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PREDICTIVE MODELS AND THEIR APPLICATION IN SLOVAK COMPANIES

Моделі аналізу, що мають справу з попереднім фінансовим аналізом, називають прогнозними моделями, тому що вони заздалегідь вказують на потенційний ризик для фінансового здоров'я компанії. Основою фінансово-економічного аналізу діяльності компанії є визначення чинників і інтенсивності їх впливу на фінансове становище компанії, щоб продовжити їх дію протягом обґрунтованого періоду часу, потрібного для створення різних сценаріїв і їх розвитку у майбутньому. Внеском у процес пізнання може бути використання основних або складних, точно орієнтованих методів і процедур. Мета цієї статті полягає в поданні історичної та поточної точки зору на деякі з численних моделей банкрутств і надійності, які використовуються у визначенні ймовірності банкрутства. Одночасно стаття презентує тестування Bonita – друга модель балансового аналізу з погляду словацьких компаній.

Ключові слова: *банкрутство, конкурентоспроможність, оцінка, прогнозування, відносні показники.*

Introduction

Owners of businesses expect, when setting up a business, a success in their business plan, meeting customer expectations, their enforcement in the competition and as long as possible maintaining on the market. The interesting finding was made as mentioned in Remišová [4], by Professor Arie des Geus who examined the conditions necessary for long-term existence and survival of firms. Based on the research of more than a hundred year old companies he developed a characteristics that was common to all these companies. One characteristic feature is the strong conservatism, which was manifested in a healthy financial basis, controlling growth development and exploiting favourable opportunities. Another feature is the sensibility to the environment, which allows to respond quickly to changes and deal with them in advance.

Among the stakeholders who are interested in the financial health of a company are mainly owners of companies, shareholders and creditors. In their own interest is to the long-term survival of the undertaking, as a going concern brings its owners gain, regular dividend payment to shareholders to and creditors certainty of return on loans. In the center of their attention is therefore corporate finance, which can be compared to the blood circulation in living organisms. Economic manager may already in advance indicate impending adverse condition with the use of certain models of financial analysis. Those models in the literature are called early warning systems, as they can assess the financial health of a company and in advance warn owners and business partners of such enterprises against the threat of bankruptcy. Creditworthy and bankruptcy models are aggregated indices, whose task is to assess the situation of analyzed company and express the financial and economic situation of the company wia single number. The first group bankruptcy models, informs the undertaking if it is threatened with bankruptcy. In the world, the first

bankruptcy models were developed based on actual data of enterprises which had gone bankrupt in the past as well as businesses that survived. They are based on the assumption that, several years before bankruptcy there occur certain anomalies in the undertaking that are manifested in other development of some indicators compared to a profitable company in the same industry. Deviations are most often related to the amount of working capital, current liquidity or profitability.

1 Literature Review

Many, especially foreign economists seek to provide information and assist management of businesses to detect an impending financial crisis of a company and to avert or delay bankruptcy. Since its inception to the present many bankruptcy and predictive models have undergone a journey from revaluation of their success to their condemnation. Among the first authors already in 1936 belonged R.A Fisher [2] describing predictive models in the article "The Use of Multiple Measurements in Taxonomic Problems."Another economists W. H. Beaver[1] in his work "Financial ratios and prediction of failure" in 1966 mentioned that at the beginning of the 20th century were known indicators as standard liquidity for assessing the credit value and then added up further, but little effort has been made to verify the usefulness of the indicators. Models created by Beaver that created belong to the one-dimensional model group based on simple characteristics. It reflects the economic situation of the company and divides companies to the prosperous businesses and firms by bankruptcy. William H. Beaver compared 79 large and medium-sized US companies that disappeared in the years 1954-1964 with companies that have been identified as prosperous. For each bankrupted enterprise be chose a thriving enterprise of comparable size in the same industry. The result of his research was thirty different ratio indicators. He found that statistically significant differences emerged in indicators that he divided into six groups (Table 1). In each group be chose one the most important variable predicting the disappearance of the business. The values of parameters were transferred to scoring. From this, using the sum or weighted sum be determined the final score.

