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REASSESSMENT OF CORPORATE BANKRUPTCY PREDICTION MODELS EFFICIENCY: EVIDENCE FROM SERBIA

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Abstract

Having in mind various negative influences that corporate bankruptcy has on the economy of the Republic of Serbia, corporate bankruptcy prediction is of extreme importance. Therefore, the basic motive for writing this paper was an attempt to assess the possibility of forecasting bankruptcy of business entities which operate on the Republic of Serbia's market. We have calculated the already formed M-score, formed based on the data from the financial statements of Serbian business entities. As a comparison models, we have calculated the two most acknowledged Z-score models. The randomly chosen sample consisted of 35 entities in bankruptcy and the same number of non-bankrupt entities. The goal of the research was to reassess the relevance of the tested models for a longer period, as well as their precision in the corporate bankruptcy prediction in an unstable economic environment of the Republic of Serbia. According to the results, the conclusion is that the tested M-score proved its precision in bankruptcy prediction in Serbia, and its use is, therefore, recommended. On the other hand, the Altman's Z-score models do not have statistical relevance and hence we recommend that their use for bankruptcy prediction in the Republic of Serbia should be with caution.

Key words: corporate bankruptcy prediction, financial indicators, Altman Z-score.

ПОНОВНА ПРОЦЕНА ПРОГНОСТИЧКЕ МОЋИ МОДЕЛА ЗА ПРЕДВИЂАЊЕ СТЕЧАЈА У РЕПУБЛИЦИ СРБИЈИ

Апстракт

Имајући у виду разноврсне негативне утицаје које на привреду Републике Србије имају привредна друштва у стечају, предвиђање одласка у стечај привредних друштава од изузетне је важности. Стога, основни мотив за писање овог рада био је покушај оцењивања способности предвиђања стечајног поступка на привредним

друштвима која послују на тржишту Републике Србије. На случајно одабраном узорку од 35 привредних друштава у стечају и истог броја „здравих" привредних друштава, израчунали смо већ формирани M-резултат, који је прилагођен тржишту Републике Србије и два најпознатија Z-резултат модела. Циљ истраживања био је провера релевантности поменутих модела у дужем временском року, као и нивоа прецизности предвиђања стечаја у нестабилном привредном окружењу Републике Србије. На основу добијених резултата, изведен је закључак да је тестирани M-резултат модел потврдио своју релевантност за предвиђање отварања стечајног поступка на подручју Републике Србије, па се његова употреба препоручује. Са друге стране, Алтманови Z-резултат модели нису у довољној мери прецизни, па се саветује опрезност при њиховој употреби.

Кључне речи: предвиђање стечајног поступка, финансијски показатељи, Алтманов Z-резултат.

INTRODUCTION

Although it has been quite a while since the world economies felt the first impacts of the global economic crisis, corporate bankruptcy figures show that the crisis has not loosened its grip on the economies of European countries[1]. This relates to the situation in the Republic of Serbia, as well, considering that in 2012 the highest bankruptcy rate was noted at almost 8% (Coface, 2013). This rate was even higher in 2011, around 15%, which could make Serbia the country with the highest bankruptcy rate of all central European countries in the observed years. Among other factors that undoubtedly influenced the number of bankruptcy proceeding filings[2]; insolvency, indebtedness and unprofitability are, at least partly, one of the reasons for increase in number of bankruptcy proceedings being filed in the previous years. Therefore, it is very important to focus on the financial indicators which could be a sign of a weakened financial situation and possible bankruptcy of a business entity. In that manner, the bankruptcy procedure could be initiated in time and thus the likelihood that entity will continue to exist will increase. It is estimated that only every tenth debtor in the Republic of Serbia submits a reorganization

[1] On the contrary, at the moment, the number of bankrupt companies rises not only in Europe, but in the US, as well. In the first quarter of 2015, the number of corporate bankruptcy filings has risen to the highest level in the last five years (Hals, 2015).

