

## Applicability of Z-score Models on the Agricultural Companies in the Republic of Srpska (Bosnia and Herzegovina)

Tamara Stojanović<sup>1</sup>, Ljiljana Drinić<sup>2</sup>

<sup>1</sup>*University of Banja Luka, Faculty of Agriculture, Republic of Srpska, BiH*

### Abstract

The aim of our research was to test the predictability of Altman's Z-score models in the case of agricultural companies in the Republic of Srpska. Due to the fact that according to these models the companies from the critical zone are supposed to go bankrupt in the near future, while the companies from the safe zone are not supposed to go bankrupt, these two groups of companies have been subject to ex-ante analysis during the period of five years (2011-2015) in order to estimate the predicting efficiency of Z-score models. The authors have also performed the ex-post analysis to see how the bankrupt companies had been classified according to these models in the years preceding their bankruptcy. The results of these analyses show that Z-score models are not reliable in predicting bankruptcy, nor for the creditworthiness analysis, but can be useful in identifying agricultural companies with long-term financial difficulties especially if other, non-financial variables are included.

*Key words:* Z-score model, agricultural companies, bankruptcy, financial position

### Introduction

Edward Altman's Z-score model is one of the most famous models, based on financial data that is used for analyzing companies' financial position and predicting future financial distress. Since its first appearance in 1968, this model has undergone a number of revisions and re-estimations.

Today, besides standard Z-score model (Altman, 1968), designed for predicting bankruptcy of publicly traded companies, there are also Z'-score model designed only for private manufacturing firms and Z''- score model designed for non-US, emerging market companies and for non-manufacturers (Altman, 2004). Although, this is not the only model used for business failure prediction (Balcaen and Ooghe, 2014; Sanobar, 2012), the original Altman's Z-score model has been the generally applied model all over the world and is still used as a main or supporting tool for bankruptcy or financial distress prediction or analysis.

However, there are many critiques concerning this model. Most of them are addressed to the use of financial ratios, sampling methods, the lack of non-financial variables, and the use of the period (Gergely, 2015). Also, there is no doubt that the characteristics of most firms change from one year to another, whereas the Z-score represents a static model. Nevertheless, many authors and researches tested and confirmed the general applicability of Z-score models (Altman et al., 2010; Altman et al., 2013; Altman et al., 2014; Sanobar, 2012; Xu&Zhang, 2009). However, the predicting ability could be improved if the model is to be adjusted to a specific economic environment, include some other variables as well and reweight the discriminant function for specific country or industry (Avenhuis, 2013; Gergely, 2015; Xu & Zhang, 2009; Zhang & Ellinger, 2006).

Agricultural companies in the Republic of Srpska face many risks (see: Stojanovic et al., 2016), while financial ratio analysis showed that the majority of agricultural companies have a weak financial position indicating that the whole industry has financial problems and needs systematic measures to improve such position (Stojanović & Stojanović, 2015). Recognizing the importance of risk management, including the possibility of predicting bankruptcy and financial position in the industry of agriculture, the aim of this paper has been to test the following hypotheses:

- H1: Z-score models are able to predict bankruptcy of the agricultural companies in the Republic of Srpska in next 2-3 years;
- H2: Z-score models are able to predict a long-term financial distress;
- H3: Z''- score model is the most reliable model to use in the Republic of Srpska as an emerging market although most of agricultural companies are manufacturing companies.

The research work covered a six-year period (2010-2015) and has been based on *secondary sources* – expert articles, official documents, relevant scientific research and studies; as well as the indicators and results of financial analysis performed by using the financial statements of agricultural companies available in the official data bases.

## Materials and Methods

In order to test the above mentioned hypotheses, the authors have used the financial data from the officially submitted financial statements (2010-2015) of 270 agricultural companies in the Republic of Srpska. Among these companies, only 25 of them are publicly traded companies, while all others are private, mostly manufacturing, but also non-manufacturing companies.

