financial reports, Business Register Agency,
<http://www.apr.gov.rs>

According to the results of Kralicek DF indicator, the company A moved from moderate insolvency (2015) to the zone of excellent financial stability (2016 and 2017), and then to the zone of very good financial stability. Company B showed marked instability during the observed period, moving from the zone of extreme insolvency in 2015 to the zone of poor financial stability in 2016 and 2017, while in 2018 its financial stability deteriorated and the company moved to the zone of insolvency. In 2019, the situation improved and the company was in the zone of average financial stability. The financial stability of the company C during the observed period was gradually improving and

the company moved from the average zone of stability to the good and very good zone. The company D showed good financial stability in 2015, excellent financial stability in 2016 and 2017, and average financial stability in 2018 and 2019. The financial stability of the company E in the observed period varied from the average to good financial stability, which indicates a good financial position of this company.

The data obtained from the companies' financial reports were used to calculate Kralicek Quick test indicators, the number of points assigned to each indicator and the indicators of financial stability (S1) and profitability (S2) and their arithmetic mean (T), which represents the total business result (Table 5).

Table 5. Results of Quick test for observed agricultural companies

Company	Year	Indicators				Points				Score		
		X1	X2	X3	X4	P1	P2	P3	P4	S1	S2	T
A	2015	0.11	-17.95	-0.04	-0.09	3	1	5	5	2	5	3.5
	2016	0.90	0.59	0.15	0.22	1	1	1	1	1	1	1
	2017	0.89	0.84	0.09	0.17	1	1	3	1	1	2	1.5
	2018	0.88	0.53	0.06	0.12	1	1	4	1	1	2.5	1.75
	2019	0.89	0.30	0.04	0.14	1	1	4	1	1	2.5	1.75
B	2015	0.23	-25.38	-0.04	-0.19	2	1	5	5	1.5	5	3.25
	2016	0.47	14.65	0.02	0.13	1	4	4	1	2.5	2.5	2.5
	2017	0.59	15.92	0.01	0.12	1	4	4	1	2.5	2.5	2.5
	2018	0.59	146.27	-0.01	0.01	1	5	5	4	3	4.5	3.75
	2019	0.61	13.93	0.02	0.15	1	4	4	1	2.5	2.5	2.5
C	2015	0.49	9.43	0.05	0.07	1	3	4	3	2	3.5	2.75
	2016	0.48	10.10	0.04	0.07	1	3	4	3	2	3.5	2.75
	2017	0.57	5.82	0.07	0.10	1	3	4	1	2	2.5	2.25
	2018	0.59	4.80	0.08	0.15	1	2	3	1	1.5	2	1.75
	2019	0.58	6.69	0.06	0.11	1	3	4	1	2	2.5	2.25
D	2015	0.36	6.09	0.08	0.06	1	3	4	3	2	3.5	2.75
	2016	0.54	1.99	0.16	0.13	1	1	1	1	1	1	1
	2017	0.55	1.11	0.24	0.29	1	1	1	1	1	1	1
	2018	0.61	7.95	0.03	0.04	1	3	4	4	2	4	3
	2019	0.51	10.49	0.04	0.05	1	3	4	4	2	4	3
E	2015	0.29	7.84	0.04	0.07	2	3	4	3	2.5	3.5	3
	2016	0.63	2.36	0.08	0.10	1	1	4	1	1	2.5	1.75
	2017	0.62	4.82	0.03	0.06	1	2	4	3	1.5	3.5	2.5
	2018	0.69	3.31	0.04	0.06	1	2	4	3	1.5	3.5	2.5
	2019	0.72	2.43	0.04	0.07	1	1	4	3	1	3.5	2.25
Average	2015	0.30	13.34	0.02	-0.01	2	4	4	5	3	4.5	3.75
	2016	0.60	5.94	0.09	0.13	1	3	2	2	2	2	2
	2017	0.65	5.71	0.09	0.15	1	3	2	2	2	1.5	1.75
	2018	0.67	32.52	0.04	0.08	1	5	4	3	3	3.5	3.25
	2019	0.66	6.77	0.04	0.10	1	3	4	2	2	3	2.5

Source: Authors' calculation based on data from financial reports, Business Register Agency,
<http://www.apr.gov.rs>