[2] It would be a complex task to determine the exact impact of the global economic crisis on the increase of bankruptcy filings in the Republic of Serbia. This is especially true if we have in mind the specificities of Serbian economy. According to the public data of the Bankruptcy Supervision Agency of the Republic of Serbia in the period from the year 1995 to 2008, an insignificant number of bankruptcy proceedings was opened in the commercial courts - only 1,214 (Bankruptcy Supervision Agency, 2015). However, by the year 2014, that number has multiplied exponentially (4,030 total), which can be ascribed to the influence of the economic crisis and unsuccessful business operations.

plan, which is later adopted at the meeting of creditors (Mizdrakovic, 2012). In order for the bankruptcy debtor to be able to reinvest, reorganize its debts and continue its business, it is necessary to predict and file for bankruptcy in time. The main purpose of that process is to reimburse all debts to bankruptcy creditors, minimizing, at the same time, the cost of the procedure. That is not possible if the bankruptcy proceeding is not predicted and opened at the exact moment when the bankruptcy estate is on a level which enables the fulfillment of the basic goals of such a procedure. Therefore, the use of precise corporate bankruptcy prediction models is of great importance in the current market conditions[3]. The goal of this paper is to reassess the accuracy of the already existing corporate bankruptcy models on an independent sample consisting of the Serbian bankrupt business entities, as well as the entities in good financial situation. The paper's contribution lies in the research results, which will provide us the evidence on whether the use of the chosen models is acceptable for corporate bankruptcy prediction in the Serbian market. Namely, most of the corporate bankruptcy prediction models are based on the financial statements of the business entities which operate in developed markets, so their application to the Serbian market cannot be automatically considered as appropriate. Due to the lack of Serbian literature on this subject, and the fact that a similar research, at least to our knowledge, has not been conducted in the Republic of Serbia in such manner, we believe that this paper will contribute in that field. The paper is structured in the following way: in the first part, we shall address the prolific literature from the area of corporate bankruptcy prediction; especially the most frequently used corporate bankruptcy prediction models. The second part deals with the methodology of the research sample choice and the methods applied in the research. The last part of the paper presents the research results and suggests further directions for model development.

LITERATURE REVIEW

Studies related to the bankruptcy prediction models can be divided into two groups, those that used univariate and those that used multivariate analysis. The first group of studies predicted the corporate bankruptcy by analyzing the values of individual financial indicators. The first research of this kind was done back in 1930 by the Bureau of Business Research (BRR). This and the subsequent research (among others (FitzPatrick, 1932), (Smith & Winakor, 1935), (Merwin, 1942), (Jackendoff, 1962)), which were conducted in a similar manner from 1930 to 1965, indicated the individual predicting power of the following indicators: (Net) Working Capital to Total

[3] The assumed probability of bankruptcy proceedings filings can serve as a good instrument in a company's management during a crisis, in favor of an increased success rate of an eventual business turnover.

Assets and Current Ratio (Bellovary, Giacomino, & Akers, 2007). In 1965, Professor Beaver (1966) concluded that simultaneous analysis of multiple financial indicators can increase the predictive power of bankruptcy proceedings, which was the starting point for the "new era" in this field (Beaver, 1966). Likewise, Beaver was one of the first who introduced statistic models in the assessment of business entities' financial position. Therefore, he is one of the most prominent authors who contributed to this field.

Edward Altman was the first author who conducted research based on a combined effect of multivariate analysis in 1968. He was the first that used a sample of 66 active business entities[4] and determined a set of indicators, actually 5, which he named "Z-score". This model accomplished an excellent 95% accuracy in forecasting the corporate bankruptcy a year before it would be opened, and 72% for a period of two years before the bankruptcy (Altman , 1968)[5]. Some time later, Altman and other authors in published studies introduced two new versions of the original model. They were named Z-score for private companies and Z"-score for industrial companies and companies which operate on developing markets.

$$Z' = .717X1 + .847X2 + 3.107X3 + .420X4 + .998X5 \quad (1)$$

$$Z'' = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4 \quad (2)$$

Where Xn represents the following:
*X*1 – Working Capital to Total Assets,
*X*2 – Retained Earnings to Total Assets,
*X*3 – Earnings before Interest and Taxes to Total Assets,
*X*4 – Book Value of Equity to Total Liabilities And
*X*5 – Sales to Total Assets.

