TEME, г. XLIV, бр. 2, април – јун 2020, стр. 503–518

Претходно саопштење https://doi.org/10.22190/TEME180619036V
Примљено: 19. 6. 2018. UDK 347.736
Ревидирана верзија: 8. 4. 2019.
Одобрено за штампу: 15. 4. 2020.

A COMPARISON OF THE BANKRUPTCY PREDICTION MODELS ON A SAMPLE OF SERBIAN COMPANIES

Sanja Vlaović Begović[1*], Ljiljana Bonić[2], Slobodanka Jovin[1]

[1]Business School, Novi Sad, Serbia
[2]University of Niš, Faculty of Economics, Niš, Serbia
[*]*sanjavbegovic@gmail.com*

Abstract

Turbulent conditions on the Serbian market, the deep consequences of the global economic crisis that have shaken the already weakened economy are strong reasons for constant monitoring of business in Serbia. Identifying financial problems in a company that lead to bankruptcy reduces the risk of potential losses. The aim of the paper is to compare the Altman model and the Zmijewski model that are applied in companies in Serbia and by that to conclude which one gives better results for predicting bankruptcy. Also, the paper will examine the significance of individual ratios in models using correlation analysis.

The results of the survey showed that the accuracy of predicting the bankruptcy of the Altman model for emerging markets on Serbian companies undergoing bankruptcy proceedings, is high, 88.68% for one and 79.25% for two years before the initiation of bankruptcy proceedings. The accuracy of the Zmijewski model is slightly higher than the Altman model for one year before the initiation of bankruptcy proceedings and amounts to 90.57%. Two years before bankruptcy, the Zmijewski model's accuracy is the same as with the Altman model (79.25%). When it comes to the overall sample (undergoing bankruptcy proceedings companies and non-bankruptcy companies), the average accuracy of the Zmijewski model is higher than the Altman model (89.62% > 85.22%). Based on Pearson's correlation coefficient, we have established that one year before initiating bankruptcy, there is almost an impeccably perfect positive relationship between the ratio of working capital and total assets on one side, and Z''- score on the other. The Zmijewski coefficient has an almost perfect negative relationship with the indebtedness ratio. By observing both models, it can be concluded that companies in Serbia had a problem with liquidity, indebtedness and the impossibility of returning the invested funds, which contributed to the poor financial situation and initiation of bankruptcy proceedings.

Key words: bankruptcy prediction, Altman Z'' model, Zmijewski model, comparative analysis, Serbian companies.

ПОРЕЂЕЊЕ МОДЕЛА ЗА ПРЕДВИЂАЊЕ СТЕЧАЈА НА УЗОРКУ СРПСКИХ ПРЕДУЗЕЋА

Апстракт

Турбулентни услови на тржишту Србије, дубоке последице светске економске кризе, која је уздрмала ионако ослабљену привреду, јаки су разлози непрестаног праћења пословања предузећа у Србији. Препознавање финансијских неприлика у предузећу које воде у стечај смањује ризик од могућих губитака. Циљ рада јесте поређењем Алтмановог модела и модела Змијевског утврдити који модел примењен на предузећа у Србији даје боље резултате предвиђања стечаја. Такође, у раду ће се испитати и значајност појединачних рација у моделима помоћу корелационе анализе.

Резултати истраживања показали су да је тачност предвиђања стечаја Алтмановог модела за тржишта у развоју за српска предузећа која су покренула стечајни поступак висока, и то 88,68% годину дана пре покретања стечајног поступка и 79,25% две године пре покретања стечајног поступка. Тачност модела Змијевског нешто је већа од Алтмановог модела за једну годину пре покретања стечајног поступка и износи 90,57%. За две године пре стечаја тачност модела Змијевског иста је као и код Алтмановог модела (79,25%). И када је реч о укупном узорку (предузећа у стечају и предузећа која нису у стечају), просечна тачност модела Змијевског већа је од Алтмановог модела (89,62% > 85,22%). На основу Пирсоновог коефицијента корелације, утврдили смо да годину дана пре покретања стечаја постоји скоро савршена позитивна веза између односа радног капитала и укупних средстава, с једне стране, и З" скора, с друге стране. Коефицијент Змијевског има скоро савршену негативну везу са рацином задужености. Посматрајући оба модела, може се закључити да су предузећа у Србији имала проблем са ликвидношћу, задуженошћу и немогућношћу повраћаја уложених средстава, што је допринело лошем финансијском стању и покретању стечајног поступка.

Кључне речи: предвиђање стечаја, Алтманов З" скор модел, модел Змијевског, компаративна анализа, српска предузећа.

