



THE ENTERPRISE CREDITWORTHINESS EVALUATION – BY Z^o SCORE MODEL

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Abstract: There are numerous models which are under contemporary business conditions used for assessment of creditworthiness and recasting bankruptcy possibility of a enterprise. One of these models is Altman Z – score model. On the basis of adjustments of original model for possibility of bankruptcy forecasting, which is applicable just to enterprises with whose stocks are traded on organized market, a modified model was developed which is applicable only to enterprises with whose stocks are not traded on organized market. Altman made additional modification of model and formulated Z^o score model that is applied on production and unproductive enterprises, as well as on enterprises that operate in developing countries. Stated models separate financially successful enterprises from those that are threatened by bankruptcy proceedings. On the basis of Z^o score model Altman classified credit rating of enterprises and with it developed Z^o score adjusted model. In this paper, we conducted the analyses of credit rating for 33 enterprises in restructuring and 90 enterprises that are not in restructuring, by using Z^o score adjusted model, as well as determined possibility of occurrence of bankruptcy of enterprise on the basis of Z^o score model. Authors concluded that approximately 57% of analyzed enterprises in restructuring have the lowest credit rating, while possibility of occurrence of bankruptcy in the next two years for those enterprises is more than 90%. On the other hand, approximately 60% of enterprises which are not in restructuring have high credit rating and operate in safe zone, while approximately 6% of enterprises have the lowest credit rating with high possibility of occurrence of bankruptcy in the next two years.

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1. Introduction

The bankruptcy possibility envision model, being widely used in practice, is Altman's Z'' score model. It is applied by the managers, creditors, investors and all other users who, based on financial reports, bring business decisions. This model became an essential element of the business analysis based on which an evaluation on the enterprise creditworthiness is given. Based on Altman's Z'' -score model, it is possible to rank the enterprise in one of three zones. The enterprise may be financially very successful, i.e. it may operate in "the safe zone", "the gray zone" or in "the distress zone". Moving away from the "safe zone" credit performances of the enterprise go worsen and the risk of bankruptcy increases.

Accuracy and applicability testing of Altman's models has been the subject of many studies. Those studies were used for bankruptcy envision accuracy testing on enterprises that have already declared bankruptcy, as well as for determination of applicability of the model on emerging markets, developed markets, production enterprises and financial institutions.

Edward I. Altman, Alessandro Danovi and Alberto Falini (Altman, Danovi, Falini, 2013) tested applicability of the Z'' -score model on Italian enterprises being in the procedure of an extraordinary administration-EA. In those studies they showed that Z'' -score adapted model classifies 95% of analyzed enterprises in the "distress zone" for the year previous to bankruptcy of the enterprise. The authors conclude that an application of the Z'' -score model to Italian enterprises is extremely informative, but also very significant for the investors, regulatory bodies, even for the makers of political decisions.

Sanobar Anjum (Anjum, 2012) summarized significant studies on bankruptcy envision and performed a comparison of different models being usually used for evaluation of creditworthiness and bankruptcy envision. He concluded that Altman had constantly built up the model in order to reach the most adequate equation, i.e. formulation of the model that may be successfully applied in modern conditions for envision of both financial troubles of the company and the bankruptcy of the company, for one, two and three year in advance.

Grant Samkin, Mary Low and Tracy Adams (Samkin, Low, Adams, 2012) tested applicability of Altman's model on 20 companies on New Zealand that had declared bankruptcy. They concluded that by using Z'' score model, majority of companies had had results pointing to unavoidable fizzle. Bearing in mind the importance of the model for financial troubles envision, the authors suggest those models which would be introduced as a part of financial reports or as a part of published review of the enterprise financial indicators.

Lalith P. Samarakoon and Tanweer Hasan (Samarakon, Hasan, 2003) tested applicability of Altman's models on the enterprises present on Sri Lanka stock market. They conclude that the possibility of bankruptcy envision by the Z'' score-model is 81% and that this model has a good potential in financial troubles envision on emerging markets, as well as on developed markets.

The goal of this work is to determine the creditworthiness of enterprises in restructuring and enterprises out of restructuring in the Republic of Serbia based on Z'' score adapted model, as well as to determinate a possibility of bankruptcy appearance, based on Z'' score model.

