

SELECTION OF PREDICTORS IN BANKRUPTCY PREDICTION MODELS FOR SLOVAK COMPANIES

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Abstract

Creation of bankruptcy prediction models, created with various sets of predictors, is nowadays a topic, which much attention in many countries all around the world is dedicated to. Many efforts of the economists in many countries have been dedicated to creation of a model which is useful for failure prediction. In these prediction models different sets of predictors, mainly financial ratios of the company or some other predictors, are used for building a strongly predictive model. Previous works have shown that these models are then less effective in application in another country or in another time. In our paper we test a significance of several predictors in different regions of Slovak republic. Through statistical methods we found a set of predictors that are significant to predict bankruptcy of companies in various regions of Slovakia. Furthermore, we propose the clusters of Slovak regions, which are so similar in their characteristics that are appropriate to be analyzed together for predicting bankruptcy.

Key words: Bankruptcy prediction models, Financial ratios, Failure prediction, Multivariate statistical methods

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Introduction

Prediction of financial distress of companies on the basis of financial analysis is in recent decades and also nowadays an important and attractive issue. This prediction of financial distress is based on an estimation, respectively on prediction whether the analyzed company is in a state of financial threats or not and furthermore, whether is its next development moving towards bankruptcy or not. For the purpose of early detection of impending problems in the analyzed company are used the predictive models, whose task is to evaluate the financial health of the company on the basis of selected financial indicators or other characteristics of the company or the environment in which it operates. Subsequently, the company is able to identify imminent bankruptcy in advance. The identification of the impending problems of the

company can be important not only for business owners but also for business partners, potential or existing creditors or for employees. (Misankova et al., 2015)

The above mentioned prediction models are designed to be able to indicate the danger of bankruptcy in advance, a year, or even more years in advance. For companies it is very important to check and to control their own financial situation, as potential permanently deteriorating financial situation may at some point reach to a limit from which the company will not be able to get out of. (Kocisova, Misankova, 2014).

An impending bankruptcy of the company is usually a danger not only for the enterprise itself, but also for all other stakeholders. Predictive models therefore serve as a tool for early warning of impending bankruptcy risk or, conversely, to identify companies that are healthy and strong and have good conditions to cope with potential economic problems. Predictive models are therefore designed precisely for that purpose, to be able to evaluate the health of the company and in advance warn all stakeholders before any imminent bankruptcy. (Weissova et al., 2015)

In the prediction models the authors use for their analysis and for model creation many types of financial indicators of the company, mostly financial ratios, or some other characteristics of the company or environment in which it operates. (Stachova, 2015)

In this paper we analyze these financial ratios of the company. By using the statistical tests we analyze significance of several predictors used for predicting bankruptcy. This significance analysis is made separately for companies in all regions of Slovak republic. Through the results of statistical test we found the differences between the variables values for companies that are prosperous or profitable and companies that are bankrupt, similarly as was made in the work of Fitzpatrick in 1932 dealing with the major differences between successful and unsuccessful businesses. (Kliestik, Majerova, 2015) Then we would be able to find a set of predictors that are significant to create a predictive model for predicting company bankruptcy in various regions of Slovakia.

1 Literature review of prediction models formation and current state

Formation of prediction models for predicting bankruptcy or financial problems of the company is in the last years the main topic that many authors in different countries all around the world devote to. The first prediction models were created at the end of the 60s' of the last century by today well known authors such as Beaver, who has developed his model in 1966. Very famous and still often used is model of Z score created by Altman in 1968. Later followed a number of authors, who have created their prediction models specialized in

company failure prediction in a particular country: Ohlson in 1980, Springate in 1983, Zmijewski in 1984, Fulmer in 1984, Kralicek in 1993, Shirata in 1995, Dimitrov and Zanakis in 1996, Shumway in 2001 and others. (Kliestik et al., 2015)

Currently, there exist hundreds of prediction models, developed in the environment and conditions of the particular economy and the particular country at some time. Many of them are used in the economic analysis.