For publicly traded companies we have used all three Z-score models ( $Z$ ,  $Z'$  and  $Z''$ ), whereas for other companies we wanted to test and compare the predictability of  $Z'$  and  $Z''$ - score models. Formulas used are as follows (Altman, 1968; Altman, 2004):

$$(1) Z = 0.012 X1 + 0.014 X2 + 0.033 X3 + 0.006 X4 + 0.999 X5$$

$$(2) Z' = 0.717 X1 + 0.847 X2 + 3.107 X3 + 0.42 X4 + 0.998 X5$$

$$(3) Z'' = 6.56 X1 + 3.26 X2 + 6.72 X3 + 1.05 X4$$

where  $X1$  = working capital / total assets,

$X2$  = retained earnings / total assets,

$X3$  = earnings before interest and taxes / total assets,

$X4$  ( $Z$ ) = market value equity / book value of total debt,

$X4$  ( $Z'$ ,  $Z''$ ) = total equity / total liabilities,

$X5$  = sales / total assets, and

$Z$ ,  $Z'$ ,  $Z''$  = overall index

We have used two types of analysis:

1) *Ex-ante analysis*. We have classified 270 companies from 2010 in three categories: critical (red), grey and safe (green). Afterwards, we followed these companies through the next five years (2011-2015), in the first place to see if the companies from the critical zone went bankrupt and to which extent. Also, we wanted to see whether the companies from the safe zone staid in business or not and to which extent. This analysis enabled us to test the predicting ability of each model and conclude which one is the most accurate, i.e. reliable, if any.

2) *Ex-post analysis*. We identified the companies (among those 270 companies from 2010) that ceased existing during these five years and followed them back to see how they were classified according to Z-score models in years preceding the year of bankruptcy.

Both analysis helped us to calculate errors Type I and  $\Pi^1$  in order to provide the final estimation of Z-score model accuracy.

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<sup>1</sup> *Type I error* represents the % of the companies from the critical zone, that were supposed to go bankrupt according to Z-score model, but did not go bankrupt, while *Type II error* represent the % of the companies from the safe zone, that were not supposed to go bankrupt, but went bankrupt.

## Results and Discussion

The first step in our analysis was to classify the whole group of companies in three categories: critical (red) zone, grey zone and safe (green) zone. Their classifications in the base year (2010) as well as in the following years are shown in *Table 1*.

Tab. 1. Classification of the whole group of agricultural companies by Z' and Z'' - score models (2010-2015)

*Класификација читаве групе пољопривредних предузећа према Z' и Z'' скор моделима (2010-2015)*

Zone	2010		2011		2012		2013		2014		2015	
	Z'	Z''										
Safe zone	26%	34%	23%	33%	20%	34%	11%	21%	11%	20%	13%	20%
Grey zone	23%	19%	25%	20%	28%	20%	17%	13%	19%	14%	13%	10%
Critical zone	50%	47%	51%	46%	51%	45%	41%	36%	36%	31%	32%	29%
Non-existing	0%	0%	0%	0%	0%	0%	31%	31%	35%	34%	42%	42%

As we can see in Table 1, both models indicate that the financial position of the agricultural companies is getting worse and even though approximately 48% of companies were in critical zone in 2010, 42% of them went bankrupt by 2015, while approximately 30% of companies are still in the critical zone implying the severe financial difficulties.

### a) Publicly traded companies

Tab. 2. The application of Z, Z' and Z'' - score models on publicly traded companies

*Примјена Z, Z' и Z'' скор модела на акционарска предузећа*

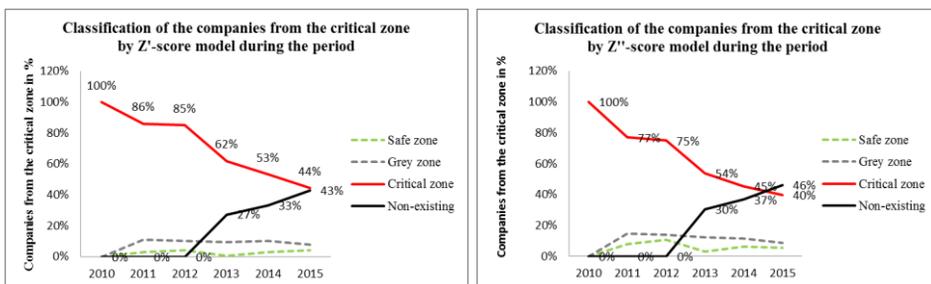
Zone	2010			2015		
	Z	Z'	Z''	Bankruptcy	Stocks trading stopped	In business
Safe zone	96%	80%	68%	32%	24%	12%
Grey zone	0%	0%	12%	0%	4%	8%
Critical zone	4%	20%	20%	0%	0%	20%

Although none of Z-score models, as we can see from Table 2, were reliable in predicting bankruptcy, Z''-score model has better prediction efficiency, compared to other two models. Classification of companies given by this model in 2010, corresponds best to the financial reality of these companies in 2015.

b) Other companies (limited liability companies and cooperatives)

Besides the ex-ante analysis of only publicly traded companies, we have also followed two groups of all agricultural companies throughout the period – those classified in the critical zone and the companies in the safe zone – to test the predicting efficiency of each model (Z' and Z'').

