

Predictive Ability of Various Bankruptcy Prediction Z-Score Models for Serbian Publicly Listed Companies ****

Rezime: U radu su testirani originalni Altmanov Z-skor model, Z'-skor model razvijen za kompanije koje nisu listirane na berzi i Z''-skor model razvijen za tržišta u razvoju, na kompanijama koje reprezentuju srpsko tržište kapitala. Prognostička moć Altmanovih modela za prognoziranje bankrotstva testirana je u periodu 2006-2009. na uzorku koji čine kompanije koje su ulazile u korpu Belex15 tokom septembra 2010. i Belexline, isključujući kompanije iz finansijskog sektora

Ključne reči: modeli za predikciju bankrotstva, ratio analiza, Altmanov Z-skor, Beogradska berza

Summary: This study uses data from Serbian publicly listed companies of non-banking sector which were part of Belex15 index during September 2010 and non-banking sector stocks that entered into the composition of Belexline index, to test the accuracy of Altman's Z-score model in predicting failure of Serbian companies for period 2006-2009. Prediction accuracy was tested for three Z-score variations: Altman's original model, a revised model for private companies, and the enhanced model for emerging markets.

Keywords: Models for bankruptcy prediction, ratio analysis, Altman's Z-score, Belgrade Stock Exchange

1. INTRODUCTION

Altman's Z-score based on multivariate approach to failure prediction became a traditional technique for measuring corporate financial distress. Despite this, academicians seem to be moving toward the elimination of

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ratio analysis as an analytical technique in assessing the performance of the business enterprise, the z-score, is still a well-accepted tool for practical financial analysis. There is an enormous volume of studies applying related approaches to the analysis of corporate failure internationally. Altman and Narayanan argue that there is a review 44 separate published studies relating to 22 countries outside the US. ([1], p.286) This number is undoubtedly higher because Altman and Narayanan argue this data in 1997, and the global crises in the meantime actualized the issue of companies failure. The z-score is used as a proxy for bankruptcy risk in exploring such areas as merger and divestment activity, asset pricing and market efficiency, capital structure determination, the pricing of credit risk, and bond ratings and portfolios as a tool in assessing financial health in going-concern research. ([1], p.286).

2. THE ORIGINAL ALTMAN'S MODEL

Altman (1968) extended Beaver's (1966) unvaried analysis and developed a discriminant function which combines ratios in a multivariate analysis:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$$

where,

X₁ = working capital/total assets

X₂ = retained earnings/total assets

X₃ = earnings before interest and taxes/total assets

X₄ = market value of equity/book value of total liabilities

X₅ = sales/total assets

Z = overall index.

Over the years many individuals have found that a more convenient specification of the model is of the form: $Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$.

Due to the original model, companies with Z-scores less than 1.8 are predicted to be bankrupt, and companies with Z-scores greater than 2.99 are predicted not to be bankrupt. The area between 1.81 and 2.99 is defined as the "zone of ignorance" or "gray area".

Altman tested the model on subsequent distressed company's samples in three subsequent tests. He examined 86 distressed companies from 1969-1975, 110 bankrupts from 1976-1995 and 120 from 1997-1999. In each test, the Type I accuracy using a cutoff score of 2.675 ranged from 82-94%, based on the data from one financial statement prior to bankruptcy or default on outstanding bonds. Indeed, in the most recent test, based on 120 companies which defaulted on their publicly held debt during 1997-1999, the default prediction accuracy rate was 94% (113 out of 120). Using the more conservative 1.81 cutoff, the accuracy rate was still an impressive 84%. The 94%, 2.675 cutoff accuracy is

comparable to the original sample's accuracy which was based on the data used to construct the model itself. The Type II error however, has increased substantially with as much as 15-20% of all companies and 10% of the largest companies having Z-Scores below 1.81. As Osler and Hong (2000) demonstrate, the average Z-Score increased significantly with the average rising from the 4-5 level in 1970-1995 period to almost 10 in 1999, but the media level has not increased much. ([3], p.18) The majority of increase in average Z-Scores was due to the dramatic climb in stock prices and its impact on X4. ([3], p.18) Altman advocates using the lower bond of the zone-of-ignorance (1.81) as a more realistic cutoff Z-Score than the score 2.675 ([3], p.18)

3. THE REVISED Z-SCORE MODEL FOR PRIVATE COMPANIES' APPLICATION

Given that the original model requires stock price data, it couldn't be applied to companies in the private sector. In the revised model, substituting the book values of equity for the Market Value in X4, resulted in decrease of impact on the Z-Score, but the scaled vector results show that the revised book value measure is still the third most important contributor.