During recent years there have been produced many models in different countries. These models were created based on real data about mostly financial ratios of selected companies. For example, Chung, Tan, Holdsworth (2008) have created a MDA model for classification of companies in the field of financial industry in New Zealand. Anandarayan et al. (2004) have used to modelling the bankruptcy of companies in German method of neural networks. Altman and Sabato (2005) have developed a Logit model applicable to small businesses in the US. Pang-Tien et al. (2008) have created a Logit model for companies in Taiwan. Logit model have been created also in the work of Lin and Piesse (2004) for industrial companies in the UK. Bandyopadhyay (2006) have used the MDA method for predicting bankruptcy of companies in India one or two years in advance. Sun and Li (2012) have applied the Logit method and also MDA method for companies in China. Shams et al. (2011) in Iran have developed a Logit model. Bellovary et al. (2007) have in their work described the situation about existing models for predicting bankruptcy from 1930 to 2007.

2 Methodology

As was mentioned above, in this paper we will focus on the statistical analyzes of predictors (financial ratios and other company characteristics) used as variables in prediction models. To describe the basic relationships and to find some differences between financial ratios of the companies that are thriving and companies that are bankrupt, we will use basic methods of mathematical statistics.

First, we focus on basic statistical characteristics of financial ratios separately for bankrupt and for non-bankrupt companies. Then we will analyze the differences between them by statistical test of hypotheses. We will compare the means of financial ratios and we will analyze, whether the difference between them is statistically significant or not. This comparison will be made by hypothesis testing of mean values and of variances for two random samples. The significance of mean differences will be analyzed separately for every region in Slovakia. That means, we will compare the financial ratios of bankrupt and non-bankrupt companies that operate in the same region of Slovakia. Then, we find the significant

differences between them. The existence of these differences will indicate that this particular financial ratio is important for identifying, whether some company belongs with some probability to the group of non-bankrupt companies or to bankrupt ones. Through this method we found a set of predictors that are significant to create a predictive model in various regions of Slovakia. (Spuchlakova, 2014).

Next step of our analysis will be the derivation of some groups, clusters, of Slovak regions that are so similar in the characteristics of financial ratios of companies, that these regions could be analyzed together. We expect that we will obtain 3 or 4 clusters of regions of such the regions in one cluster are as similar as possible, but different from regions in other cluster. (Mackovicova, Stachova, 2012).

2.1 Data used for our research

In our analysis we use real data about 109 550 Slovak companies. For every one of them we have the values of 11 various financial ratios and furthermore, we have the region in which the company operates and the classification the sector of national economy. By the ratio of indebtedness of the company we classify the company into one of the following group: bankrupt (non-prosperous, default) and non-bankrupt (prosperous, non-default). The number of companies in every group is in the following table. In the table, the notation 0 means non-bankrupt company and 1 means bankrupt company.

Tab. 1: Frequency table of bankrupt and non-bankrupt companies

Frequency table				
Bankrupt company	Frequency	Percent	Valid Percent	Cumulative Percent
0	82882	75,7	75,7	75,7
1	26668	24,3	24,3	100,0
Total	109550	100,0	100,0	

Source: own elaboration

In Table 2 we present the frequency tables of bankrupt and non-bankrupt companies for regions of Slovakia. On the left side of the table are the numbers of non-bankrupt companies in all regions of Slovakia, in the middle are the numbers of bankrupt companies and on the right side are total numbers of companies in all regions. The notation of Slovak regions is the following: BA = Bratislava region, BB = Banska Bystrica region, KE = Kosice region, NT = Nitra region, PO = Presov region, TN = Trencin region, TT = Trnava region, ZA = Zilina region.

Tab. 2: Frequency table of bankrupt and non-bankrupt companies in Slovak regions

Default and non-default companies according to the region						
Region	Default companies		Non-default companies		Total	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
BA	25180	30,38	9292	34,84	34472	31,47
BB	8020	9,68	2410	9,04	10430	9,52
KE	8986	10,84	2901	10,88	11887	10,85
NT	9413	11,36	2619	9,82	12032	10,98
PO	7870	9,50	2247	8,43	10117	9,24
TN	7302	8,81	2207	8,28	9509	8,68
TT	7326	8,84	2212	8,29	9538	8,71
ZA	8785	10,60	2780	10,42	11565	10,56
Total	82882	100	26668	100	109550	100

Source: own elaboration

The set of financial ratios use the following notation: OM = Current assets, KZ = Current liabilities, CK = Total liabilities, CM = Total assets, VI = The equity, EBIT = Earnings before Interest and Taxes, DT = Sales / 360, KP = Accounts receivable, Z = Inventory, CPK = Net Working Capital, NZ = Retained earnings, KFM = Cash.