2. Theoretical Basis

In 1968, Edward I. Altman (Altman, 1968) conducted a multivariate study of relationships between financial indicators and possibilities for the bankruptcy to appear, resulting in generation of the Z model score. This study covered 66 production enterprises, divided in two equal groups, according to their activity and size. The first group was represented by 33 enterprises which successfully operated in the period of time from 1946-1965, and the second group counted 33 enterprises that were running bankruptcy and that went bankrupted in the stated period of time.

In stated study, a multivariate discriminatory analysis was applied, based on which 5 financial indicators, significant for an interpretation of the enterprise financial situation, were generated from 22 financial indicators in initial phases of analysis. Thereby, these financial indicators had a different significance and importance for the enterprise operation, so an applicable weight was given to them. The stated procedure has generated the following function, i.e. model (Altman, 1968, p. 594):

$$Z = 1,2X_1 + 1,4X_2 + 3,3X_3 + 0,6X_4 + 1,0X_5$$

Where:

Z – discriminatory function value

X1- working capital to total property ratio

X2- retained earnings to total property ratio

X3- earnings before interest and tax and total property ratio

X4- capital market value and total obligations ratio and

X5- business income and total property ratio

This study conclusion was that stated model makes the most successful division between financially successful (healthy) enterprises and those ones under bankruptcy. Namely, according to Altman, those enterprises with Z-score greater than 3 are considered as successful and financially healthy enterprises. If they have Z-score in interval 2.99-1.81, they are considered as enterprises

operating in the gray zone, subject to bankruptcy and are characterized as financially jeopardized, but with a recovery possibility. Those enterprises with an indicator smaller than 1.80 are enterprises that are likely to go bankrupt.

Reliability of this model, while using data for one year before the bankruptcy, amounted 95%, for two years 75%, for three years 48%, for four years 36%, and for five years only 29%. Based on expressed data it is possible to conclude that a greater possibility of failure goes together with an envision time delay.

The stated original model's main lack is in its non-applicability to those enterprises whose securities (shares) are not traded on the stock market. In order to remove the original model's stated lack, Altman set up the new Z-score model in 1983. The basic difference in relation to the original model was in an indicator X4 where the trade value was replaced by the enterprise bookkeeping value. Taking into consideration that a modified model was in charge, it was needed to allot new weights to all indicators, as stated (Altman, 1983, p. 122):

$$Z' = 0,717X_1 + 0,847X_2 + 3,107X_3 + 0,42X_4 + 0,998X_5$$

Limit values for an evaluation of Altman Z –score model differ from an original model, so the lower limit value for financially successful enterprises is 2,9. Enterprises operating in the gray zones have the Z score of 2.89 -1.24, while enterprises with no credit performances have the Z score smaller than 1.23.

Besides detecting all basic lacks of an initial Z-score model and of formulation of model modified version, designed for those enterprises with no shares traded on the stock market, this model couldn't have been applied to non-production enterprises. Realizing this lack, Altman revised this model one more time in order to decrease an influence of the activity branch where the enterprise belongs to. Namely, the indicator X5 is excluded from the original model because it showed the biggest deviations for certain activities. This revised model has the following shape (Altman, Hartzell, Peck, 1995, p. 3):

$$Z'' = 6,56X_1 + 3,26X_2 + 6,72X_3 + 1,05X_4$$

This model is suitable for analysis of creditworthiness of production and non-production industrial enterprises, as well as for those enterprises operating on emerging markets.

Obtained Z – score is interpreted in the following way: financially successful enterprises have Z-score greater than 2.6; enterprises operating in the gray zone have Z-score in an interval from 2.59-1.11; financially unsuccessful enterprises have Z-score smaller than 1.10.

Altman classified the enterprises credit rating based on Z-score model, equivalent to classification of the creditworthiness used by the agency for credit

rating monitoring *Standards & Poor's*. Namely, Altman performed an adaptation of Z –score model by involving the constant of 3.25,, thereby an adapted Z-score model is calculated in the following manner:

$$Z''\text{score}_{\text{adapted}} = 3,25 + 6,56X_1 + 3,26X_2 + 6,72X_3 + 1,05X_4$$

Obtained result is classified in one of categories shown in Table 1 explaining the credit rating degree, i.e. it evaluating the enterprise creditworthiness.