The results of the revised Z-Score model with a new X4 variable is:

$$Z' = 0.717(X1) + 0.847(X2) + 3.107(X3) + 0.420(X4) + 0.998(X5)$$

Private companies with Z'-Scores less than 1.23 are predicted to be bankrupt, and companies with Z'-Scores higher than 2.9 are predicted to not be bankrupt. The area between 1.23 and 2.9 is defined as the "zone of ignorance" or "gray area".

The test results showed that the Type I accuracy is only slightly less impressive than the model utilizing market value of equity (91% vs. 94%) but the Type II accuracy is identical (97%). The revised model is probably somewhat less reliable than the original, but only slightly less.

4. THE Z-SCORE MODEL DEVELOPED FOR EMERGING MARKETS

Based on previously developed model for non-manufacturers, which didn't contain the sales/total assets ratio in order to minimize the potential industry effect, Altman, Hartzell, and Peck [6] create the emerging market scoring (EMS)

model to assess the financial health of non - U.S. companies, specifically Mexican companies that had issued Eurobonds denominated in U.S. dollars.

The new Z"-Score model is: $Z'' = 6.56 (X1) + 3.26 (X2) + 6.72 (X3) + 1.05 (X4)$

The book value of equity was used for X4 in this case.

Companies with Z"-Scores less than 1.1 are predicted to be bankrupt, and companies with Z"-Scores greater than 2.6 are predicted to not be bankrupt. The area between 1.1 and 2.6 is defined as the "zone of ignorance" or "gray area". ([5], p.25)

This particular model is also useful within an industry where the type of financing of assets differs greatly among companies and important adjustments, like lease capitalization, are not made. In the emerging market model, Altman, Hartzell, and Peck added a constant term of +3.25 so as to standardize the scores with a score of zero (0) equated to a D (default) rated bond.

5. USE OF Z-SCORE ON SERBIAN COMPANIES LISTED ON BELGRADE STOCK EXCHANGE

We have tested the original Z-Score, the revised Z-Score model for private companies' application and the Model developed for emerging markets on a sample of Serbian companies. Z-Score calculations for stocks that represent the Serbian capital market are based on data published in prospectuses on the website of Belgrade Stock Exchange. All the stocks of non-banking sector which were part of Belex15 index during 2006 and 2010 and non-banking sector stocks that entered into the composition of Belexline index, have been included in the calculation. 73 companies were chosen this way, but the final sample was 44 due to the lack of data. Including all 73 companies would lead to inconsistent sample, and data comparison would not be reliable. Lack of reliable data is a constant problem influencing all analyses on Serbian capital market.

Due to the privatization method in Serbia there has been a process of the concentration of capital under the ownership of one majority stockholder and a tendency to transform such stock companies into closed companies. As a rule, the interest of the strategic investor is to close or limit public access. Such companies prefer other forms of organization to that of the public company. This produces a tendency toward transformation into private companies or even limited companies, with their possibilities for conflict with small stockholders. ([13], p.78)

We used the revised Z-Score model for private companies' application on listed companies because the value that is established on the Serbian capital market doesn't reflect the real value of shares. In [15] it is shown that capital market does not have a significant importance for Serbian companies. "Many studies

show that the regularity of the developed capital markets is not valid in the Serbian capital market. Namely, the level of market liquidity is persistently low in Serbia. Additionally, results confirm that time-varying illiquidity and its volatility is highly unstable in this market. ([Živković, B., Minović, J., 2010] For example, research of Radivojević et al. [2009] points out the limitations of the application of modern portfolio theory in the Serbian capital market while research [Muminović, S., Pavlović, V., 2007] points out the unreliability of the application of the CAPM model.” (according: [16]) The shallow and undeveloped Serbian capital market also produces more significant changes in stock price levels as a result of smaller transaction values. ([14], p.56) And finally we used the Model developed for emerging markets because Serbian capital market is an emerging market, table 1.