The company A did not have difficulties with solvency in terms of its own financing in 2015 ($X_1 > 10\%$). The second indicator had a negative sign, because the value of the achieved business result (loss) is higher than the amount of depreciation, so the obtained value indicates that the company had difficulties with solvency ($X_2 > 12$). The average value of these two indicators is used for assessing the financial stability, so it can be concluded that the company had very good financial stability ($S1=2$). The value of the profitability indicator (X_3) was lower than the recommended value of 8%, and the share of cash flow in operating income (X_4) was also below the recommended value of 5%. As the average value of these two indicators (the result of $S2$) is used for assessing profitability, it can be concluded that the company had difficulties with profitability in the observed year. The average value of the stability and profitability indicators suggest that the company had difficulties with solvency. In the following years (from 2016 to 2019), the solvency of the company was excellent and very good ($T<2$).

The company B had good solvency ($T < 3$) during the whole observed period, except in 2018 when the solvency of this company was at an unsatisfactory level. The poor financial position of the company B in 2018 is accounted for by too long debt repayment period ($X_2 = 146.27$) poor profitability ($X_3 < 8\%$) and low share of cash flow in operating income (X_4) which is significantly lower than the recommended value of 5%.

In 2015 and 2016, the company C showed the same trends for all four indicators and it was in the zone of good solvency ($T < 3$). During these two years, the company had a high value of indicator X_1 , which indicates a high share of equity. In the following years of the observed period, the company was in the zone of very good solvency, and it can be seen that in this period there was an increase in the share of equity and a decrease in the time required to repay the debt (X_2).

The company D was in the zone of good solvency in 2015, 2018 and 2019. It is a result of a longer debt repayment period (X_2) compared to 2016 and 2017, when the company was in the zone of excellent solvency with the time of debt repayment less than 2 years.

The company E was in the zone of good solvency due to low profitability ($S2$) in 2015, 2017, and 2018. Its profitability improved in 2016 and the company was then in the zone of very good solvency. The company E was in the zone of very good solvency also in 2019 due to good financial stability ($S1 = 1$).

The average values of the indicators for the observed agricultural companies suggest that the companies did not have difficulties with solvency in terms of their own financing ($X_1 > 10\%$). Indicator X_2 shows that in 2015 and 2018 the companies had difficulties with the debt repayment period, which was longer than the recommended value of 12 years. According to the average scores for the first two indicators, the companies in the agricultural sector had good financial stability during the observed period. The value of the profitability indicator (X_3) was lower than the recommended value of 8%, except

in 2016 and 2017, while the share of cash flow in operating revenues (X_4) was only in 2015 below the recommended value of 5%. The average values of these two indicators show that the companies in the agricultural sector in 2015 and 2018 had difficulties with profitability. The final result (T) indicates that the observed agricultural companies had difficulties with solvency only in 2015, while during the rest of the observed period the companies had good and very good solvency.

The values of Z' -score indicator were calculated also for the observed food companies (Table 6).

Table 6. Values of Z' indicators for observed food companies

Company	Value Z' indicator				
	2015	2016	2017	2018	2019
F	2.215	3.355	3.137	3.224	2.128
G	2.421	2.385	2.694	2.627	3.528
H	1.506	2.409	2.067	1.502	1.951
I	2.184	2.118	1.997	2.377	2.611
J	1.086	1.968	1.405	1.000	1.181

Source: authors' calculations based on data from financial reports, Business Register Agency, <http://www.apr.gov.rs>

The values of Z' indicator for the company F suggest that this company was in the gray zone in 2015 and 2019 ($Z' < 2.9$), i.e., at risk of bankruptcy, due to low profit rate. In the other years of the observed period, the company F was in the safe zone. The company G was improving its financial position over the years and after being in the gray zone during the first four years ($Z' < 2.9$), it moved to the safe zone in 2019 ($Z' > 2.9$). The company H and the company I were in the gray zone during the entire observed period ($1.23 < Z' < 2.9$). These results indicate that the companies are at risk of bankruptcy, but that it is still possible to improve the companies' business and move to the safe business zone. The company J was in the distress zone in 2015, while in 2016 and 2017 it moved to the gray zone due to increased profit rate. However, as the company was in the distress zone during the rest of the observed period ($Z' < 1.23$), it can be concluded that the company has a high risk of bankruptcy.

The financial stability of the observed food companies was assessed also by calculating the values of Kralicek DF indicator (Table 7).