From 1965 to this day, over 165 studies of this kind have been conducted, but still, Altman's original Z-score model (and its variants) remains dominant in forecasting corporate bankruptcy in the USA, and in other states as well. However, it can be assumed that in the case of a repeated test of the accuracy of these bankruptcy prediction models, their precision would most likely not be the same as in the original research. The main reasons would be: the characteristics of the model, the timeframe for which the research is performed, as well as the characteristics of the sample entities and the markets on which they operate.

For example, in one research conducted on companies from the USA in period 1962-1999, the authors noted the impressive forecasting

[4] The sample is divided into two parts, 33 "healthy" and 33 companies in bankruptcy.
[5] The accuracy of prediction refers to the sample on which Altman based his model while the test sample accuracy had a result of 79%. As it will be shown in the part with the research results, the accuracy of the company samples from Serbia was around 72%.

performance of Shumway's model as opposed to Altman and Zmijevski (Chava & Jarrow, 2004)[6]. However, when business entities from developing markets are the object of research, the Z-score model has shown good results. In the research performed on the data of public companies which operate in Sri Lanka, the accuracy of Altman's model one year before bankruptcy is quite solid at 75%, 63% and 81% for the original formula and Z' and Z", respectively (Samarakoon & Hasan, 2003). However, for a period of two years before the opening of the procedure, the accuracy of the model drops considerably, and it is the highest for the Z"-score at 68%. A recent study which included 82 public companies from Colombo Stock Exchange from Sri Lanka, for the period 2008-2012, shows similar results, where Altman's Z and Z" have fewer Type I mistakes, as opposed to the Solvency Test and the Springate model (Gunathilaka, 2014).

Likewise, Altman et al. conducted research which measured the reliability of bankruptcy prediction probability of companies from Italy (Altman, Danovi, & Falini, 2013). The research included 52 production companies, part of which started the process of reorganization in the period 2000-2010. The authors concluded that the implementation of the Z"-score model[7] for the purpose of bankruptcy prediction of production companies from Italy is reasonable if the balance sheet figures were not manipulated and under other assumptions. Altman and a group of authors, in a currently unpublished paper, have analyzed the performance of the Z"-score model in 32 European and 2 states outside Europe (Altman, Iwanicz-Drozdowska, Laitinen, & Suvas, 2014). The results showed that the accuracy of the model differs according to the state in which it has been used. On average, the model is 75% accurate in some markets while in others even higher than 90%. However, in some states, models formed in those markets have the highest accuracy (Altman, Iwanicz-Drozdowska, Laitinen, & Suvas, 2014). The authors described that the models formed on the tested market have an advantage, because they include financial indicators which are specific to those markets[8].

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[6] It should be noted that Shumway model belongs to the hazard models, as opposed to the accounting-based models, such as Altman and Zmijewski. Authors mentioned here and other authors claim that hazard models have an advantage in bankruptcy prediction in comparison with the traditional accounting-based models (Bauer & Agarwal, 2014). The fact that the hazard models include market indicators is their biggest flaw in their implementation. The former is specifically true for the Serbian market, having in mind that public companies make only 0.04% of the total number of companies.

[7] This is Altman's Z-score model which is intended for industrial companies and companies which operate on developing markets. Having in mind that the Serbian market is in growth, in this research we shall use the mentioned corporate bankruptcy prediction model.

[8] Even though the mentioned research included the Republic of Serbia (accuracy of 74%), it should be noted that the data used for Serbia was used only in the test sample, because there were not enough observations. Therefore, the results should be taken with caution.