Table 1. Companies not in bankruptcy

		sample	Altman_Z	Altman_Z score	Altman_Z score Emerging M
	“Safe” Zones		Z > 2.99	Z' > 2.9	Z > 2.6
	“Grey” Zones		1.8 < Z < 2.99	1.23 < Z' < 2.9	1.1 < Z < 2.6
	“Distress” Zones		Z < 1.80	Z' < 1.23	Z < 1.1
2006	accuracy I “Safe” Zones	44	43,2%	31,8%	70,5%
	accuracy II “Safe” Zones+“Grey” Zones		77,3%	93,2%	93,2%
	Model average values		3,55	2,54	5,44
	Standard Deviation		3,25	1,41	4,14
	Minimum		0,18	0,20	-0,28
	Maximum		18,78	8,08	20,48
2007	accuracy I “Safe” Zones	44	54,5%	29,5%	70,5%
	accuracy II “Safe” Zones+“Grey” Zones		81,8%	81,8%	93,2%
	Model average values		4,59	2,38	5,17
	Standard Deviation		5,12	1,40	4,01
	Minimum		0,44	0,52	0,77
	Maximum		29,09	7,21	18,39
2008	accuracy I “Safe” Zones	44	31,8%	25,0%	68,2%
	accuracy II “Safe” Zones+“Grey” Zones		61,4%	81,8%	90,9%
	Model average values		2,76	2,35	5,03
	Standard Deviation		2,24	1,56	4,27
	Minimum		0,47	0,53	-0,70
	Maximum		11,09	9,53	23,86
2009	accuracy I “Safe” Zones	44	25,0%	25,0%	77,3%
	accuracy II “Safe” Zones+“Grey” Zones		50,0%	81,8%	95,5%
	Model average values		2,87	2,51	5,60
	Standard Deviation		3,31	2,21	5,98
	Minimum		-0,15	0,04	-3,55
	Maximum		17,07	11,67	29,29

Average values for all three variant of Z-Score models, for all 4 years are above "distress zone". But the standard deviation is the lowest for Altman Z score for private companies, even that formula had less accuracy comparing Z-Score Model Developed for Emerging Markets.

Type I error represents an actually bankrupt firm classified as non-bankrupt and the Type II error represent an actually non-bankrupt firm classified as bankrupt. "For investors, banks and the government the most serious and expensive mistake is to consider a firm as healthy when actually it will be in bankruptcy soon. Therefore, Type I error represent real losses for shareholders, banks and other stakeholders. On the other hand, Type II error can be seen as an opportunity cost; an investor can lose the opportunity to make a good investment, a bank can lose the opportunity to lend money to a good customer or a supplier can lose the opportunity to make an additional sell." ([18], p.302)

Table. 2: Per cent Type Error II

2009		
Altman Z	Z	(22 out of 44) = 50,00 %
Altman Z score	Z'	(8 out of 44) = 18,18 %
Altman Z score Emerging M	Z''	(2 out of 44) = 4,55 %
2008		
Altman Z	Z	(17 out of 44) = 38,64 %
Altman Z score	Z'	(8 out of 44) = 18,18 %
Altman Z score Emerging M	Z''	(4 out of 44) = 9,09 %
2007		
Altman Z	Z	(8 out of 44) = 18,18 %
Altman Z score	Z'	(8 out of 44) = 18,18 %
Altman Z score Emerging M	Z''	(3 out of 44) = 6,82 %
2006		
Altman Z	Z	(10 out of 44) = 22,73 %
Altman Z score	Z'	(3 out of 44) = 6,82 %
Altman Z score Emerging M	Z''	(3 out of 44) = 6,82 %

Error I couldn't be present in the observed sample because not a single one of these companies has failed. In the original Altman's model, possibility of Error I could almost not even exist, given that half of all companies were classified in the distress zone. It is observed that the Error II is extremely high. It is observed that the Error II of the revised Z-Score model for private companies' application is significantly smaller. According to the results of the Emerging Markets Score model, Error I is lower than Z-Score model for private companies' application, although the size of the errors is significantly above the faults observed in the initial sample.

Comparing results from mentioned sample and U.S. Bond Rating Equivalent Based on EM Score ([3], p.29) shows that the majority of companies are classified in first five groups or last five groups table 3 and table 4. Significant number of companies classified as AAA, and significant number of companies classified as D between the companies which represent the Serbian market leads to the conclusion that Average EM Score isn't a reliable instrument for the Serbian entities.