Table 1 Comparative Review of the Z-score and Standard & Poor's Rating

Zone	Rating	Z'' score - Treshold
Safe zone	AAA	>8,15
	AA+	8,15
	AA	7,60
	AA-	7,30
	A+	7,00
	A	6,85
	A-	6,65
	BBB+	6,40
Grey zone	BBB	6,25
	BBB-	5,85
	BB+	5,65
	BB	5,25
	BB-	4,95
Distress zone	B+	4,75
	B	4,50
	B-	4,15
	CCC+	3,75
	CCC	3,20
	CCC-	2,50
D	<1,75	

Source: Altman, Hotchkiss, 2006, p. 314

In the creditworthiness safe zone, there are all enterprises having Z-score greater than 5.85, then all enterprise with Z-score in an interval between 4.5-5.85 operate in the creditworthiness gray zone, while for those enterprises with

Z-score smaller than 4.50 we can say they operate in the distress zone. We also should underline that, as the score of some enterprise is to be decreased, the risk of bankruptcy for the same is to be increased.

The Z-score model results may be converted into the bankruptcy possibility by this formula (Stanisic, 2013, p. 68):

$$P = 1 - \frac{e^z}{1 + e^z}$$

Obtained value P shows a degree of possibility for some enterprises to go bankrupt in the next two years.

3. Methodology and Data Used in the Study

In this work, the creditworthiness analysis of enterprises in restructuring and those ones out of restructuring in the Republic of Serbia was performed, based on showed methodology of the Z-score adapted model. This model was chosen because of its applicability to the enterprises operating on emerging markets, as well as to production and non-production industrial enterprises. This work also foresees an appearance of possibility for bankruptcy based on the Z-score model.

A data base according to which the study was performed, covers two occasional samples, the first one made of 33 enterprises in restructuring and the second one made of 90 enterprises out of restructuring. All enterprises that make the data base represent those enterprises with no shares traded on Belgrade stock market and whose financial reports have been published for the last three years (<http://www.belex.rs>, accessed 20.11.2013)

The study, performed according to methodology of the Z-score adapted model covers the years of 2010, 2011 and 2012.

4. Study Results

The credit rating of the enterprise in restructuring for three simultaneous years is shown in Table 2. In the highest percentage, over 70%, the analyzed enterprises operate in the distress zone during the observation period of time. Namely, app. 57,58% of enterprises in restructuring got the lowest credit rating. Those enterprises are envisaged to go bankrupt in future, i.e. to stop operating. In the gray zone, there is app. 12,12 % of analyzed enterprises and small oscillations of enterprises total number within the gray zone in observed period are noticed. Approximately, 14,14% of analyzed enterprises total number in restructuring operate in the safe zone which means that those enterprises have positive credit performances with a great possibility to terminate the privatization process successfully in future period of time.

Table 2 Credit Rating of the Enterprise in Restructuring

Zone	Rating	Treshold	2010		2011		2012		(2010-2012)
			N	%	N	%	N	%	Average values
Safe zone	AAA	>8,15	1	3,03%	0	0,00%	1	3,03%	2,02%
	AA+	8,15	2	6,06%	1	3,03%	0	0,00%	3,03%
	AA	7,60	0	0,00%	0	0,00%	1	3,03%	1,01%
	AA-	7,30	0	0,00%	0	0,00%	0	0,00%	0,00%
	A+	7,00	0	0,00%	0	0,00%	0	0,00%	0,00%
	A	6,85	0	0,00%	1	3,03%	1	3,03%	2,02%
	A-	6,65	0	0,00%	2	6,06%	0	0,00%	2,02%
	BBB+	6,40	1	3,03%	0	0,00%	0	0,00%	1,01%
	BBB	6,25	0	0,00%	1	3,03%	2	6,06%	3,03%
	Total			4	12,12%	5	15,15%	5	15,15%
Grey zone	BBB-	5,85	1	3,03%	3	9,09%	0	0,00%	4,04%
	BB+	5,65	1	3,03%	0	0,00%	2	6,06%	3,03%
	BB	5,25	0	0,00%	0	0,00%	2	6,06%	2,02%
	BB-	4,95	2	6,06%	0	0,00%	0	0,00%	2,02%
	B+	4,75	1	3,03%	0	0,00%	0	0,00%	1,01%
	Total			5	15,15%	3	9,09%	4	12,12%
Distress zone	B	4,50	1	3,03%	0	0,00%	0	0,00%	1,01%
	B-	4,15	0	0,00%	1	3,03%	1	3,03%	2,02%
	CCC+	3,75	2	6,06%	1	3,03%	2	6,06%	5,05%
	CCC	3,20	2	6,06%	2	6,06%	1	3,03%	5,05%
	CCC-	2,50	3	9,09%	0	0,00%	0	0,00%	3,03%
	D	<1,75	16	48,48%	21	63,64%	20	60,61%	57,58%
Total			24	72,73%	25	75,76%	24	72,73%	73,74%
TOTAL			33	100,00%	33	100,00%	33	100,00%	100,00%

Source: Authors' calculations.