Our intention in this paper is to compare the accuracy of Altman's bankruptcy prediction model for developing markets with a model which is formed on such a market. Biandyopadhyay (2006) had the same idea when he compared the accuracy of bankruptcy prediction models, which he derived analyzing 104 public companies from India. He discovered that the accuracy of the newly formed model, on a hold-out sample for a period of two years before bankruptcy proceedings, is around 68%, whereas Altman's model had a result of slightly over 50% (Bandyopadhyay, 2006).

We will now provide the insight into the studies related to the validity of the implementation of bankruptcy prediction models in the Republic of Serbia. In the research conducted by Muminović, Pavlović & Cvijanović (2011), which included public companies listed on the stock indices Belex and Belexline. The results showed that with certain limitations, the original Z-score, Z'-score and Z"-score models are not reliable when used for bankruptcy prediction in the Republic of Serbia. The authors pointed out that the model intended for private companies showed much better results when compared to the other two models, but nevertheless, the accuracy was not satisfying (Muminović, Pavlović, & Cvijanović, 2011). The same was confirmed by recent research, which was primarily focused on the process of revaluation and its effect on Altman's Z-score (Muminović, 2013). The already mentioned authors also tested Taffler's bankruptcy prediction model and came to the same conclusion: that the model is not applicable for bankruptcy prediction in the Republic of Serbia. The sample included 62 companies from the mentioned stock indices and the data was related to the companies which filed for bankruptcy during 2009 and 2010 (Pavlović, Muminović, & Cvijanović, 2011).

There is also the BEX (Business Excellence) index which is used to measure a company‘s financial performance and possible gains and losses measured by investor‘s multiplier and industry‘s risk ratings (Belak & Alijanović-Barać, 2008). The model is developed on Croatian publicly owned companies. The group of authors from Serbia tested the relevance of this model on the public companies from the Republic of Serbia. The linear regression analysis of BEX index results in the 2008-2010 period and net income in euros earned by Serbian entities indicated that there was a moderate relationship between the BEX index in 2008 and net income in 2010, as well as between BEX 2010 and net income in 2012 (Knežević, Stanišić, & Mizdraković, 2014). Therefore, authors concluded that the BEX index is not suitable as a good measure of performance valuation to be used in the Serbian market.

It can be noticed that the models whose accuracy was assessed in the mentioned research in the Republic of Serbia were not derived from data from that market. To our knowledge, however, there is only one model which was formed on the data of such companies. Namely, in research conducted by Stanišić, Mizdraković & Knežević (2013) on a sample of 232

entities, whose results were presented in a paper called: "Corporate Bankruptcy Prediction in the Republic of Serbia", a bankruptcy prediction model was derived for business entities which operate on Serbian market. Out of 43 financial indicators, using logistic regression method, the following formula for bankruptcy prediction was formulated (Stanišić, Mizdraković & Knežević, 2013):

$$M = -.00039\,X1 + .003786\,X2 + .997167\,X3 - 1.900213\,X4 \qquad (3)$$

Where Xn represents the following:
*X*1 – EBITDA
*X*2 – Number of employees
*X*3 – Debt ratio
*X*4 – Sales to total assets.

In the mentioned study, the authors noted that the newly formed model provides the same, or at least, better results in bankruptcy prediction when compared to Altman's Z-score models. The authors conclude that both variants of Altman's original model (Z' and Z") are acceptable for corporate bankruptcy prediction in Serbia.

Except for the last one, the above-mentioned research may suggest that applying the models to time periods and industries other than those used to develop the models may result in a significant decline in the models' accuracies (Muminović, 2013). Yet in most cases, the usage of Altman's variants of the original formula is acceptable and gives good results all over the world. Therefore, in this paper, we shall test the accuracy of bankruptcy prediction of the M-model, formed for the Serbian market, as the only one of its kind, and the Z' and Z"-score models, which have been proven as applicable for implementation on developing markets. What distinguishes this research is the reassessment of a corporate bankruptcy prediction model formed on the market on which its accuracy is being tested, as well as other models intended for usage on markets which are similar to the tested one in its characteristics.