3 Results

3.1 Equality of means of financial ratios for bankrupt and non-bankrupt companies

First, we checked the basic statistical characteristics of financial ratios of companies that operate in the same region of Slovakia. These characteristics were analyzed separately for every of 8 regions of Slovakia. Due to lack of space we do not provide detailed values of all characteristics in this paper.

Then we analyzed, whether there is a statistically significant difference between the mean values of 11 financial ratios for bankrupt and non-bankrupt companies. This analysis was first made for whole Slovakia, then, in the next step separately for all regions of Slovakia. In Table 3 are financial ratios, of which the means are statistically significantly different, as was decided from the test of hypothesis for mean values.

The ratios marked with the star have significantly different means for significance level 0,01. The others without the star are significant for the level of 0,05. As can be seen according to the Table 3, some ratios are repeating in more regions.

Tab. 3: Significantly different financial ratios in each Slovak region

Region	Financial ratio with significantly different means							
whole Slovakia	EBIT/VI*	KZ/DT*	KP/DT	Z/DT				
BA	OM/KZ*	KFM/KZ	KZ/DT	KP/DT	Z/DT	NZ/CM*	EBIT/VI*	
BB	CK/CM	EBIT/CM	EBIT/VI	KZ/DT	KP/DT	CPK/CM		
KE	EBIT/VI	KP/DT	Z/DT					
NT	OM/KZ*	KFM/KZ*	EBIT/VI	KP/DT*	NZ/CM*			
PO	EBIT/CM	KZ/DT	KP/DT	Z/DT	NZ/CM			
TN	CK/VI*	EBIT/VI	KZ/DT	KP/DT	NZ/CM*			
TT	OM/KZ*	CK/VI	EBIT/CM*	EBIT/VI	KZ/DT*	KP/DT	Z/DT	NZ/CM*
ZA	KFM/KZ*	KZ/DT	KP/DT	Z/DT	NZ/CM			

Source: own elaboration

In the Table 4 are the numbers of financial ratios which are different for all regions in Slovakia. The numbers are listed for significance level 0,01 and 0,05 separately.

Tab. 4: Number of financial ratios that are significantly different

Region	Number of different ratios	
	significance level 0,01	significance level 0,05
whole Slovakia	4	2
BA	7	4
BB	6	6
KE	3	3
NT	5	1
PO	5	5
TN	5	3
TT	8	4
ZA	5	4

Source: own elaboration

In Table 5 are the variables sorted according to the frequency of their occurrence in the results of testing the difference of means to be significantly different. Again, separately for each region of Slovakia, for 0,01 and 0,05 significance level.

At the significance level 0,05 we can consider first 4 financial ratios as very important in classification of companies as bankrupt or non-bankrupt. The mean values of ratios $\frac{KP}{DT}$, $\frac{Z}{DT}$, $\frac{EBIT}{VI}$, $\frac{KZ}{DT}$ are significantly different for bankrupt and for non-bankrupt companies. These four ratios are repeated more times in all regions of Slovakia as the ones with different mean values. So we consider them as the most important ratios for distinction of the companies as non-bankrupt ones or possible bankrupt.

Tab. 5: Importance of financial ratios for indicating differences between bankrupt and non-bankrupt companies

Financial ratio	Significance level 0,01		Financial ratio	Significance level 0,05	
	Importance	No. of occurrences		Importance	No. of occurrences
KP/DT	1	9	KP/DT	1	8
EBIT/VI	2	7	Z/DT	2	6
KZ/DT	3	7	EBIT/VI	3	5
Z/DT	4	6	KZ/DT	4	5
NZ/CM	5	6	NZ/CM	5	2
OM/KZ	6	3	EBIT/CM	6	2
KFM/KZ	7	3	KFM/KZ	7	1
EBIT/CM	8	3	CK/VI	8	1
CK/VI	9	2	CK/CM	9	1
CK/CM	10	1	CPK/CM	10	1
CPK/CM	11	1	OM/KZ	11	0