INTRODUCTION

In order to survive, financial market participants must carefully select business partners. One aspect of risk management is to monitor operations of affiliated companies and predict financial distress and bankruptcy of these companies.

Turbulent market conditions in Serbia and the deep impact of the global economic crisis that has shaken the already weakened economy are strong reasons for the constant monitoring of operations of Serbian companies. Risk related to the financial problems of these companies is not only taken by customers, suppliers, and creditors, but also investors and speculators. Recognition of financial distress in the affiliated company reduces the risk of potential losses.

There are a number of models used for predicting bankruptcy or financial distress in the company. While some authors, such as Beaver (1966), Altman (1983, 1995), Ohlson (1980), or Zmijewski (1984), base their models on accounting information, there are those who use market

data for the models, namely Black and Scholes (1973) Merton (1974), and Shumway (2001).

This paper will compare two corporate bankruptcy prediction models, based on accounting data. These are the models that have been widely applied in practice, i.e. Altman Z" score model (1995) and the Zmijewski model (1984). The aim of the paper is to determine which model, when applied to Serbian companies, gives better results in the prediction of bankruptcy. Furthermore, the paper will examine the significance of individual ratios within the models, by using correlation analysis.

The paper is organized as follows: the first part highlights the most important studies on the application of the Altman and Zmijewski models. The next part focuses on the methodology and presentation of data used in the paper, followed by the results of model application to companies in Serbia, and the conclusion.

LITERATURE REVIEW

The first bankruptcy prediction model, and at the same time one of the most cited in scientific literature[1] (Kumar, Kumar, 2012) using multiple discriminant analysis (MDA) was designed by Altman in 1968. As the original model was applicable only to companies whose shares are traded on the stock exchange, it had to be adjusted to include companies whose shares are not traded on the stock exchange (Altman, 1983), companies that belong to both production and non-production sectors, and companies that operate on the emerging markets (Altman, Hartzell & Peck, 1995). The accuracy of the original bankruptcy prediction model one year before the bankruptcy proceedings was 95%, and two years before the initiation of bankruptcy 83%.

Grice and Ingram (2001) examined the validity of the Altman model in respect of production and non-production companies in the period 1985-1991. Their study showed that the accuracy of the Altman model was lower than the results obtained by Altman, and that predicting bankruptcy was better in production than in non-production companies.

Given that Altman applied the model to the developed and stable US market, the need arose to examine the validity of the model on other markets. Boritz et al. (2007) compared Canadian bankruptcy prediction models with the Altman and Ohlson models, using Canadian data. The results showed great similarity with respect to Canadian bankruptcy models and the Ohlson model, while the Altman model showed lower performance than other models tested. Lawson (2008) applied the Altman model to the Australian equity market, while Pitrova (2011) applied the same model to Czech firms. For public industrial firms in Taiwan, Lin (2009)

[1] In addition to Altman's (1968) model, the authors state that the most cited are also both the Zmijewski (1984) and the Ohlson (1980) models,

used multiple discriminant analysis, logit, probit, and neural networks models for predicting financial distress. Through model comparison, he came to the conclusion that the probit model had the best and most stable performance if the data used satisfied the assumptions of the statistical model. In contrast, neural networks models achieved greater accuracy in predicting than other models tested. Samkin et al. (2012) used the Altman Z-score model to predict the bankruptcy of companies in New Zealand with a recommendation that the model should be used as part of the financial indicators in the published financial review to increase investor confidence, or as an integral part of the financial statements.

A number of authors compared accounting and market models. Hillegeist et al. (2004) compared Altman's and Ohlson's models, based on accounting information, with the BSM-Prob structural model, based on market information, giving priority to the market model. Beaver, McNichols and Rhie (2005) used their study to examine the bankruptcy prediction ability on the basis of accounting information, market-based variables, and combination of financial statement and market-based variables over a long period of time from 1962 to 2002. These authors found that the predictive models were marked by robustness during the observed period, and that the slight decline in bankruptcy prediction ability based on financial ratios was compensated through the use of market-based variables. Based on the sample of 5784 companies, Reisz and Purlich (2007) compared the structural models with Altman Z score and Z" score models. The authors concluded that, with respect to short-term bankruptcy prediction, priority should be given to accounting-based measures. However, by extending the period of bankruptcy prediction, market-based structural models should be used.

In their paper, Paquette and Skender (1996) showed that the Z score model could be useful in providing guidelines to auditors in the assessment of the going concern principle of the company for its clients.

In Serbia, Muminović et al (2011) examined the adequacy of the application of the original Altman model, the Z'score and Z''score model on a sample of enterprises operating in Serbia. Although the research results showed a higher degree of accuracy of the Z''score model, made for developing markets (also sometimes referred to as emerging markets), compared to the other two models tested, the predictive power of the model is not satisfactory. The reason for this, according to the authors, is in looking for different performance treasures and different nature of the firm's financial structures.