At the end of the literature review section, we would like to note that the method called Discriminant Analysis was mostly used in similar studies for the classification of entities into bankrupt and non-bankrupt ones[9]. The main advantage of this method over ANN is the understanding of the contribution of every variable in bankruptcy predicting. Discriminant Analysis (Logistic Regression) indicates which financial indicators have

[9] This method was the most common in studies performed in this field up to the year 2007. But if we look only at the period 1990-2007, almost half of the studies used the Neural Networks method - Artifical Neural Networks (ANN) (Bellovary, Giacomino, & Akers, 2007). The same authors point out that this method is also the most accurate one in bankruptcy prediction.

more significance in bankruptcy predicting, as opposed to ANN, where the procedure of determination of bankruptcy occurrence probability and classification of entities as sound and bankrupted ones is less prominent (Stanišić, Mizdraković & Knežević, 2013). Likewise, one of the most recent methods is the spline model which improves the predictive power when introducing spline functions to take account of highly nonlinear relationships between firm failure and leverage, earnings, and liquidity in a logistic bankruptcy model (Giordani, Jacobson, Schedvin, & Villani, 2014).

RESEARCH METHODOLOGY

This research required financial statements of the bankrupt and non-bankrupt entities, so that, on the basis of the calculated financial indicators and the models used, we could classify the sample entities into these two groups. The data about the entities in bankruptcy were obtained from the Bankruptcy Supervision Agency of the Republic of Serbia. Namely, from January 1 to December 31, 2012, total of 2.410 corporate bankruptcy proceedings were filed, qualifying those proceedings for our research sample. However, only 35 of them had complete financial statements for the three reporting periods before bankruptcy available to the public on the internet site of Serbian Business Registry Agency. The remaining number of legal entities included small legal entities or entrepreneurs (now micro-legal entities), which at that moment did not have the obligation of preparation of complete set of financial statements (Balance Sheet, Income Statement, Statement of Cash Flows, Statement Of Changes in Equity and Notes). The sample for the models whose accuracy we are testing in this paper, the M-score and the Z' and Z"-score models, was also formed based on medium and large legal entities, while the small ones were not included, for the already mentioned reason. The non-bankrupt entities (35 of them) for our research were randomly chosen out of the total number of large and medium legal entities which operated in the Republic of Serbia in the year 2012. This sample did not include financial institutions, banks, and insurance companies since they have different business regulations and different bankruptcy proceeding process.

Financial statements for last three reporting periods were acquired for the sample entities. Based on the date of the bankruptcy proceedings filing, a set of financial statements corresponding to the period of two years prior to the proceedings was chosen for each entity. That was done because the goal of the research was to reassess the accuracy of bankruptcy prediction models in a period of two years before the bankruptcy proceedings, which is, after all, their original purpose. The M-score and all versions of Z-score refer to the period of two years before the bankruptcy.

Table 1. Entities included in training and test sample split per their core activities