Table 3: U.S. Bond Rating and EM Score for the companies that represent Serbian market

U.S. Equivalent Rating	Average EM Score	2006		2007		2008		2009	
		Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
AAA	8.15	7	15,9%	8	18,2%	5	11,4%	6	13,6%
AA	7.60	2	4,5%	1	2,3%	2	4,5%	3	6,8%
AA	7.30	1	2,3%	0	0,0%	1	2,3%	0	0,0%
AA-	7.00	2	4,5%	2	4,5%	0	0,0%	0	0,0%
A+	6.85	1	2,3%	0	0,0%	0	0,0%	0	0,0%
A	6.65	0	0,0%	1	2,3%	2	4,5%	0	0,0%
A-	6.40	2	4,5%	1	2,3%	2	4,5%	0	0,0%
BBB	6.25	1	2,3%	1	2,3%	2	4,5%	0	0,0%
BBB	5.85	3	6,8%	1	2,3%	1	2,3%	4	9,1%
BBB-	5.65	0	0,0%	0	0,0%	0	0,0%	1	2,3%
BB	5.25	1	2,3%	1	2,3%	2	4,5%	4	9,1%
BB	4.95	0	0,0%	2	4,5%	2	4,5%	1	2,3%
BB-	4.75	1	2,3%	1	2,3%	1	2,3%	0	0,0%
B+	4.50	1	2,3%	0	0,0%	1	2,3%	0	0,0%
B	4.15	2	4,5%	2	4,5%	1	2,3%	1	2,3%
B-	3.75	2	4,5%	3	6,8%	4	9,1%	3	6,8%
CCC+	3.20	4	9,1%	6	13,6%	2	4,5%	6	13,6%
CCC	2.50	1	2,3%	2	4,5%	2	4,5%	6	13,6%
CCC-	1.75	8	18,2%	2	4,5%	6	13,6%	1	2,3%
D	0.00	5	11,4%	10	22,7%	8	18,2%	8	18,2%
total		44		44		44		44	

Table 4: U.S. Bond Rating and EM Score for the companies that represent Serbian market – reclassified

Group/year	2006	2007	2008	2009
A+ to AAA	29,5%	25,0%	18,2%	20,5%
BBB- to A	13,6%	9,1%	15,9%	11,4%
B to BB	11,4%	13,6%	15,9%	13,6%
D to B-	45,5%	52,3%	50,0%	54,5%

Since not a single one of the companies from the index basket of Belex15 and Belex line has failed, the following analysis includes companies which went bankrupt in 2009 and 2010 and were listed on Belgrade Stock Exchange. The analysis excludes companies classified as small entities. Those companies are not part of Belexline and Belex15. Thirty companies have been observed, for which the bankruptcy proceeding started in 2009, 2010 and in January 2011.

Three companies for which the bankruptcy proceeding started in January 2011 have been added to the table below, although, according to the model, they should have started in 2010. Total assets of bankrupt companies summarize table 5.

Table 5: Total assets value of bankrupt companies

Total Asset	2008	2009
min in 000 RSD	3.777	4.765
max in 000 RSD	5.140.158	5.253.605
average in 000 RSD	734.357	752.959
average in EUR	8.344.970 €	7.529.590 €

Table 6: Companies in bankruptcy

		sample	Altman_Z	Altman_Z_score	Altman_Z_score_Emerging_M
2008	"Distress" Zone	6	np	100,0%	100,0%
	Model average values		np	-0,30	-3,58
	Standard Deviation		np	0,69	1,78
	Minimum		np	-0,81	-5,38
	Maximum		np	1,18	-0,38
2009	"Distress" Zone	20	np	95,0%	90,0%
	Model average values		np	-0,26	-3,01
	Standard Deviation		np	0,80	3,24
	Minimum		np	-1,91	-8,98
	Maximum		np	1,85	4,55
	(including 3 companies in bank. Jan. 2011)	23	np	95,7%	87,0%
	Model average values		np	-0,28	-3,12
	Standard Deviation		np	0,88	3,39
	Minimum		np	-2,19	-8,98
	Maximum		np	1,85	4,55

Table. 7: Per cent Type Error I

2009 (including companies failure January 2011)		
Altman Z score	Z'	(1 out of 23) = 4,3 %
Altman Z score Emerging M	Z''	(3 out of 23) = 13,4 %
2009		
Altman Z score	Z'	(1 out of 20) = 5 %
Altman Z score Emerging M	Z''	(2 out of 20) = 10 %
2008		
Altman Z score	Z'	= 0 %
Altman Z score Emerging M	Z''	= 0 %

Table 7. shows that Error I isn't present in the observed sample in 2008, but it's present in 2009. It is interesting that the revised Z-Score model for private companies' application gives smaller Error I than the Model Developed for Emerging Markets. When we have increased the sample for the three companies that went bankrupt in January 2011, and which we consider as failed in 2010 due to the slow pace of bankruptcy proceedings in Serbia, Error I is further reduced according to the revised Z-Score model, and thus accuracy of the revised model increased to 95.7% and the accuracy of the Emerging Market Model decreased to 87%).