Stanišić, Mizdraković and Knežević (2013) compared models of logistic regression, decision trees and artificial neural networks (ANNs) with the Altman models for emerging markets and for private enterprises. The results of the research have shown that the only model of neural networks gives better results than the Altman model for private enterprises, which, according to the author, is adequate for use at enterprises in Serbia.

Very often, the authors in Serbia decide to test the creditworthiness of one or more enterprises using the Altman model (Filipović, Mirjanić, 2016; Zlatanović et al, 2016). In examining the enterprises' corporate credit rating, the authors use other models besides the Altman model. Andrić and Vuković (2012) investigated the impact of the crisis on the performance of 50 enterprises in Serbia in the period from 2008 to 2010, using the following models: Kralicek Quick Test, the Altman EMS model, Sandin and Porporato Model, Kralicek's discriminatory function and the BEX index. All applied models have shown that the effects of the economic crisis were most felt in 2009, while already in 2010 the effects of the crisis began to decrease.

Zmijewski (1984) used probit analysis to calculate the probability of bankruptcy in the interval from 0 to 1. The accuracy of the original bankruptcy prediction model for the total sample was 98%. Although the model was not sensitive to industrial classification (Grice and Dugan, 2001), the accuracy of the model eventually decreased. Therefore, Grice and Dugan (2003) believed that it was necessary to adjust the coefficients used in the original model, to achieve higher accuracy.

In Serbia, Pavlović et al. (2012) applied Zmijewski model to predict bankruptcy of Serbian firms, and found a high degree of accuracy of the model. Zmijewski model demonstrated high predictability of financial distress following the sample taken from all sectors listed on Karachi Stock Exchange (Waqas et al., 2014).

RESEARCH METHOD

The paper uses the Altman Z" score model (1995) for predicting bankruptcy, as a suitable model for emerging markets. The model reduces the impact of the industry in which the company operates and applies to companies whose shares are not traded on the stock exchange, which is consistent with the sample used in the paper. The Altman Z" score model reads (Altman, Hartzell & Peck, 1995, p.3):

$$Z" = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4 \quad (1)$$

where:

X_1– Working Capital / Total Asset – Ratio of liquidity expressed through working capital and the total assets of the company. For companies in bankruptcy, this ratio is usually negative.

X_2 – Retained Earnings / Total Assets – Ratio of cumulative earnings and total assets of the company is low in the newly established companies.

X_3 – Earnings before Interest and Taxes / Total Assets – Ratio of profitability of total assets independently of costs of financing and tax.

X_4 – Book Value of Equity / Book Value of Total Liabilities – Ratio which measures how much the assets of the company can be reduced before the company becomes insolvent.

After calculating the Z" score, the company is classified into one of three groups, namely, if the Z" score is greater than 2.6, the company is considered to be financially successful; a company that operates in a gray zone has the Z" score in the range from 2.59 to 1.11, while financially unsuccessful companies have the Z" score lower than 1.10.

Another model used in the paper for predicting bankruptcy is the Zmijewski model. Based on the data on 40 bankrupt and 800 non-bankrupt companies, the model has been formed, which, by examining return on assets, financial leverage, and liquidity, determines the probability of bankruptcy proceedings. The model is as follows (Zmijewski, 1984, p.69):

$$ZFC = -4.336 - 4.513(ROA) + 5.679(FINL) + 0.004(LIQ) \qquad (2)$$

where:

ROA – net income to total assets –ratio shows the net income that the company realizes in relation to the invested funds;

$FINL$ – total debt to total assets – debt ratio shows how much of the total assets is financed by debt;

LIQ – current assets to current liabilities – shows the ability of the company to fulfil its short-term liabilities with the total available working capital

In order to determine the probability of bankruptcy, the following formula is used:

$$P = 1/(1 + e\text{^}(-y)) \qquad (3)$$

e – constant (e = 2.71828)

y – model result (ZFC)

When the obtained probability is greater than 0.5, there are high chances that the bankruptcy will be initiated.

After the comparison of the above-mentioned models, the paper will examine the strength and direction of the correlation between individual ratios and model results using Pearson correlation coefficient. According to Cohen (1998, pp. 79-81), the correlation will be assessed as small if r ranges from 0.10 to 0.29, medium if r is in the interval from 0.30 to 0.49, or large if r is greater than 0.5 but smaller than 1.