Industry	Bankrupt	Non-bankrupt	Total	Percentage
Agricultural production	4	3	7	10.00%
Food production	7	1	8	11.43%
Drink production	1	0	1	1.43%
Textile production	0	1	1	1.43%
Wood processing and wood products	0	1	1	1.43%
The production of coke and refined petroleum products	0	1	1	1.43%
The production of chemicals and chemical products	1	1	2	2.86%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	2	0	2	2.86%
Rubber and plastic products production	1	0	1	1.43%
Manufacture of other non-metallic minerals	2	2	4	5.71%
Basic metals production	1	0	1	1.43%
Fabricated metal products, except machinery and equipment	1	3	4	5.71%
Electrical equipment production	1	1	2	2.86%
Manufacture of motor vehicles, trailers, and semi-trailers	2	0	2	2.86%
Transport equipment production	1	0	1	1.43%
Furniture production	1	2	3	4.29%
Electricity, gas, steam and air conditioning supply	0	1	1	1.43%
Waste collection, treatment and disposal activities; materials recovery	0	1	1	1.43%
Construction of buildings	3	0	3	4.29%
Construction of other buildings	2	2	4	5.71%
Specialized construction activities	1	2	3	4.29%
Wholesale and retail trade and repair of motor vehicles and motorcycles	1	0	1	1.43%
Wholesale, except of motor vehicles and motorcycles	0	5	5	7.14%
Retail trade, except of motor vehicles and motorcycles	0	3	3	4.29%
Land transport and transport via pipelines	0	1	1	1.43%
Accommodation	0	1	1	1.43%
The activity of preparing and serving food and drinks	0	1	1	1.43%
Publishing activities	1	0	1	1.43%
Holding companies' activities	2	1	3	4.29%
Scientific research and development	0	1	1	1.43%
Total	35	35	70	100.00%

Source: Authors' data

The next step was to calculate the values for the tested bankruptcy prediction models. Prior to that, however, the value of the balance sheet items was converted into euros, a currency more stable than the reporting (national) currency. The financial ratios were mostly calculated based on the financial statements for the reporting period of 2010. Having calculated the absolute values of the M-score and Z' and Z"-score models, with the purpose of distinguishing non-bankrupt entities from those in bankruptcy, we also calculated the implied bankruptcy probability of the sampled entities. We assumed that the prediction model recognized entities as bankrupt if they had the implied probability higher than 50%.

RESEARCH RESULTS AND DISCUSSION

By using the bankruptcy prediction model, two kinds of mistakes can arise. Namely, the model may classify a healthy entity as a company in bankruptcy, which would be a Type I error. As for the creditors and the stakeholders of the business entity, the damage caused by the Type I error would lead to the respective entity not establishing cooperation with financial institutions or other stakeholders (unapproved loans, the value of goods or products, which would not be realized, etc.). On the other hand, if a model recognized bankrupt entity as a healthy one, it would lead to a Type II error. Damage caused due to incorrect classification would be "more expensive" in comparison to the Type I error, since the creditor or investor would lose the invested capital. The best model would be the one which would not make Type I and II errors; however, a model can be either specific (the participation of healthy entities which are classified that way) or sensitive (the participation of entities which are in bankruptcy and are classified that way). It should be noted that the accuracy of the model is influenced by the frequency of the observed phenomena, and not only by its characteristics. In the table that follows, we have shown the accuracy of the tested models from the aspect of the error type which they made classifying the entities into those in bankruptcy and those which are not. The observed period is two years before the entities filed for bankruptcy.

Table 2. Precision of tested models two years before the bankruptcy

Error	M-score	%	Z'-score	%	Z"-score	%
Type I	12	34.29%	4	11.43%	10	28.57%
Type II	6	17.14%	23	65.71%	20	57.14%
Total	18	25.71%	27	38.57%	30	42.86%

Source: Authors' data

It can be noticed that Altman's Z-score models make more Type II errors whereas, with the Serbia-based model, the situation is opposite. That would mean that the M-score recognizes bankruptcy in entities which are

officially not in bankruptcy. This may be a good basis for further research. Namely, considering the fact that a great number of entities in the Republic of Serbia actively operate with very bad results and negative capital, the model is expected to recognize, among the seemingly healthy entities, those, which, in reality, should be bankrupt. On the other hand, Altman's models do not recognize the poor state of the entities which are officially in bankruptcy and consider them as healthy ones. The explanation for this type of error could be the fact that the second Altman's model was based on entities in developing countries, so it is more cautious when evaluating the poorer results of Serbian entities. Finally, there are always present problems of modern financial reporting which have disrupted the relationship between the important qualitative characteristics of accounting information and has violated some of the fundamental accounting principles, such as usage of fair value accounting (Todorović & Pantelić, 2014).