Table 7. Values of Kralicek DF indicators for observed food companies

Company	Values of Kralicek DF indicator				
	2015	2016	2017	2018	2019
F	1.871	2.711	2.083	2.045	1.457
Financial stability	Good	Very good	Good	Good	Average
G	1.211	0.653	1.238	0.785	0.832
Financial stability	Average	Poor	Average	Poor	Poor
H	0.318	1.144	0.175	1.021	1.537

Company	Values of Kralicek DF indicator				
	2015	2016	2017	2018	2019
Financial stability	Poor	Average	Moderate insolvency	Average	Good
I	3.625	2.882	2.761	2.918	3.036
Financial stability	Excellent	Very good	Very good	Very good	Excellent
J	3.054	4.079	3.556	0.891	1.308
Financial stability	Excellent	Excellent	Excellent	Poor	Average

Source: authors' calculations based on data from financial reports, Business Register Agency, <http://www.apr.gov.rs>

According to the results of Kralicek DF indicator, the company F moved from good financial stability in 2015 to the zone of very good financial stability in 2016. However, it was followed by moving again to the zone of good financial stability in 2017, where the company remained until the end of the observed period. The company G was in the zone of poor and average financial stability during the observed period. The company H showed marked instability during the observed period, moving from the poor financial stability zone in 2015 to the average stability zone in 2016, and then to the moderate insolvency zone in 2017. The following year, this company moved to the zone of average financial stability, while in the last year of the observed period the company was in the zone of good financial stability. The company I was in the zones of excellent and very good financial stability during the observed period, which indicates that this company is not at risk of bankruptcy. The company J was in the zone of excellent stability for the first three years of the observed period, but in 2018 its position deteriorated and the company passed into the zone of poor financial stability. In the last year of the observed period, the company managed to move to the zone of average financial stability by improving its business.

In addition, the data from the financial reports of the observed food companies were used to calculate Kralicek Quick test indicators, the number of points assigned to each indicator and the indicators of financial stability (S1) and profitability (S2) and their arithmetic mean (T), which represents the total business result (Table 8).

Table 8. Results of Quick test for observed food companies

Company	Year	Indicators				Points				Score		
		X1	X2	X3	X4	P1	P2	P3	P4	A	B	Total
F	2015	0.72	2.43	0.05	0.14	1	1	4	1	1	2.5	1.75
	2016	0.81	1.44	0.07	0.13	1	1	4	1	1	2.5	1.75
	2017	0.79	2.17	0.05	0.11	1	1	4	1	1	2.5	1.75
	2018	0.81	0.79	0.05	0.10	1	1	4	1	1	2.5	1.75
	2019	0.68	-0.13	0.04	0.11	1	1	4	1	1	2.5	1.75
G	2015	0.74	3.82	0.03	0.07	1	2	4	3	1.5	3.5	2.5
	2016	0.76	7.21	-0.01	0.04	1	3	5	4	2	4.5	3.25
	2017	0.72	3.41	0.03	0.06	1	2	4	3	1.5	3.5	2.5
	2018	0.76	5.94	0.01	0.04	1	3	4	4	2	4	3
	2019	0.84	3.94	-0.01	0.04	1	2	5	4	1.5	4.5	3

Company	Year	Indicators				Points				Score		
		X1	X2	X3	X4	P1	P2	P3	P4	A	B	Total
H	2015	0.48	-1458.42	-0.01	-0.01	1	1	5	5	1	5	3
	2016	0.59	8.21	0.04	0.05	1	3	4	4	2	4	3
	2017	0.61	187.62	-0.01	0.01	1	5	5	4	3	4.5	3.75
	2018	0.41	11.54	0.03	0.06	1	3	4	3	2	3.5	2.75
	2019	0.45	5.69	0.06	0.09	1	3	4	2	2	3	2.5
I	2015	0.60	1.65	0.16	0.22	1	1	1	1	1	1	1
	2016	0.57	2.58	0.13	0.16	1	1	2	1	1	1.5	1.25
	2017	0.51	2.90	0.13	0.17	1	1	2	1	1	1.5	1.25
	2018	0.58	2.64	0.13	0.14	1	1	2	1	1	1.5	1.25
	2019	0.63	2.12	0.13	0.14	1	1	2	1	1	1.5	1.25
J	2015	0.23	4.85	0.12	0.35	2	2	3	1	2	2	2
	2016	0.30	2.94	0.19	0.26	1	1	1	1	1	1	1
	2017	0.19	4.82	0.16	0.26	3	2	1	1	2.5	1	1.75
	2018	0.22	14.03	0.02	0.07	2	4	4	3	3	3.5	3.25
	2019	0.26	10.15	0.04	0.12	2	3	4	1	2.5	2.5	2.5
Average	2015	0.56	-289.13	0.07	0.15	1	5	3	1	3	2	2.5
	2016	0.60	4.47	0.08	0.13	1	2	2	2	1.5	2	1.75
	2017	0.56	40.18	0.07	0.12	1	5	3	2	3	2.5	2.75
	2018	0.55	6.98	0.05	0.08	1	3	4	3	2	3.5	2.75
	2019	0.57	4.35	0.05	0.10	1	2	3	3	1.5	3	2.25