DATA

In order to examine the accuracy of the bankruptcy prediction model and make a comparison, a sample of 159 companies was formed. On the basis of periodic publication of active bankruptcy proceedings of companies on the territory of the Republic of Serbia, a part of the sample consisting of 53 medium and large companies that began the bankruptcy proceeding from 01/01/2013 to 01/07/2014 was made by Bankruptcy Supervision Agency (2015). Enterprises are constituted as limited liability

companies and joint stock companies. The analysis of the bankruptcy prediction was carried out in one and two years before the initiation of the bankruptcy proceeding.

The second part of the sample is made up of 106 active companies (which are continuously in business and are not bankrupt) also of medium and large size. Non-bankruptcy companies are public companies whose shares are traded on Belgrade Stock Exchange and they are selected on a random basis. The analysis of the initiation of the bankruptcy proceedings prediction was carried out for 2012 and 2013.

The structure of the sample based on the activity of the analysed companies is shown in Table 1.

Table 1. Sample divided by sector of activity

Sectors	Number of non-bankruptcy companies	Number of bankruptcy companies
Financial and insurance activities	3	0
Agriculture, forestry, fisheries	27	4
Water supply	1	0
Construction	22	4
Education	1	0
Manufacturing industry	40	25
Mining	1	1
Professional, scientific, innovation and technical activities	3	1
Traffic and storage	3	3
Wholesale, retail trade; repair of motor vehicles	5	15
Total:	106	53

Source: the authors' calculation

The companies' financial statements were taken from the Business Registers Agency (2015).

RESEARCH RESULTS

Summary statistics comparison of the Altman and Zmijewski models for companies undergoing bankruptcy proceedings is shown in Table 2. The average value of the Altman's Z" score is negative both one and two years before the bankruptcy proceedings, provided that one year before the start of bankruptcy proceedings the ratio shows an even clearer picture of the financial situation in companies (it is considered that the financially unsuccessful company has the Z" score less than 1.10). The standard deviation is low. However, there is a company whose Z" score was 5.03 one year before the bankruptcy proceedings, and 5.43 two years before the bankruptcy proceedings, which, according to the Altman model,

puts the company into the group of financial successfulness (the Z" score greater than 2.6). Nevertheless, the accuracy of the Altman bankruptcy prediction model for Serbian companies on emerging markets is high, i.e. 88.68% one year and 79.25% two years before the bankruptcy proceedings (out of 53 companies that have filed for bankruptcy, the Altman model predicted the bankruptcy of 47 companies one year, and for 42 companies two years prior to the bankruptcy proceedings). Error type I (when the analyzed company initiated bankruptcy but was predicted to continue operations) amounts to 11.32% one year before the bankruptcy proceedings, and 20.75% two years prior to bankruptcy proceedings. The model predicted continuing operations for 6, i.e. 11 of the analyzed companies, but these companies began bankruptcy proceedings.

The average value of the Zmijewski model for both periods classified the observed sample as companies in which bankruptcy was likely to occur. A company that the Altman model described as successful will be categorized by the Zmijewski model as a company with a minimum probability of bankruptcy. The causes of the bankruptcy of the company that is, based on the models, financially stable, should be looked for in the factors that are not built into the model (for example, macroeconomic conditions). The accuracy of the Zmijewski model is slightly higher than in the case of the Altman model one year before the bankruptcy proceedings, and amounts to 90.57% (bankruptcy is predicted for 48 out of 53 companies). Two years before the bankruptcy, the accuracy of the Zmijewski and Altman models is the same and amounts to 79.25%. Consequently, Error type I for that period is unchanged and equals 20.75%, being lower one year before bankruptcy, i.e. 9.43%.

Table 2. Summary statistics comparison of Altman and Zmijewski models for companies undergoing bankruptcy proceedings

	Altman model		Zmijewski model	
	One year before bankruptcy	Two years before bankrupt.	One year before bankrupt.	Two years before bankrupt.
Average	-4.75	-2.65	0.82	0.73
S. Deviation	6.17	5.38	0.24	0.26
Min	-24.02	-23.23	0.07	0.08
Max	5.03	5.42	1.00	1.00
Median	-3.44	-1.28	0.92	0.81
Sample	53	53	53	53
	Cut-off <1,1		Cut-off >0.5	
Accuracy for	88.68	79.25	90.57	79.25
Error type I	11.32	20.75	9.43	20.75

Source: the authors' calculation

When it comes to non-bankruptcy companies, the average value of the Altman model is extremely high for the years 2013 and 2012 (9.47 and 8.37) as shown in Table 3. However, the deviation of the Z" score from the average value is greater than in companies undergoing bankruptcy proceedings. The accuracy of the model is lower compared to companies in bankruptcy, and the Z" score shows the deterioration in the financial position of the investigated companies in 2013 compared to 2012. Error type II amounts to 16.98 in 2013, and 11.32 in 2012. This means that the model predicted the bankruptcy of 18, i.e. 12 out of 106 companies examined, which then just kept operating.