6. CONCLUSION

This study tests the predictive ability of various bankruptcy prediction z-score models on sample of Serbian companies.

We consider that the original Altman's model can not be successfully applied on Serbian companies. The level of Error II is too high. Error I for the original Altman's model couldn't be measured due to lack of data, but having in mind that according to this model the half of sample are classified in the distress zone, there is a low probability of the occurrence of Error I. The application cutoff 2.675 additionally decreases the accuracy of the model.

The revised Z-Score model for private companies' application gives more relevant results than the original Z-Score model. This is not a surprise because it's well known that the Serbian capital market doesn't reflect the real value of shares. The level of Error I is partially acceptable, but the Error II is too high. The revised Z-Score model for private companies' application gives lower Error I, but a higher Error II than the Model developed for emerging markets. It turns out that neither Z'-Score nor Z''-Score aren't reliable indicators for prediction failure on the Serbian capital markets.

So, the results of testing Z-Score Model and Z'-Score Model on Serbian companies approve the claim that models created for a developed capital market are not reliable for prediction bankruptcy of companies from the emerging markets. Naturally, Z'-score Model provides better results than the Z-Score, but it is unsatisfactory.

Significant Error II found with Model developed for emerging markets is not a surprise. Firstly, prediction failure models are created during stable period, and they provide reliable results when they are applied in the same conditions as in the period when they were developed. The Serbian economy is significantly affected by the global financial crises. The crisis affects the economy of Serbia by the decrease of export and the level of loan and capital inflow. ([23], p.145) The global financial crisis has just further encouraged the emergence of the structural abnormalities, occurred well before and during the process of transition in Serbian economy. ([19], p.353). It is uncertain how long the crisis will last and which dimension it will have. ([9], p.79) We can partially explain increasing Error I and Error II in the observed period by the crisis. But, as Agarwal and Taffler mention, the specific nature of z-score models is such that it can only be appropriately applied to the population of companies from which they were developed. ([1], p.299) This also implies the existence of similar conditions in the country where the model is developed and the country where this model is applied. We should emphasize that both macroeconomic ambience and legislation by which bankruptcy is regulated in Mexico and Serbia are different. Type II error can also be attributed to the consequence of the fact that bankruptcy process in Serbia often starts rather later than in more developed economies. For example, it occasionally happened that some companies which have been insolvent for the period longer than three years didn't start the bankruptcy proceedings. ([16]) Additional difficulty in the use of models is that size of Serbian companies was not similar to the population of companies from which the models were developed.

In the literature, there is an attitude that differences between accounting regimes and changes into accounting legislative can have a significant impact on the reliability of the model ([11],[7]) but we consider that differences between accounting regimes in USA, Mexico and Serbia don't have a significant influence on the accuracy of the model. Different economic environment, different performance treasures and different nature of firm's financial structures (homogeneity in firm financial structures, using of new financial instruments) are certainly more significant. One of the significant differences between USA companies from which the model was developed and national companies from post-transition and transition economies is the share of intangible assets. "The results of the analysis prove that in the period 2004-2008 intangibles constitute an important asset for traditional market economies, which does not result for post-transition and transition economies, despite the fact that many analyses underline their growing significance in today's business environment. The difference between selected companies implies the fact that post-transition and transition economies operate with a significantly lower share of intangibles in comparison with traditional market economies."([10], p.60) Having in mind that Serbian companies don't have extraordinary profitability, it turns out that

intangibles that do not meet the criteria for their recognition can't be present as they are in the USA companies.

Finally, the competitive position of Serbian companies is low, currency risk is very in a high degree, and Serbian economy is characterized by chronic illiquidity.

Whether the company will go bankrupt, depends firstly on business performance of the company, and secondly on legal regulations, bankruptcy law and its application, such as political will.

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