Source: authors' calculations based on data from financial reports, Business Register Agency,
<http://www.apr.gov.rs>

According to the results of Kralicek Quick test, the company F had very good solvency during the observed period ($T = 1.75$). As can be seen from Table 8, this company should increase its profitability, which was low during all years of the observed period ($X_3 < 8\%$). The company G was in the zone of good solvency during all years of the observed period. As was the case with the company F, this company also had difficulties with profitability, which was extremely low ($X_3 < 8\%$).

The company H was in the zone of good solvency in 2015, but based on indicator X_2 it can be seen that the debt repayment period was far longer than 30 years, and that the company had low profitability rate ($X_3 < 8\%$) and low share of cash flow in operating income (X_4), which was significantly lower than the recommended value of 5%. In 2016, the company remained in the zone of good solvency, with slightly better results. In 2017, the company moved into the zone of bad solvency, due to a new increase in debt repayment time, poor profitability and low share of cash flow in total revenues. In 2018 and 2019, the company returned to the zone of good solvency due to reduced debt repayment time, which was shorter than the recommended value of 12 years, and due to increased share of cash flow in total revenues.

The company I was in the zone of excellent solvency during the observed period, and it can be concluded that this company is not at risk of bankruptcy.

During the first three years of the observed period, the company J was in the zone of very good and excellent solvency, while in 2018, due to increased debt repayment time (X_2), low profitability rate (X_3) and low share of cash flow in total revenues (X_4), the company moved to the zone of good financial stability. In the last year of the observed period, the company reduced the time required to repay the debt, as well as the share of cash flow in total revenues, but it remained in the zone of good solvency due to low profitability rate.

The average values of the indicators for the food companies indicate that the companies in the observed sector did not have difficulties with their own financing ($X_1 > 10\%$). Based on the values of the second indicator, it can be observed that the companies had difficulties with debt repayment time in 2015 and 2017, which was the result of debt repayment period of the company H, as other companies in this sector had good debt repayment period (less than 12 years). The average values for the first two indicators show that the company had very good and good financial stability during the observed period. The value of the profitability indicator (X_3) was lower than the recommended value of 8% in all observed years except in 2016, while the share of cash flow in operating income (X_4) was above the recommended value of 5% during the entire period. The average values of these two indicators show that the food companies had difficulties with profitability only in 2018. The final result (T) indicates that the observed food companies had good or very good solvency during the entire observed period.

Conclusion

According to the results of the applied models for assessing the companies' financial position, the following conclusions can be drawn for the observed agricultural companies:

- Based on all three models, the company A is a financially stable company. The results of all three models show that the company A had difficulties with solvency in 2015, caused by negative business results, long debt repayment period and low share of cash flow in total revenues. In 2016, the company made profit and improved its business results, remaining in the zone of financial stability until the end of the observed period.
- According to Altman's Z'-score model, the company B was in the distress zone, i.e., in the bankruptcy zone, during the whole observed period. The results of Králíček DF indicators show that this company was in the zone of extreme insolvency in 2015, and then in the zone of poor financial stability 2016 and 2017, followed by moving to the zone of beginning of insolvency in 2018, and the zone of average financial stability in 2019. The results of Quick test indicate that the company B had good financial stability in all years of the observed period, with the exception of 2018 when the debt repayment period was too long and the company had low profitability rate and low share of cash flow in operating income.

-The results of Altman's Z'-score model suggest that the company C was in the gray zone, i.e., at risk of bankruptcy, during the whole observed period, but that there is

a possibility of business improvement. On the other hand, the results of Kralick DF indicators and Quick test indicated that the company was in the zone of good solvency, i.e., it was not at risk of bankruptcy.