The Zmijewski model shows a higher degree of accuracy with non-bankruptcy companies than with companies undergoing bankruptcy. As with the Altman model, accuracy was slightly higher in 2012, indicating a difficult financial position of the companies in 2013. Compared to the Altman model, the Zmijewski model classified smaller number of companies in the group of companies with a higher probability of occurrence of bankruptcy, and, therefore, the model is characterized by higher accuracy (bankruptcy is predicted for the 9 companies in 2013, and 8 in 2012 out of the 106 companies examined).

Table 3. Summary statistics comparison of the Altman and Zmijewski models for non-bankruptcy companies

	Altman model		Zmijewski model	
	2013	2012	2013	2012
Average	9.47	8.37	0.18	0.17
S. Deviation	17.77	13.09	0.21	0.19
Min	-5.97	-3.06	0.00	0.01
Max	118.22	88.78	0.99	0.88
Median	4.05	4.11	0.09	0.10
Sample	106	106	106	106
	Cut-off <1,1		Cut-off >0.5	
Accuracy for	83.02	88.68	91.51	92.45
Error type II	16.98	11.32	8.49	7.55

Source: the authors' calculation

Looking at the overall sample (non-bankruptcy and bankruptcy companies for two years of observation), the average accuracy of the Altman Z" score model is 85.22% for the period 2011-2013. The average accuracy of the total sample in the Zmijewski model is 89.62%, as shown in Table 4.

Table 4. Comparison of the Altman and Zmijewski models for total sample

	Altman model	Zmijewski model
Correctly predicted	271	285
Sample	318	318
Total accuracy	85.22%	89.62%

Source: the authors' calculation

Comparing the research carried out on the territory of Serbia for the period 2006-2010 (Pavlović et al., 2012) on a sample of 94 companies, where the average accuracy of the Zmijewski model was 94.15%, one can see a reduction in the average accuracy of the Zmijewski model (made on the sample of 159 companies for the period 2011-2013).

The Analysis of the Impact of Individual Ratios on the Results of the Model

In order to establish the strength and direction of the bond between individual ratios and the overall result of the Altman model, the correlation analysis of companies undergoing bankruptcy proceedings was conducted. Pearson linear correlation coefficient in respect of two, i.e. one year before the bankruptcy proceedings is shown in Tables 5 and 6.

Table 5. Pearson's correlation coefficient with respect to the Z" score two years before the bankruptcy proceedings

		X_1 WC/TA	X_2 RE/TA	X_3 EBIT/TA	X_4 BVE/BVTL	Z" Score
X_1 WC/TA	Correlation	1				
	Probability	-----				
X_2 RE/TA	Correlation	0.282	1			
	Probability	0.040	-----			
X_3 EBIT/TA	Correlation	0.512	0.166	1		
	Probability	0.000	0.234	-----		
X_4 BVE/BVTL	Correlation	0.523	0.232	0.204	1	
	Probability	0.000	0.094	0.142	-----	
Z" Score	Correlation	0.890	0.318	0.840	0.486	1
	Probability	0.000	0.020	0.000	0.000	-----

Source: the authors' calculation

Table 5 shows that between the ratio X_1 (Working Capital / Total Asset) and the Z" score there is a strong positive correlation, as well as between the ratio X_3 (Earnings before Interest and Taxes / Total Assets) and Z" score, r= 0.840, p <0.0001 By increasing the value of X_1 and X_3, Z" score increases.

Table 6. Pearson's correlation coefficient with respect to the Z" score one year before the bankruptcy proceedings

		X_1 WC/TA	X_2 RE/TA	X_3 EBIT/TA	X_4 BVE/BVTL	Z" Score
X_1	Correlation	1				
WC/TA	Probability	-----				
X_2	Correlation	-0.077	1			
RE/TA	Probability	0.580	-----			
X_3	Correlation	0.418	0.349	1		
EBIT/TA	Probability	0.001	0.010	-----		
X_4	Correlation	0.302	-0.106	0.074	1	
BVE/BVTL	Probability	0.027	0.448	0.595	-----	
	Correlation	0.952	0.110	0.658	0.341	1
Z" Score	Probability	0.000	0.432	0.000	0.012	-----