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Table 1 : Dichotomous classification test

indicator	Number of years before bankruptcy				
	1	2	3	4	5
Cash flow/ external capital	13(10)	21(18)	23(21)	24(24)	22(22)
Net profit/assets	13(12)	20(15)	23(22)	29(28)	28(25)
external capital / assets	19(19)	25(24)	34(28)	27(24)	28(27)
Net working capital /assets	24(20)	34(30)	33(33)	45(35)	41(35)
Liquidity of the 3rd degree	20(20)	32(27)	36(31)	38(32)	45(31)
No credit interval	23(23)	38(31)	43(30)	38(35)	37(30)

Source: BEAVER, W.H. :
Financial Ratios as Predictors of Failure, Vol.4, Empirical Research in Accounting: Selected Studies 1966, p.85

The table shows the probability of error in assessing whether the rated entity is threatened by bankruptcy, or is smooth, depending on the number of years before the bankruptcy. The smaller the number of years in approaching bankruptcy, the more reduced the likelihood of incorrect placement. The disadvantage of Beaver's method was just chosen a sample of large and medium-sized enterprises, which limits its application on other samples. As presented by Sušický [6] for the model created by distinctive analysis there must be available financial data on a specific set of undertakings for the given period and also knowledge it that these establishments in the reporting period went bankrupt or not. In the set there must be two kinds of businesses. Then, on the basis of selected financial ratios there is set a certain limit, which divides firms into those likely going bankrupt and those that probably will not fail.

Another well-known American economist E. I. Altman in 1968 created the first model of prediction of financial distress, which in the following be modified. It was a model created by the multiple distinctive analysis where the objects were graded into two or more groups according to predetermined criteria. Among the best known Altman's model we include Z-Score, which was created in 1968 from a survey carried out in the years 1947-1965. The survey included a total of 66 US companies from which 33 went bankrupt and 33 were healthy. Altman divided selected companies by industries and company size to 1 million $ and up to 25 million $ and the weights of the model were based on the above distinctive analysis. The research was conducted in two stages, where the from first phase of the 22 indicators there were selected 5, in the second phase was then determined the weight to these variables in order of importance. The probability of predicting bankruptcy one year ahead is simply by Altman 94%, but in the estimation of two years in advance decreases the probability of correct prediction to 72%. Altman's proposed equation for predicted bankruptcy is:

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

where:
X_1=(working capital)/assets
X_2=(retained earnings)/ assets
X_3=EBIT/ assets
X_4=(market value of equity)/(accounting value of liabilities)
X_5=sales/ assets

Table 2: Altman model

Z-Score	explanation
>2,99	good financial situation
1,81-2,99	grey zone , it cannot be clearly evaluated
<1,81	financial problems, bankruptcy risk

Source: *RUČKOVÁ, P.:"Finanční analýza- metody, ukazatele, využití v praxi." Grada Publishing, 2008, p.73*

For enterprises that are not traded on a sock exchange, however was calculation problematic. Therefore, in 1983 there , was designed a new variant of Altman's model with changed weights of individual indicators and unchanged indicators X1, X2, X3, X5, but changed variable X4:
$$Z= 0{,}72*X_1+0{,}85*X_2+3{,}11*X_3+0{,}42*X_4+1{,}0*X_5$$
where: X4 =share capital / the value of all debts

Later in 1995 there came the next version of Altman model designed for the non-manufacturing companies and companies with differences in the method of financing assets and businesses operating in emerging markets. The modified models differ by weights and interval differences in the evaluation of results.

Creditworthy models have been developed for the purpose of examining whether the firm belongs to the good or bad firms in the industry. According to the author Szyguła A. [6] for financial companies, especially banks, it is important to assess the creditworthiness of the company applying for the loan and the risk of investing by the creditworthiness of the applicant. Similarly, states the author Sowa [5] for financial managers in enterprises it is necessary to assess the development of the company according to financial indicators. There are many ways of evaluating the creditworthiness of the company. Like in abroad, and the Czech and Slovak economists are concerned with creating