-According to the results of Altman's Z'-score model, the company D operated in the gray zone in all years of the observed period, except in 2016, due to low profit rate. Contrary to the results of Z'-score, the results of Kralicek DF indicators and Quick test suggest that the company was in the zone of average to good financial stability in 2015, 2018 and 2019, and that in 2016 and 2017 the company had excellent financial stability.

- The results of Altman's Z'-score model for the company E indicate that it was in the gray zone in all years of the observed period, except in 2019, when the company moved to the safe zone due to increased liquidity rate and profit rate. The results of Kralicek DF indicators and Quick test show similar results: the company had average stability in 2015, then good financial stability in 2016, average financial stability in 2017 and 2018 and very good stability, i.e., solvency in 2019.

The results of the applied models for assessing the financial position of food companies pointed to the following conclusions:

-In the case of the company F, all three models indicated different results. Based on Altman's Z'-score model, the company was in the gray zone in 2015 and 2019, while in other years of the observed period it was in the safe zone. The results of DF indicators show that the company was not at risk of bankruptcy, as from 2015 to 2018 the company had good and very good financial stability, while in 2019 it had average financial stability. The results of Quick test showed that the company F had very good solvency in all years of the observed period.

-According to the results of Altman's Z'-score model, the company G was in the gray zone from 2015 to 2018, moving to the safe zone in 2019. The values of DF indicators suggest that the company had poor to average financial stability during the observed period, while the results of Quick test show that the company had good solvency in all years of the observed period.

-The results of Altman's Z'-score model showed that the company H was in the gray zone, i.e. at risk of bankruptcy, during the entire observed period. The values of DF indicators varied greatly over the years. The company had poor financial stability in 2015, and average financial stability in 2016. Due to improved business result, the company had average financial stability in 2017, followed by moderate insolvency in 2018, and good financial stability in 2019. Quick test showed that the company had good solvency in all years of the observed period, except in 2017, when the company had poor solvency due to long debt repayment period and low profitability.

- Based on the results of Altman's Z'-score model, the company I was in the gray zone during the entire observed period. The results of DF indicators and Quick test indicated that the company had a very good and excellent solvency during the observed period and that it was not at risk of bankruptcy.

- The results of Altman's Z'-score model indicate that the company J was in the distress zone in 2015, followed by moving to the gray zone in 2016 and 2017 due to increased profit rate, and then returning to the distress business zone in 2018 and 2019. According to these results, the company was at risk of bankruptcy. The results of DF indicators suggest that the company had excellent financial stability in the first three years of the observed period, followed by poor financial stability in 2018, and average financial stability in 2019. The results of Quick test confirmed the results of DF indicators, suggesting that the company had excellent solvency during the first three years of the observed period, while in 2018 the company had good solvency due to increased debt repayment period, low profitability and low share of cash flow in operating income.

Based on the research results, it can be concluded that each of the applied models provided different results for bankruptcy assessment of the agricultural and food companies in AP Vojvodina. Since the applications of Kralicek DF indicators and Quick test provided similar results, it is recommended to use them in future research.

By calculating the average values of Quick test indicator for agricultural companies, it was observed that the companies from this sector had difficulties with debt repayment period and profitability in 2015 and 2018, which led to financial instability in 2015, while during the rest of the observed period the companies had good and very good solvency. In contrast, the results of Quick test indicated that the companies from the food sector had good or very good solvency throughout the whole observed period. According to the presented results, it can be concluded that large companies in the food sector have better business results and better financial stability compared to large companies in the agricultural sector.

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Conflict of interests

The authors declare no conflict of interest.