Source: the authors' calculation

Comparing the correlation coefficient between the individual ratios and the Z" score one and two years before the bankruptcy proceedings, one can see the strengthening of the positive correlation between X_1 and Z" score, $r = 0.952$, $p < 0.0001$. The bond is almost perfect which means that the increase in the value of X_1 by 1% leads to an increase in the value of the Z" score by almost 1%. A strong positive correlation exists between X_3 and Z" score, $r = 0.658$, $p < 0.0001$ but, compared to the previous year, this correlation is somewhat weaker ($r = 0.840$). At the same time, between the ratio X_2 (Retained Earnings / Total Assets) and the Z" score, the correlation coefficient is not statistically significant. Similar research was conducted with companies in the Czech Republic. Pitrova (2011) examined the relationship between the Altman Z score (1968) and individual ratios, and confirmed strong positive correlation between X_5 (sales/total assets) and the Z score. At the same time, the weakest significant relationship was established between X_4 (market value of owner´s equity / book value of total liabilities) and the Z score.

The correlation coefficient between return on assets, financial leverage and liquidity, and the Zmijewski coefficient is also expressed by the Pearson linear correlation in Tables 7 and 8 in respect of the period of two, i.e. one year before the bankruptcy proceedings. Increasing the Zmijewski coefficient increases the chances that the company will initiate bankruptcy proceedings.

Table 7. Pearson's correlation coefficient with respect to Zmijewski model two years before bankruptcy proceedings

		ROA	FINL	LIQ	ZMIJEWSKI
ROA	Correlation	1			
	Probability	-----			
FINL	Correlation	-0.216	1		
	Probability	0.118	-----		
LIQ	Correlation	0.091	-0.402	1	
	Probability	0.512	0.002	-----	
ZMIJEWSKI	Correlation	-0.941	0.533	-0.218	1
	Probability	0.000	0.000	0.116	-----

Source: the authors' calculation

Looking at the values in Table 7 in respect of the period of two years before the bankruptcy of companies in Serbia, nearly perfectly negative and statistically significant correlation between return on asset and the Zmijewski coefficient was calculated, $r = -0.941$, $p < 0.0001$, where reducing return on asset increases the Zmijewski coefficient by almost the same percent, which is consistent with a higher probability of bankruptcy proceedings. Negative, but small correlation ($r = -0.218$) was observed between liquidity and the Zmijewski coefficient, while between indebtedness and the Zmijewski coefficient there is strong positive correlation, $r = 0.533$.

Table 8. Pearson's correlation coefficient with respect to Zmijewski model one year before bankruptcy proceedings

		ROA	FINL	LIQ	ZMIJEWSKI
ROA	Correlation	1			
	Probability	-----			
FINL	Correlation	-0.576	1		
	Probability	0.000	-----		
LIQ	Correlation	0.230	-0.348	1	
	Probability	0.097	0.010	-----	
ZMIJEWSKI	Correlation	-0.723	0.981	-0.348	1
	Probability	0.000	0.000	0.010	-----

Source: the authors' calculation

One year before the bankruptcy proceedings, the correlation between the ratios and the Zmijewski coefficient is somewhat different. Almost perfect positive correlation ($r = 0.981$, $p < 0.0001$ exists between debt and the Zmijewski coefficient. Compared to the previous year, the correlation has strengthened and maintained the same direction. Somewhat weaker, but still strong negative correlation exists between return on asset and the Zmijewski coefficient, $r = -0.723$, $p < 0.0001$ Between liquidity and the Zmijewski coefficient there is the medium negative correlation, $r = -0.348$, $p > 0.0001$.

CONCLUSION

The paper is based on the comparison of the Altman and Zmijewski models, applied to companies in Serbia. The sample consists of 53 companies that have filed for bankruptcy and 106 non-bankruptcy companies. On the basis of the average accuracy of the models applied to the total sample, a slight advantage is given to the Zmijewski model, which predicted bankruptcy of the analyzed companies with 89.62% accuracy. High predictive power of the model is consistent with the research conducted by Pavlović et al. (2012) in Serbian companies. At the same time, the average accuracy of the Altman model is 85.22% on a sample of 159 companies over the period 2011-2013.

The observed models use different indicators for predicting bankruptcy. Correlation analysis was used to determine the bond strength between the individual ratios and model results. Two years before the onset of bankruptcy, liquidity and profitability of total assets, independent of financing and tax costs, recorded a strong positive correlation with the Altman Z" score. One year before the initiation of bankruptcy, nearly perfect positive correlation between the ratio of working capital to total assets and the Z" score was recorded. This observation is consistent with the economic statistics that confirms that companies more often go bankrupt due to illiquidity than because of losses (Rodić et al., 2007, p. 285).

When it comes to the Zmijewski model, two years before the bankruptcy proceedings, companies recorded a problem with the return on assets, there being almost perfect negative correlation between return on assets and the Zmijewski coefficient. The following year (one year before bankruptcy), indebtedness of companies in Serbia pointed to a strong positive correlation with the Zmijewski coefficient.