their own models for prediction of financial distress. In Slovakia, in the 1997 Zalai [9] worked on creating a tool that would allow with a reasonable reliability include an undertaking in the group of prosperous, respectively a non/going prosperous enterprises and then predict their future development. The analysis was focused on joint-stock companies belonging to the sectors- manufacturing, services, trade. For profitable firms be chose criterion of the third grade of liquidity (total liquidity) higher than 1.5, while return on sales was higher than 5%. Ailing businesses were selected from the sample with total liquidity of less than 1.0, as well as those businesses that have a negative return on sales. Description of financial and economic situation of enterprises was performed using a set comprising 72 of indicators. These demonstrate the assets, financial situation and the yield of businesses. Such an extensive set of indicators was gradually compressed into 8 indicators. He received a sufficiently clear view of the area of income, finance and equity. According to his research candidate for insolvency varies considerably especially by low state of liquid assets, followed by problems in the generation of profit and profitability derived there from. Evident are already problems in the financial situation and the year before bankruptcy it is the inability to settle obligations.

In the Czech Republic since the nineties has been created creditworthy model, of the Czech financial analyst Rudolf Doucha, where as mentioned [3] is a rating system developed in similar conditions to those in Slovakia, therefore its expressiveness capability is quite high. There are three variants, which differ from each other by complexity, level of detail, and the number of indicators. The indicators are designed so as to allow via this analysis, in a simple way to verify the operation of the business. Balance sheet analysis I consists of four indicators such as stability, liquidity, activity and profitability, and one endpoint. The balance sheet analysis II. is working with the 17 indicators and one indicator of the total. As in the balance sheet analysis I., there are also four variables that are then developed into 3- 5 partial indicators. They are composed in a such way that the rising value means improving situation of the company. It can be used for strategic decision-making, for denouncing the particular situation of the company. The balance sheet analysis III. is the most complex variant, based on the balance analysis II and adds to it cash flow calculating .

3.Research Methodology

The aim of the article was to test in terms of Slovak enterprises one of creditworthy models which best corresponds to the economic conditions in the Slovak Republic. Prerequisite for evaluating the success of that creditworthy model was therefore to obtain the necessary information from adequate number of financial statements.

Although businesses registered in the commercial register are required to disclose its financial statements in the collection of documents, they do not comply with this obligation. In general, SME-s do not have financial statements with much explanatory power. Besides objective factors such as method of assets depreciation and its impact on the carrying value of the

assets, often plays a large role the lack of legislation knowledge in the field of accounting. Some companies deliberately misrepresent certain information for certain purposes. The research is, therefore based on the sample of 35 enterprises which were a public limited companies and at the same time, which had to satisfied the following conditions:

1)according to the law to have audited their final statement by auditor,

2)to cease from business by bankruptcy declaration.

The material in processing were accounts of randomly selected companies for the years 2008 - 2010. From 01 January 2002 to 31 December 2013 there were required to have an audit companies and cooperatives if they met two of the three terms in the Act; total assets exceed 1.0 million € and turnover will exceed 2.0 million € . The third condition in the law was that the average number of employees was higher than 30. Such firms are required to disclose the balance sheet and profit and loss account in the Commercial Bulletin. An accounting entity in the Slovak Republic is obliged to publish financial statements within 30 days after the approval of the financial statements.

4 The purpose and objectives

The object of the investigation was to determine the percentage of correctly estimated future development of a company that could be a tool for manager of a company as well as company owners. In adverse trends it can help take corrective action and change negative development. The conducted research points to the usefulness of one of prediction models for the practice of Slovak companies.

5 The presentation of research results

The main data sources were reports of large companies (public limited company) published in the Commercial Bulletin of the Ministry of Justice of the Slovak Republic. In addition for the analysis of financial statements there was also used a paid database - Index of entrepreneur. The main data sources were reports of large companies (public limited company) published in the Commercial Bulletin of the Ministry of Justice of the Slovak Republic. In addition for analysis of financial statements, there was also used paid database to index of entrepreneur. During the test of a small number of Slovak enterprises, there were conducted 70 observations (one observation, i.e. one statement = balance sheet +profit and loss statement). The object of the investigation was to determine what percentage can correctly estimate future development. For each of the holdings there were acquired 2-3 complete final statements for the year-end (Dec.31).