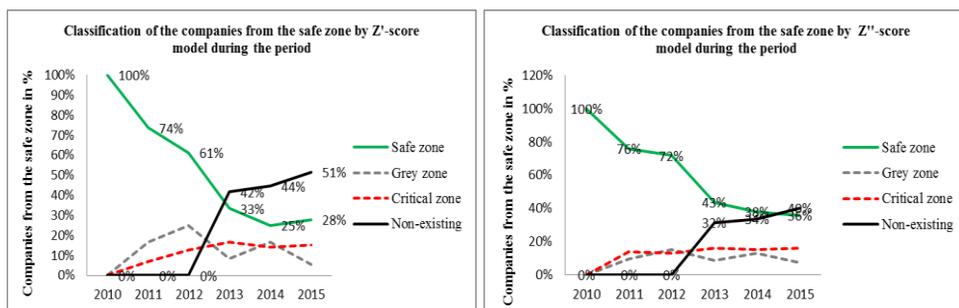
As shown in Graph 1, none of the companies from the critical zone (according to both models - Z' and Z'') went bankrupt in next two years. However, 43% of companies, classified in critical zone by Z'-score model (46% by Z''-score model) closed down in next five years. Still, 44% of companies, by Z' model, i.e. 40% by Z'' model, remained in the same critical zone indicating a long-term financial imbalance and distress. Therefore, Z-score models selected a group of companies which from 87% (by Z' model), i.e. 86% (by Z'' model) of companies whether went bankrupt or maintained the same financial position throughout the period.



Graph 1. Classification of the companies from the critical zone according to Z' and Z''-score models by years

*Класификација предузећа из критичне зоне према Z' и Z'' скор моделима по годинама*

Graph 2 clearly shows that the companies classified in the safe zone by Z-score models are not safe in the near future. According to Z-score models, 51% of these companies (by Z' model) and 40% (according to Z'' model) went bankrupt in next five years. Only 25%, by Z'-score model, and 36%, by Z''-score model, remained in the same, safe zone.



Graph 2. Classification of the companies from the safe zone according to Z' and Z'' model by years

*Класификација предузећа из безбједне зоне према Z' и Z'' скор моделима по годинама*

c) Ex-post analysis of bankrupt companies

In order to test our hypotheses 1 and 3, we have also performed an ex-post analysis of the companies that closed down in the tested period. Although it would be logical that the majority of bankrupt companies were classified in the critical zone in the year proceeding the bankruptcy, our ex-post analysis showed that here this was not the case (see Table 3).

Tab. 3. Classification of companies according to Z' and Z''- score models in years proceeding the bankruptcy

*Класификација предузећа према Z' и Z'' скор моделима у годинама које претходе банкротству*

	2013		2014		2015		Total/Average	
	Z'	Z''	Z'	Z''	Z'	Z''	Z'	Z''
No of bankrupt companies	83		15		22		120	
Classification (X-1):								
Red zone	48%	53%	83%	79%	62%	59%	55%	57%
Grey zone	28%	13%	11%	14%	24%	23%	25%	15%
Safe zone	24%	34%	6%	7%	14%	18%	20%	28%
Classification (X-2):								
Red zone	52%	53%	58%	57%	75%	68%	57%	56%
Grey zone	23%	17%	25%	14%	19%	23%	22%	18%
Safe zone	25%	30%	17%	29%	6%	9%	21%	26%
Classification (X-3):								
Red zone	45%	100%	67%	43%	38%	45%	46%	83%
Grey zone	19%	0%	8%	14%	50%	32%	24%	8%
Safe zone	36%	0%	25%	43%	13%	23%	30%	10%

a) Type I and Type II Errors

According to the classification of the bankrupt companies in the years preceding the bankruptcy, we were able to estimate the level of predicting accuracy of each model and conclude which one is more accurate if any (see Table 4).