Looking at both models, it can be concluded that companies in Serbia have had problems with liquidity, indebtedness, and the inability of return on investment, which contributed to poor financial condition and bankruptcy proceedings. Using the Altman and Zmijewski models, it is possible to predict financial distress in the company and bankruptcy with high accuracy. The research restriction comes from the models used. Bankruptcy prediction is carried out on the basis of financial statements, and the research results depend on the quality and reliability of those statements. Future research will be devoted to the use of contemporary models for predicting bankruptcy, such as neural networks and decision-making trees.

REFERENCES

Altman, E. I. (1968). Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy. Journal of Finance, 23, 589-609.

Altman, E.I. (1983). Corporate Financial Distress, New York, Wiley InterScience

Altman, E.I., Hartzell, J. & Peck, M. (1995). Emerging Markets Corporate Bonds: A Scoring System, Salomon Brothers Inc. New York.

Andrić, M. & Vuković, B. (2012). Reflections of the Crisis on the Corporate Operational Performance of Serbian Industrial Companies. Strategic management, 17(3), 21-28.

Bankruptcy Supervision Agency. (2015). Statistics bankruptcy procedures. Retrieved from http://alsu.gov.rs/statistika-stecajnih-postupaka/

Beaver, W. H (1966). Financial Ratios as Predictors of Failure. Journal of Accounting Research 4, 71-111.

Beaver, W.H., McNichols, M.F. & Rhie, J. (2005). Have financial statements become less informative? Evidence from the ability of financial ratios to predict bankruptcy. Review of Accounting Studies, 10, 93-122.

Black, F. & M. Scholes (1973). The Pricing of Options and Corporate Liabilities. Journal of Political Economy, 81, 637-659.

Boritz, J., Kennedy, D. & Sun, J. (2007). Predicting business failures in Canada. Accounting Perspectives, 6, 141-165.

Business Registers Agency. (2015). Business entities search. Retrieved from http://www.apr.gov.rs/

Cohen, J.W. (1998). Statistical power analysis for the behavioral sciences (2nd edition). Hillsdale, NJ: Lawerence Erlbaum Associates.

Filipović, L. & Mirjanić, B. (2016). Finansijska analiza i ocean kreditnog boniteta privrednog društva – studija slučaja "Aleva ad Novi Kneževac". Ekonomija – teorija i praksa. 9(3),16-31.

Grice, J. S., & R. W. Ingram. (2001). Tests of the generaiizability of Altman's bankruptcy prediction model. Journal of Business Research 54 (1), 53-61.

Grice, J. & Dugan, M. (2003). Re-estimations of the Zmijewski and Ohlson bankruptcy prediction models. Adv. Account. 20, 77–93.

Grice, J. & Dugan, M. (2001). The limitations of bankruptcy predictionmodels: some cautions for the researcher. Rev. Quant. Finan. Acc. 17 (2), 151–166.

Hillegeist, S. A., Keating, E. K., Cram, D. P., & Lundstedt, K. G. (2004). Assessing the probability of bankruptcy. Review of accounting studies, 9(1), 5-34.

Kumar, R. G., & Kumar, K. (2012). A comparison of bankruptcy models. International Journal of Marketing, Financial Services and Management Research, 1(4). 76-86.

Lawson, R. (2008). Measuring company quality. The Journal of Investing,17(4), 38-55.

Lin, T. H. (2009). A cross model study of corporate financial distress prediction in Taiwan: Multiple discriminant analysis, logit, probit and neural networks models. Neurocomputing, 72(16), 3507-3516.

Merton, R. C. (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. Journal of Finance, 28, 449-470.

Muminović. S., Pavlović, V. & Cvijanović, J. (2011). Predictive Ability of Various Bankruptcy Prediction Z-Score Models for Serbian Publicly Listed Companies. Industrija. 39(3), 1-12.

Ohlson, J. (1980). Financial Ratios and the Probabilistic Prediction of Bankruptcy. Journal of Accounting Research, 19, 109-131.