The calculated data was processed in the statistical software package, SPSS, and the results will be shown graphically and by table. In order to check the applicability of the mentioned methods, we have shown them by the ROC (Recovery Operating Characteristic) curve. This curve shows the ability of a method to notice the observed phenomena, in our case, the fact that observed entity is in bankruptcy. The surface below the ROC curve, or the AUC (The Area under the Curve), often called the concordance index, can be used to evaluate the accuracy of the tested model. Using the ROC curve, we provide a graphic representation of the level of likelihood that the tested model may arbitrarily show whether the observed phenomenon exists or not. Likewise, by using this tool we can compare the models being tested and in that way facilitate the choice between them. The reference line is set at an angle of 45 degrees and all the curves above the reference line are considered relevant for phenomenon prediction. If all the curves are below the reference line, the models have the same possibility of arbitrary prediction. In the graph No. 1 we have shown the ROC curves for the tested models.

Observing the figure above we can notice that the three formulas applied to the test sample have led to the curves forming above the reference line. The further away the curve is from the reference line, the more accurate the prediction model is. As seen in the graphic, the formed M-score model is the furthest from the reference line, and can thus be considered the most accurate for the tested sample.

All the methods applied in the research are much better at classifying the business entities into the mentioned groups than a random classification. The table above shows the results of model comparison, where, as with the already shown graph of the ROC curve, it can be noticed that the M-score takes about 75% of the surface, followed by the

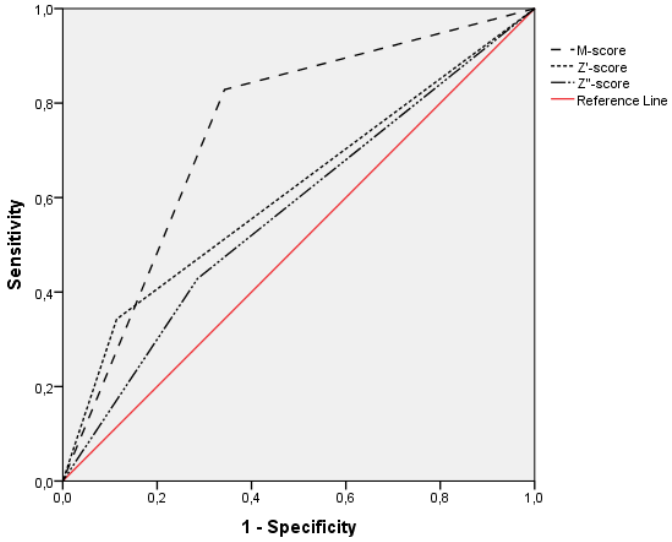

Figure 1. Precision of the tested models on the ROC curve

Table 3. Area under the curve for the tested models

Tested Models	Area	Std. Error	Asymptotic Significance	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
M-score	0.743	0.061	0.000	0.624	0.862
Z'-score	0.614	0.068	0.100	0.482	0.747
Z''-score	0.571	0.069	0.304	0.437	0.706

Source: Authors' data

Z'-score at 61.4% and the last is the Z"-score with approximately 57%[10]. Depending on the characteristics of the sample, the accuracy of the M-score model varies from 62.4% to 86.2%. This suggests that in the repeated research, or by using the model in practice, this model would be accurate in that range. The table above also shows that the M-score is the only one which is statistically relevant, with a value below 0.05, whereas other models are below that threshold.

[10] If we were to add up the mentioned percent to the total error percentage from table 2, we would get 100%.