References

1. Alihodžić, A. (2013). Testing the Kralicek DF indicator application on the Belgrade.
2. Altman, I. E. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589-609. <https://doi.org/10.1111/j.1540-6261.1968.tb00843.x>
3. Altman, E.I. (1983). Corporate Financial Distress, New York, Wiley InterScience.
4. Altman, E.I., Hartzell, J. & Peck, M. (1995). Emerging Markets Corporate Bonds: A scoring system. In Levich R.M. Emerging Market Capital Flows. *The New York University Salomon Center Series on Financial Markets and Institutions*, 2, 391-400. https://doi.org/10.1007/978-1-4615-6197-2_25

5. Apan, M., Öztel, A., & İslamoğlu, M. (2018). Comparative Empirical Analysis of Financial Failures of Enterprises with Altman Z-score and VIKOR Methods: BIST Food Sector Application. *Australasian Accounting, Business and Finance Journal*, 12(1), 77-101. <https://doi.org/10.14453/aabfj.v12i1.6>
6. Bărbuță-Mișu, N., & Madaleno, M. (2020). Assessment of Bankruptcy Risk of Large Companies: European Countries Evolution Analysis. *Journal of Risk and Financial Management*, 13(58). <https://doi.org/10.3390/jrfm13030058>
7. Burja, C., & Burja, V. (2013). Entrepreneurial risk and performance: empirical evidence of Romanian agricultural holdings. *Annales Universitatis Apulensis Series Oeconomica*, 15(2), 561-569.
8. Didenko, K., Meziels, J., & Voronova, I. (2012). Assessment of enterprises insolvency: challenges and opportunities. *Economics and Management*, 17(1), 69-76. <https://doi.org/10.5755/j01.em.17.1.2253>
9. Domanović, V., Vujičić, M., & Ristić, L. (2018). Profitability of food industry companies in the Republic of Serbia. *Economics of Agriculture*, 65(1), 11-32. <https://doi.org/10.5937/ekoPolj1801011D>
10. Godišnji izveštaj o poslovanju privrede (2020), Retrieved from <http://www.apr.gov.rs> (January 12, 2020). [in English: Annual Report on Business Operations (2020), Retrieved from <http://www.apr.gov.rs> (January 12, 2020).]
11. Jakovčević, K., & Andrašević, J. (2011). Indikatori poteškoća u funkcionisanju industrijskog preduzeća. *Industrija*, 39(3), 175-192. [in English: Jakovčević, K., & Andrašević, J. (2011). Indicators of difficulties in functioning industrial enterprise. *Industry*, 39(3), 175-192.]
12. Kovács, S., Fróna, D., & Rózsa, A. (2020). Analysing the situation of agricultural enterprises in liquidation by means of bankruptcy prediction models. *SEA-Practiacal Application of Science*, 8(2), 23-31.
13. Novaković, T. (2019). Analiza bruto dodate vrednosti poljoprivrede u Republici Srbiji. *Ekonomski ideje i praksa*, (32), 39-55. [in English: Novaković, T. (2019). The analysis of gross value added of agricultural production in the republic of Serbia. *Economic ideas and practices*, (32), 39-55.]
14. Scoring System, Salomon Brothers Inc. New York. Stock Exchange. Banking, 3, 70-95.
15. Stojanović, T., & Drinić, Lj. (2017). Applicability of Z-score Models on the Agricultural Companies in the Republic of Srpska (Bosnia and Herzegovina). *Agro-knowledge Journal*, 18(4), 227-236. <https://doi.org/10.7251/AGREN1704227S>
16. Stošić, I. (2019). An assessment of the financial (un)success of medium-sized enterprises in the Republic of Serbia, *Revizor*, 22(87-88), 33-39.
17. Stošić, I., & Domazet, I. (2014). Analiza konkurentnosti poslovanja i potencijali rasta privrede Srbije u period svetske krize, *TEME: časopis za društvenu teoriju i praksu*, 38(2), 491-506. [in English: Stošić, I., & Domazet, I. (2014). Analysis of business competitiveness and the growth potential of Serbian economy during the global crisis. *Teme*, 38(2), 491-506.]

18. Šverko-Grdić, Z., Krstinić-Nižić, M., & Mamula, M. (2017). Insolvency in the Republic of Croatia. *Economic Research*, 30(1), 1693-1704. <https://doi.org/10.1080/1331677X.2017.1383177>
19. Vučković, B. (2014). Značaj pojedinih indikatora poslovanja određenim grupama analitičara. *Ekonomija, teorija i praksa*, 7(1), 19-49. [in English: Vučković, B. (2014). The importance of some performance indicators for certain groups of analysts. *Economics, theory and practice*, 7(1), 19-49.]
20. Vukadinović, P., Vujović, S., & Vojnović, B. (2018). Analysis of the financial position of enterprises in privatization in the agricultural sector in Serbia. *Economics of Agriculture*, 65(3), 955-970. <https://doi.org/10.5937/ekoPolj1803955V>