Source: own elaboration

3.2 Cluster analysis of regions of Slovakia

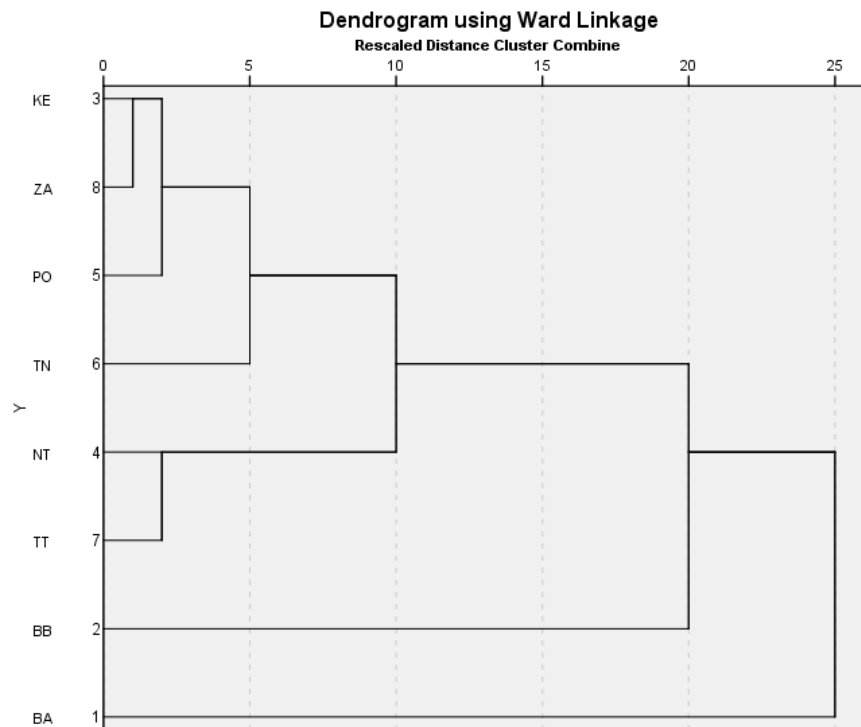
Next goal of our research is to find groups, clusters, of Slovak regions. In one cluster will be such regions that are very similar to the other in the same group but very different from the regions in other groups. We suppose to obtain 3 or 4 clusters of regions. For this purpose we have made the hierarchical cluster analysis with Ward's method or distance computing and Z-scores standardization. The analysis starts from 8 groups, where every region is in its own cluster and stops with 1 cluster with all regions in it. In the next dendrogram we can see the models.

For our purpose the possibility with 4 groups is better usable and more helpful. The model with 4 groups consists of the following clusters:

1. group: Bratislava region,
2. group: Banská Bystrica region,
3. group: Trnava region and Nitra region,
4. group: Trencin region, Presov region, Zilina region and Kosice region.

In the first and the second clusters is one region alone, but it means that these regions are really different from the other regions in other groups and between each other too. In fact, especially Bratislava region is really different from other parts of Slovakia and the companies there really have different values of financial characteristics.

Fig. 1: Dendrogram of cluster analysis for regions of Slovakia



Source: own elaboration

In the third group there are two regions, Trnava and Nitra. These two regions are both close to Bratislava region of capital city and companies in both could be affected by the capital city influence. Other 4 regions, namely Trenčin, Zilina, Prešov and Košice, are together in one cluster. So, companies in these regions are similar in their characteristics of financial ratios. Consequently we could analyze these regions together.

Conclusion

In this paper we focused on analysis of financial ratios which are often used as predictors in bankruptcy prediction models. By using the values of these financial ratios of companies we could from the prediction model obtain the probability of incoming bankrupt of the company in advance. Or alternatively, we could obtain the classification of the company into the group of bankrupt or group of non-bankrupt ones. In the process of such models creation it is important to use a set of variables that could build a strongly predictive model with high classification ability. In our analysis we have compared the means of variables and have found the ratios with significantly different mean values for prosperous and for non-prosperous companies. This set of variables can be used as a set of predictors in bankruptcy prediction model for Slovak companies. All analyzes were made separately for each region of

Slovakia. Then we have compared the results, the occurrences of financial ratios which have significantly different values in group of bankrupt companies and in group of non-bankrupt ones. We suppose that these ratios are important for predicting bankruptcy of the companies.

Moreover, in our paper we have introduced the cluster analysis of Slovak regions based on the characteristics of financial ratios of the companies which operates in the region. We have obtained four groups of regions of Slovakia. Accordingly, this analysis could be used in the process of bankruptcy prediction model creation as groups of regions that could be analyzed together because of their similarity in the characteristics.

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