CONCLUDING REMARKS

The accuracy of the bankruptcy prediction models is of great importance for their further use in practice. Namely, the accuracy of a model will depend on the specificity of the sample on which it was derived. Therefore, it might happen that the model is over-fitted, which will result in a poorer accuracy in further use. In this paper, we collected financial statements of 70 entities for the corresponding periods, out of which half were in bankruptcy. We wanted to test the accuracy of Altman's Z' and Z"-score models and the M-score model which was formed on the entities from Serbia. Even though Altman's second model was intended for developing markets, such is Serbian; it was still expected for the M-score to have better accuracy. The results of the research show that the usage of the M-score model is acceptable since it had statistical significance and the accuracy degree of 74.3%. Altman's models, as the previous studies from the Republic of Serbia previously discussed in this paper, are not statistically relevant. Therefore, their usage is questionable. Nevertheless, it is important to note that the Z'-score had better accuracy results than the other model and that in further usage its accuracy would be from 48.2 to 74.7 percent. By comparing the results of this research with the original research in which the M-score was formed, we can notice that the accuracy of the model decreased from 80% to 74% but also that the accuracy of Altman's models drastically decreased as well, and in the mentioned research they did have statistical relevance (Stanišić, Mizdraković, & Knežević, 2013). The results of this research should be taken with caution, having in mind that the financial statements which were used were for the year 2010 (because for most of the bankrupt entities the proceedings were opened in 2012) and that in that year the entities of the Republic of Serbia had poorer results due to the economic crisis and a generally weaker state of the economy. Likewise, we should have in mind that the results of the research would be different had the sample of entities been larger. Also, the sampled entities originate from different industries which have certain specificities and characteristics. Therefore, it would be interesting to assess the prediction quality of the tested models on the entities from single or akin industries, like tourism or tourism and hospitality. The greatest obstacle in forming models for certain industries is the lack of information on bankrupt entities. Namely, financial statements of at least 30 bankrupt entities are needed for the training sample and an additional number for the test sample. However, by increasing the research time frame this problem could be circumvented and new models, suitable for certain industries, could be formed.

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ПОНОВНА ПРОЦЕНА ПРОГНОСТИЧКЕ МОЋИ МОДЕЛА ЗА ПРЕДВИЂАЊЕ СТЕЧАЈА У РЕПУБЛИЦИ СРБИЈИ

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Резиме

Стабилан и здрав развој привреде једне државе не може се замислити без стечаја привредних друштава. Тим поступком, уколико се спроведе у одговарајућем моменту, врши се ослобађање уложеног капитала и његова редистрибуција ка привредним друштвима која имају бољу пословну и финансијску стратегију. Међутим, стечајни поступак може изазвати високе трошкове и имати негативне последице по финансијски сектор. Стога је пожељно да управе привредних друштава редовно процењују изложеност стечајном ризику и да правовремено стратешким одлукама утичу на његово смањење. Предвиђање стечајног поступка помоћу финансијских показатеља има богату историју и постоји велики број модела који их користе. У овом раду смо покушали да на подацима о привредним друштвима из Републике Србије оценимо способност предвиђања стечајног поступка коју имају такви модели. Најпознатији модели за предвиђање стечајног поступка јесу модели професора Едварда Алтмана. На случајно одабраном узорку од 35 привредних друштава у стечају и истог броја „здравих" привредних друштава израчунали смо већ формирани М-резултат, који је прилагођен тржишту Републике Србије, и два

Алтманова Z-резултат модела. Циљ истраживања јесте провера релевантности поменутих модела у дужем временском року, као и ниво прецизности предвиђања стечаја у разноликом привредном окружењу Републике Србије. На основу добијених резултата, односно утврђене статистичке значајности, изведен је закључак да тестирани M-резултат јесте релевантан за предвиђање отварања стечајног поступка. Из претходног закључујемо да је предвиђање стечајног поступка у Републици Србији релативно поуздано и поред нестабилног тржишног окружења. Међутим, Z-резултат модели нису показали тај степен прецизности, већ не поседују статистичку значајност у предвиђању стечаја. Ипак, прецизност M-резултат модела не изненађује (може се рећи да је очекивана била и већа), имајућу у виду да је модел формиран на подацима о пословању привредних друштава из Републике Србије.