To test the use of creditworthy models in practice of Slovak business as there was selected model of balance sheet analysis II., described and presented in Chapter 2.Each of enterprises has been tested with the following 17 partial indicators, which represented 4 summary fields. Four summary indicators of stability (S) activity (A), liquidity (L) and profitability (R) are the weighted average of the partial indicators belonging to one group and one indicator is the total (C). In all indicators the best resulting value is equal to the number 1 or number close to it.

The variable (S) is the weighted average of indicators S1 to S5, the stability of each of these parame ters is assigned a weight according to the extent of the impact on the overall stability of the enterprise:

Table3 Indicator STABILITY according to balance sheet analysis II

$S = \dfrac{2 \cdot S_1 + S_2 + S_3 + S_4 + 2 \cdot S_5}{7}$		(1)
	$S_1 = \dfrac{equity}{fixed\ assets}$	
	$S_2 = \dfrac{2 \cdot equity}{total\ assets}$	
	$S_3 = \dfrac{equity}{borrowings}$	
	$S_4 = \dfrac{total\ assets}{5.short\text{-}term\ borrowings}$	
	$S_5 = \dfrac{total\ assets}{15 \cdot stocks}$	

Source: KOČIŠOVÁ, K.-KUBALA, P.: Bankrotné a bonitné modely a ich využitie v konkurenčnom prostredí. (Bankruptcy and creditworthy models and their use in competitive environment) Available at:
http://of.euba.sk/merkur_2012_cd/prispevky/Kočišova_Kubala.pdf

According to the model of the balance-sheet analysis II a variable L liquidity is weighted average of incremental causal indicators of company's liquidity. These are incorporated into the equation of the total liquidity with coefficients that reflect the weight of their influence:

Table 4 Indicator LIQUIDITY according to balance sheet analysis II

$L = \dfrac{5 \cdot L_1 + 8 \cdot L_2 + 2 \cdot L_3 + L_4}{16}$		(2)
	$L_1 = \dfrac{2 \cdot financial\ assets}{short\text{-}term\ borrowings}$	
	$L_2 = \dfrac{financial\ assets + accounts\ payable}{2,17 \cdot short\text{-}term\ borrowings}$	
	$L_3 = \dfrac{current\ liabilitie\ s}{2,5 \cdot short\text{-}term\ borrowings}$	
	$L_4 = \dfrac{working\ capital}{total\ assets}$	

Source: KOČIŠOVÁ, K.-KUBALA, P.: Bankrotné a bonitné modely a ich využitie   v konkurenčnom prostredí. (Bankruptcy and creditworthy models and their use in competitive environment) Available at: http://of.euba.sk/merkur_2012_cd/prispevky/Kočišova_Kubala.pdf

Variable of activity (A) is the weighted average of the indicators of the activity of the under taking, it is therefore complemented by their impact factor:

Table 5 Indicator ACTIVITY according to balance sheet analysis II

$A = \dfrac{A_1 + A_2 + A_3}{3}$		(3)
	$A_1 = \dfrac{turnover + production}{2 \cdot total\ assets}$	
	$A_2 = \dfrac{turnover + production}{4 \cdot equity}$	
	$A_3 = \dfrac{4 \cdot added\ value}{turnover + production}$	

Source: KOČIŠOVÁ, K.-KUBALA, P.: Bankrotné a bonitné modely a ich využitie   v konkurenčnom prostredí. (Bankruptcy and creditworthy models and their use in competitive environment) Available at: http://of.euba.sk/merkur_2012_cd/prispevky/Kočišova_Kubala.pdf

The variable of profitability (R) represents the weighted average of profitability together with the respective weights.

Table 6 Indicator PROFITABILITY according to balance sheet analysis II

$R = \dfrac{3 \cdot R_1 + 7 \cdot R_2 + 4 \cdot R_3 + 2 \cdot R_4 + R_5}{17}$		(4)
	$R_1 = \dfrac{10 \cdot earnings\ before\ interest\ after\ taxes}{added\ production}$	
	$R_2 = \dfrac{8 \cdot earnings\ before\ interest\ after\ taxes}{capital}$	
	$R_3 = \dfrac{20 \cdot earnings\ before\ interest\ after\ taxes}{total\ liabilitie\ s}$	
	$R_4 = \dfrac{40 \cdot earnings\ before\ interest\ after\ taxes}{turnover + production}$	
	$R_5 = \dfrac{1,33 \cdot profit\ from\ economic\ activities}{accounting\ profit}$	