Paquette, L. R., & Skender, C. J. (1996). Using a bankruptcy model in the auditing course: The evaluation of a company as a going concern. Journal of Accounting Education, 14(3), 319-329.
Pavlović, V., Muminović, S., & Cvijanović, J. M. (2012). Adequateness of applying the Zmijewski model on Serbian companies. Industrija, 40(4), 25-39.
Pitrova, K.. (2011). Possibilities of the Altman ZETA Model application to Czech firms. E+ M Ekonomie a Management, 201(1), 66-75.
Reisz, A., & Purlich, C., (2007). A market-based framework for bankruptcy prediction. Journal of Financial Stability, 3(2), 85–131.
Rodić, J., Vukelić, G. & Andrić, M., (2007). Teorija politika i analiza bilansa, Poljoprivredni fakultet Univerziteta u Beogradu, Beograd.
Samkin, G., Low, M., & Adams, T. (2012). The use of Z-scores to predict finance company collapses: a research note. New Zealand Journal of Applied Business Research, 10(2), 69-82.
Shumway, T. (2001). Forecasting Bankruptcy More Accurately: A Simple Hazard Model. Journal of Business, 74, 101-124.
Stanišić, N., Mizdraković, V. & Knežević, G. (2013). Corporate Bankruptcy Prediction in the Republic of Serbia. Industrija. 41(4), 145-159.
Waqas, H., Nasir, H., & Umair, A. (2014). Zmijewski financial distress prediction model and its predictability, A case of Karachi stock exchange. Journal of Basic and Applied Scientific Research, 4(4), 155-163.
Zlatanović, D., Bugarin, M., Milisavljević, V. & Zlatanović, V. (2016). Forecasting the financial distress of mining companies: Tool for testing the key performance indicators. Mining and Metallurgy Engineering Bor, 1, 73-80.
Zmijewski, M. E. (1984). Methodological Issues Related to the Estimation of Financial Distress Prediction Models. Journal of Accounting Research, 22, 59-82.

ПОРЕЂЕЊЕ МОДЕЛА ЗА ПРЕДВИЂАЊЕ СТЕЧАЈА НА УЗОРКУ СРПСКИХ ПРЕДУЗЕЋА

Сања Влаовић Беговић[1], Љиљана Бонић[2], Слободанка Јовин[1]
[1]Висока пословна школа струковних студија, Нови Сад, Србија
[2]Универзитет у Нишу, Економски факултет, Ниш, Србија

Резиме

Правовременим уочавањем пословних потешкоћа које проузрокују отварање стечаја могу се избећи губици. Због важности саме проблематике, предвиђање стечаја и примена модела који мере пословни успех у функцији покретања стечаја представља неисцрпну тему. Испитивање оригинално изграђених модела на специфична тржишта доноси закључке о томе да ли поједине моделе треба користити и који модели боље предвиђају покретање стечајног поступка.

У овом раду поређене су моћи предвиђања Алтмановог модела, изграђеног на основу мултидискриминационе анализе, и модела Змијевског, изграђеног на основу пробит-анализе. Алтманов Z" скор предузеће класификује у једну од три групе, и то, ако је Z" скор већи од 2,6, предузеће се сматра финансијски успешно; предузеће које послује у сивој зони има Z" скор у интервалу од 2,59 од 1,11, док финансијски неуспешно предузеће има Z" скор мањи од 1,10. Модел

Змијевског испитивањем повратa уложених средстава, финансијског левериџа и ликвидности утврђује вероватноћу покретања стечајног поступка. Када је добијена вероватноћа већа од 0,5, предузеће има велике шансе да у наредном периоду донесе одлуку о покретању стечајног поступка.

На основу 53 предузећа која су покренула стечајни поступак и 106 предузећа која нису покренула стечај, извршена је анализа предвиђања покретања стечајног поступка за две узастопне године. Анализирана предузећа се класификују као средња или велика. Примена Алтмановог Z'' скора на предузећа која су покренула стечајни поступак показује тачност предвиђања за једну годину пре стечаја од 88,68%, односно 79,25% за две године пре стечаја. Модел Змијевског показао је нешто прецизније предвиђање када је реч о једној години пре стечаја од 90,57%. За две године пре стечаја тачност Змијевски модела иста је као и код Алтмановог модела (79,25%). Примена Алтмановог модела на предузећа која нису у стечају показује да је тачност модела нижа у односу на предузећа у стечају, и то Z'' скор показује погоршање финансијског положаја испитиваних предузећа у 2013. години у односу на 2012. годину. У односу на Алтманов, модел Змијевског мањи број предузећа сврстава у групу предузећа са већом вероватноћом наступања стечаја, те самим тим модел има и већу тачност. Посматрајући укупан узорак, просечна тачност Алтмановог Z'' скор модела износи 85,22% за период 2011–2013. године, док модел Змијевског показује већу просечну тачност од 89,62%.

Анализом значајности утицаја појединих коефицијената на коначан резултат модела изводи се закључак да су предузећа у Србији имала проблем са ликвидношћу, задуженошћу и немогућношћу повраћаја уложених средстава, што је допринело лошем финансијском стању и покретању стечајног поступка. Иако оба испитивана модела показују високу тачност предвиђања стечаја, аутори благу предност дају коришћењу модела Змијевског.