By conversion of the Z-score model for the year of 2012 into possibility of bankruptcy to appear, the results showed in Figure 1 are obtained. The lowest possibility of bankruptcy to appear (bellow 10%) belongs to app. 5 enterprises, while possibility of bankruptcy for 4 enterprises is envisaged to be up to 20% which is in an average equivalent to those enterprises operating in the safe zone, i.e. in the gray zone. The rest of analyzed enterprises in restructuring have a possibility of bankruptcy 30%-100%, taking into consideration that 19 enterprises have a possibility of bankruptcy over 90%, which is equivalent to

the number of enterprises with the lowest D credit rating. Those enterprises are, out of any doubt, envisaged to go bankrupt in next two years.

Figure 1 Z-score Implied Bankruptcy Possibility for Enterprises in Restructuring

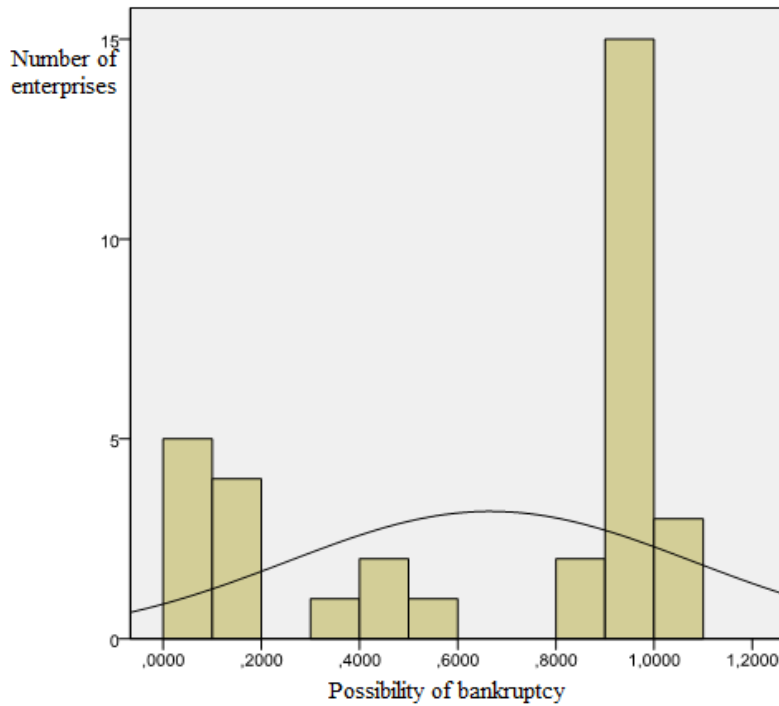


Table 3 Z-score Implied Bankruptcy Possibility for Enterprises in Restructuring

Min	Percent. 05	Percent. 25	Median	Percent. 75	Percent. 95	Max	Average	Size of sample
0.0025	0.0113	0.1345	0.9789	0.9941	1.0000	1	0.6664	33

Source: Authors' calculations.

The authors also applied the Z-score adapted model to 90 enterprises with shares traded on Belgrade stock market, and which are out of restructuring. The credit rating for those enterprises out of restructuring is given in Table 4. It is obvious that 60% of the total number of enterprises operate in the safe zone, i.e. over 50% of analyzed enterprises have good credit performances. In the gray zone operate approximately 20% of analyzed enterprises, the same as in the distress zone. The lowest credit rating belongs to approximately 6% of analyzed enterprises. Those enterprises are envisaged to go bankrupt in next two years.