Tab. 4. Type I and Type II Errors  
*Грешке Tuna I u Tuna II*

Time period	HIT		AMISS	
	Z'	Z''	Z'	Z''
<i>1 and 2 years before the bankruptcy:</i>				
<i>TYPE I ERROR</i>	0%	0%	66%	58%
<i>TYPE II ERROR</i>	35%	42%	0%	0%
<i>TOTAL:</i>	35%	42%	66%	58%
<i>3 years before the bankruptcy:</i>				
<i>TYPE I ERROR</i>	17%	17%	48%	41%
<i>TYPE II ERROR</i>	20%	29%	15%	13%
<i>TOTAL:</i>	37%	46%	63%	54%
<i>4 years before the bankruptcy:</i>				
<i>TYPE I ERROR</i>	22%	21%	44%	37%
<i>TYPE II ERROR</i>	19%	28%	15%	14%
<i>TOTAL:</i>	41%	49%	59%	51%
<i>5 years before the bankruptcy:</i>				
<i>TYPE I ERROR</i>	28%	27%	37%	31%
<i>TYPE II ERROR</i>	17%	25%	17%	17%
<i>TOTAL:</i>	45%	52%	55%	48%

As we can see from Table 4, both models are more accurate if the timeline is more spread. Z'-score model's hits increase from 35% in first two years before the bankruptcy to 45% five years before the bankruptcy. The same case is with Z''-score model. Its hits increase from 42% to 52%. These figures also show that none of the models has a satisfying predicting ability, but Z''-score model is more accurate throughout the whole period.

## Conclusion

Based on the results of our research we cannot accept the hypothesis 1 since none of Z-score models is reliably accurate in predicting bankruptcy of agricultural companies in the Republic of Srpska in next 2-3 years. Also, this level of accuracy increases with number of years preceding the bankruptcy not vice versa.

However, we can accept the hypothesis 2, to a certain extent, as both models could identify companies (87% by  $Z'$ , i.e. 86% by  $Z''$  model) that would rather go bankrupt or stay in the same critical financial position in the future, i.e. the companies with long-term financial difficulties. However, Z-score models are not recommended to be used in estimation of creditworthiness of these companies since their classification in the safe zone is not a guarantee that they will survive or stay stable in the near future. Finally, although none of the models is quite accurate in predicting the bankruptcy in the near future, we can accept hypothesis 3 as we have confirmed that the  $Z''$ -score model is more accurate as recommended by prof. Altman and his associates.

Our research also shows that agricultural industry is again very special and specific and cannot be approached the same way as other industries. Many non-financial factors, such as climatic changes, price and market risks, institutional risks, etc., effect immensely the agricultural production and yields and consequently the financial position and/or survival of these companies. Therefore, in the case of agricultural companies in the Republic of Srpska, in order to predict possible future difficulties and bankruptcy, it is not enough to look at the financial statements but also to take into account all the above-mentioned non-financial variables.

The established differences in the absolute values of the examined parameters of the potential fertility of the buds in the treatments (average for the fruit canes for the period 2013-2015) are almost always statistically proven.

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# Примјена Z-score модела за пољопривредна предузећа у Републици Српској (Босна и Херцеговина)

Тамара Стојановић<sup>1</sup>, Љиљана Дринић<sup>1</sup>

<sup>1</sup>Универзитет у Бањој Луци, Пољопривредни факултет, Република Српска, БиХ

## Сажетак

Циљ овог истраживања је да тестира могућност предвиђања Алтманових Z-score модела у случају пољопривредних предузећа у Републици Српској. С обзиром да ће према овим моделима предузећа из критичне зоне највјероватније банкротирати у блиској будућности, док то није случај са предузећима из безбједне зоне, ове двије групе предузећа су подвргнуте ex-ante анализи током наредних пет година (2011-2015) како би се процијенила њихова ефикасност предвиђања. Такође је извршена и ex-post анализа како би се сагледала класификација предузећа, која су банкротирала током овог периода, у годинама које претходе њиховом банкротству. Резултати анализа показују да Z-score модели нису поуздани у предвиђању банкротства, као ни за оцјену кредитног бонитета пољопривредних предузећа, али могу бити корисни у идентификовању предузећа са дугорочним финансијским потешкоћама, посебно уколико се у обзир узму и други, нефинансијски фактори.

*Кључне ријечи:* Z-score модел, пољопривредна предузећа, банкротство, финансијски положај

Тамара Стојановић  
E-mail address: [tamara.stojanovic@agro.unibl.org](mailto:tamara.stojanovic@agro.unibl.org)

Received: August 23, 2017  
Accepted: November 15, 2017