Source: KOČIŠOVÁ, K.-KUBALA, P.: Bankrotné a bonitné modely a ich využitie   v konkurenčnom   prostredí. (Bankruptcy and creditworthy models and their use in competitive environment) Available at :http://of.euba.sk/merkur_2012_cd/prispevky/Kočišova_Kubala.pdf

The resulting value of the C model analysis (II) balance will then be:

C > 1,00   good financial standing,quality enterprise enterpriseenterpriseenterprise quality

C 1,00-0,50 the deteriorating state of the enterprise

C < 0,50   the financial problems, the risk of bankruptcy

$C = \dfrac{2.S - 4.L + 1.A - 5.R}{12}$		(5)

Source: KOČIŠOVÁ, K.-KUBALA, P.: Bankrotné a bonitné modely a ich využitie v konkurenčnom prostredí. _2012_cd/prispevky/Kočišova_Kubala.pdf

Correctly classified, i.e. a one –year forecast of upcoming problems was 73.5%(see Chart 1) of all evaluated enterprises . Should the management exercise regularly examination of the financial situation of the company, they should still have time to prepare for the upcoming challenges. Following calendar year, which was after tested financial statements year before bankruptcy, businesses actually got into financial mismanagement of the situation and they declared bankruptcy. In 26.5% of tested enterprises systems, however did not warn against impending danger, through value of C was above 1.0 and the company's financial situation appeared to be stable. The following year, however there was declared bankruptcy of the company.
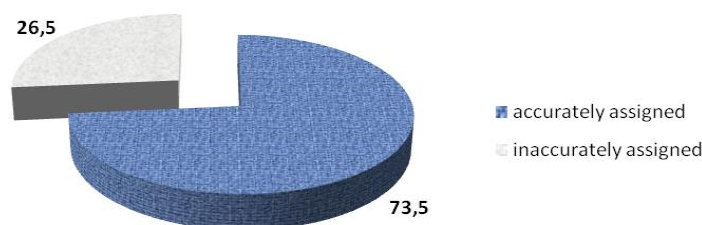
Graph 1:Successfulness of Balance analysis II model
Source: own research based on the sample of bankrupted Slovak companies from the period 2008-2010.

The reasons for this unexpected turn could be several .One of them, for example was the selection of the sample itself, which was based on the actual bankrupt businesses. Here it would be appropriate to test for example by the Z-Score. Suitable would also be conduct testing by balance analysis II., for the same number of successful enterprises in the same period of time, which despite the difficult economic period, which was characterized by economic crisis, managed to succeed.

6. Conclusions

Within a closer look on the issue of Slovak enterprises it would be useful to test the commercial enterprises not only industrial enterprises. According to the authors Kočišová and Kubala [3] known Czech analyst Rudolf Doucha recommends for the business enterprises omit one of the indicators of stability- S5, because these compnies have no or only small stocks and variable therefore can not be calculated, and its value can be extremely high i.e. they distort the evaluation of the company.

According to Úradníček[8] there are economists who lead the ongoing discussions on the weight allocated to the use of quantitative or qualitative methods in their everyday practice. The objective of using quantitative methods in solving problems and decision-making tasks at the enterprise level is mainly contribute to the knowledge or clarification of studied phenomena, processes, links, or their causes and mutual conditionality. Exclusive use of quantitative methods is largely unrealistic. It may end up at best at a few experimental applications that are administratively or due to a short period of a few individuals to pursue. The opposite extreme are economists who prefer in research and in practice only the minimum quantitative approaches. They justify it by pointing to completely unsatisfactory results of quantitative economic theory in financial and economic practice, or unfit modelling of significant factors determining processes in financial-economic practice. They often justify their rejection by low efficiency of results of their activities in relation to the costs incurred to achieve them. It is therefore recommended in making financial analysis to choose a reasonable compromise between the primary and the often costly effort to solve complex problems only by exact methods and their counterparts, i.e, using only heuristic methods alone or even attempt to meet exclusively with solutions based on previous experience, knowledge and intuition of the financial analyst.

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