Table 4 Credit Rating for Enterprises out of Restructuring

Zone	Rating	Treshold	2010		2011		2012		(2010-2012)
			N	%	N	%	N	%	Average value
Safe zone	AAA	>8,15	23	25,56%	25	27,78%	24	26,67%	26,67%
	AA+	8,15	7	7,78%	9	10,00%	8	8,89%	8,89%
	AA	7,60	5	5,56%	6	6,67%	2	2,22%	4,81%
	AA-	7,30	1	1,11%	3	3,33%	4	4,44%	2,96%
	A+	7,00	0	0,00%	2	2,22%	0	0,00%	0,74%
	A	6,85	6	6,67%	1	1,11%	2	2,22%	3,33%
	A-	6,65	4	4,44%	1	1,11%	3	3,33%	2,96%
	BBB+	6,40	1	1,11%	1	1,11%	2	2,22%	1,48%
	BBB	6,25	5	5,56%	8	8,89%	8	8,89%	7,78%
Total			52	57,78%	56	62,22%	53	58,89%	59,63%
Gray zone	BBB-	5,85	4	4,44%	3	3,33%	5	5,56%	4,44%
	BB+	5,65	5	5,56%	7	7,78%	4	4,44%	5,93%
	BB	5,25	4	4,44%	1	1,11%	2	2,22%	2,59%
	BB-	4,95	2	2,22%	3	3,33%	3	3,33%	2,96%
	B+	4,75	5	5,56%	2	2,22%	4	4,44%	4,07%
	Total			20	22,22%	16	17,78%	18	20,00%
Distress zone	B	4,50	3	3,33%	4	4,44%	1	1,11%	2,96%
	B-	4,15	1	1,11%	1	1,11%	2	2,22%	1,48%
	CCC+	3,75	3	3,33%	3	3,33%	3	3,33%	3,33%
	CCC	3,20	3	3,33%	1	1,11%	3	3,33%	2,59%
	CCC-	2,50	4	4,44%	3	3,33%	4	4,44%	4,07%
	D	<1,75	4	4,44%	6	6,67%	6	6,67%	5,93%
Total			18	20,00%	18	20,00%	19	21,11%	20,37%
TOTAL			90	100,00%	90	100,00%	90	100,00%	100,00%

Source: Authors' calculations.

Figure 2 shows the results obtained by the Z-score model conversion into possibility for bankruptcy to appear for the year 2012. The biggest number of enterprises (over 50) have a low percentage of possibility for bankruptcy to appear (up to 10%) which is equivalent to the number of enterprises operating in the safe zone. Possibility of bankruptcy to appear up to 20%, have app. 15 enterprises. It is followed by gradual increasing of possibility for bankruptcy to appear, without significant oscillations in the number of enterprises belonging to the certain interval. The biggest possibility of bankruptcy to appear, over 90%, belongs to 6 analyzed enterprises out of restructuring.

Figure 2 Z-score Implied Bankruptcy Possibility for Enterprises out of Restructuring

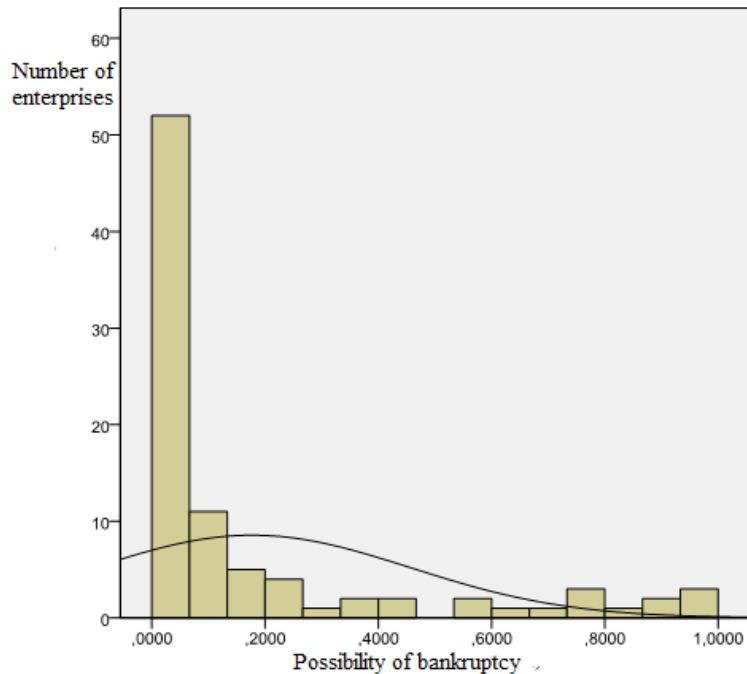


Table 5 Z-score Implied Bankruptcy Possibility for Enterprises out of Restructuring

Min	Percen. 05	Percen. 25	Median	Percent. 75	Percent. 95	Max	Average	Size of sample
0,0000	0,0000	0,0069	0,0465	0,1884	0,8924	0,999	0,1772	90

Source: Authors' calculations.

By comparing the creditworthiness of enterprise in restructuring and enterprises out of restructuring, significant differences in their participation in certain zones of operation are visible. Namely, in the safe zone operate app. 14% enterprises in restructuring and more than half (app. 60%) enterprises being out of restructuring. A significant difference of creditworthiness of tested enterprises is clearly seen in the distress zone in which operate app. 73% of enterprises in restructuring and app. 20% of enterprises out of restructuring. It is especially needed to underline that the lowest credit rating has app. 57% of tested enterprises in restructuring and only 6% of enterprises out of restructuring.

5. Conclusion

Enterprises restructuring main goal in the process of privatization is to provide easier selling of enterprises or parts of them which have chances for recovery and continuation of business. On the other side, for enterprises having bad credit performances and which are without investors, need to initiate a bankruptcy proceeding. From an attitude of potential investors, the enterprise creditworthiness cognition is of crucial significance and for this purpose we use different models to evaluate the enterprise credit performance and bankruptcy envision.

An increase of bankruptcy possibility shall decrease all chances to find an investor who would maintain the enterprise operation by investment of an additional capital. The enterprise creditworthiness analysis is significant not only for the investors, but also for the state organs that, based on possibility of bankruptcy envision, may plan all connected activities.

It should be underlined that, before any investment in some enterprises, before granting any loan, before any important business decisions are brought, it is required to make an analysis of the enterprise's credit performance and to follow their movement during time. This analysis relates to the enterprises in restructuring, healthy enterprises, small, medium and large enterprises, as well as to young and matured enterprises. It is needed to apply the model suitable to the market on which the enterprise operates, to the enterprise activity, as well as to the fact that the enterprise's shares are traded on the stock market.

This work uses the Z-score adapted model that has over 70% of analyzed enterprises classified in the group of enterprises operating in the distress zone. More significant is that the model has categorized app. 57% of analyzed enterprises as enterprises with the lowest credit rating. By the Z-score model conversion into possibility of bankruptcy, one may conclude that 9 enterprises have a possibility of bankruptcy in next 2 years of up to 20%, and that even 19 enterprises have possibility of bankruptcy initiation of over 90%.

On the other side, analyzing the group of enterprises out of restructuring shows a majority belonging of these enterprises to the operation safe zone, as well as the fact that app.60% of enterprises have a low degree of possibility for bankruptcy to appear (below 10%).

Comparison of study results for both enterprises in and out of the restructuring procedure, gives a conclusion that Altman's Z-score model provides an adequate separation between financially healthy enterprises and those ones being threatened by a possibility of bankruptcy.

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OCENA KREDITNOG BONITETA PREDUZEĆA Z" – SCORE MODELOM

Apstrakt: Postoje brojni modeli koji se u savremenim uslovima poslovanja koriste za ocenu kreditnog boniteta i predviđanje verovatnoće stečaja preduzeća. Jedan od tih modela jeste i Altmanov Z - score model. Na osnovu prilagođavanja originalnog modela predviđanja verovatnoće stečaja, koji je primenljiv samo na preduzeća čijim se akcijama trguje na organizovanom tržištu, nastao je modifikovan model primenljiv na preduzeća čijim se akcijama ne trguje na organizovanom tržištu. Altman je izvršio dodatnu modifikaciju modela i formulisao Z"score model koji se primenjuje na proizvodna i neproizvodna preduzeća, kao i na preduzeća koja posluju u zemljama u razvoju. Navedeni modeli razdvajaju finansijski uspešna preduzeća od onih kojima pretilo pokretanje stečajnog postupka. Na osnovu Z"score modela, Altman je klasifikovao kreditni rejting preduzeća i time razvio Z"score prilagođeni model. U radu je izvršena analiza kreditnog boniteta 33 preduzeća u restrukturiranju i 90 preduzeća koja nisu u restrukturiranju, korišćenjem Z"score prilagođenog modela, kao i utvrđivanje verovatnoće nastanka stečaja preduzeća na osnovu Z"score modela. Autori su došli do zaključka da oko 57% analiziranih preduzeća u restrukturiranju ima najniži kreditni rejting, dok je verovatnoća nastanka stečaja u naredne dve godine za ta preduzeća preko 90%. S druge strane, oko 60% preduzeća koja nisu u restrukturiranju imaju visok kreditni rejting i posluju u bezbednoj zoni, dok oko 6% preduzeća ima najniži kreditni rejting, sa visokom verovatnoćom nastanka stečaja u naredne dve godine.

Ključne reči: kreditni bonitet, restrukturiranje, Z –score, stečaj