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COMPARISON OF THE MODELS OF FINANCIAL DISTRESS PREDICTION

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Abstract

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Prediction of the financial distress is generally supposed as approximation if a business entity is closed on bankruptcy or at least on serious financial problems. Financial distress is defined as such a situation when a company is not able to satisfy its liabilities in any forms, or when its liabilities are higher than its assets. Classification of financial situation of business entities represents a multidisciplinary scientific issue that uses not only the economic theoretical bases but interacts to the statistical, respectively to econometric approaches as well.
The first models of financial distress prediction have originated in the sixties of the 20th century. One of the most known is the Altman's model followed by a range of others which are constructed on more or less conformable bases. In many existing models it is possible to find common elements which could be marked as elementary indicators of potential financial distress of a company.
The objective of this article is, based on the comparison of existing models of prediction of financial distress, to define the set of basic indicators of company's financial distress at conjoined identification of their critical aspects. The sample defined this way will be a background for future research focused on determination of one-dimensional model of financial distress prediction which would subsequently become a basis for construction of multi-dimensional prediction model.

bankruptcy model, financial distress, financial indicators, financial position, financial ratios

In recent years, financial distress of enterprises was a frequently discussed topic, even with regard to its potential correlation to the global financial crisis that began in 2007, and opinions on the end of this crisis are still differing. Not even due to that, the question of financial distress prediction of enterprise is still actual, but also in the context of globalizing markets and current state of the business environment, for the companies it is necessary to be more careful in their business relationships. Bankruptcy models are relatively fast and easy to use tools for indication of potential financial problems, i.e. financial distress of a company.

First bankruptcy models have been created in the sixties of 20th century (Beaver, 1966; Altman, 1968), and in basic classification they can be divided into one-dimensional and multi-dimensional models. Especially multidimensional bankruptcy models are then characterized by the simplicity of their application and interpretation of achieved result. This result is a factor score, respectively its value. According to this value, the analysed subject can be classified in terms of whether it is probably a company threatened by bankruptcy, i.e. company in financial distress, or not (Čamská, 2012).

OBJECTIVE AND METHODOLOGY

Objective of this article is to define the set of basic indicators that indicate a potential threat of financial distress in a business entity, and to identify their critical aspects with regard to the accounting bases of these indicators.

Prediction of financial distress is generally understood as a method based on estimating whether a company is in financial distress, i.e. company potentially facing to bankruptcy. Company is in financial distress if it is not able to meet its obligations or in a situation where the value

of its liabilities exceeds the value of its assets. In this sense, so called relative and absolute inability of company are distinguished here (Marek *et al*., 2009).

If the individual financial distress prediction models are evaluated in terms of their predictive power, it is necessary to perceive the fact that the occurrences of financial distress in the company and declaration of bankruptcy are not in a clear causal relationship. It is also important to take into account that these are statistical models based on the probability distribution, and the predictive ability of neither of them is not a hundred per cent. Therefore their results should be interpreted as a possibility or probability of existence or absence of financial distress in the analysed company.

For this purpose, the authors applied mainly the secondary research within the existing financial distress prediction models. Subsequently, they identified essential common characteristics of these models, which are subjects of critical analysis.

Methodological Background of Financial Distress Prediction

Construction of all the financial distress prediction modes has the common bases rest in comparison of historical economic data of prosperous business entities and business entities bankrupted in the same period of time. In fact, this procedure is used right from the beginning of efforts for a financial distress or bankruptcy prediction, and is also the basis of one of the first models in this issue that is Beaver's profile analysis (1966). At preparation of this model, Beaver has analysed the pairs of companies – "twins" while one of them was a company with financial problems, the second one was a company without any signs of financial problems. In the set of companies, 79 companies in total, Beaver has observed 30 indicators of financial position and performance. By use of analysis of differences, only 6 financial ratios where the differences were the highest entered to the final model. The selected ratios for the final Beaver's model are as follows:

- Operating cash flow to debts;
- Net profit (EAT) to assets;
- Debts to assets;
- Net working capital to assets;
- Current ratio, i.e. current assets to current liabilities;
- No credit interval, i.e. sum of short-term receivables and cash to operating costs, depreciation cost excluded.

Subsequently, these ratios are possible to be found also in other multi-dimensional model of financial distress prediction when some of these ratios are already included in the Altman's Z-score model that followed Beaver's work.

The basic methodological tool of the most of "classic" multi-dimensional model of financial distress prediction is the discriminant analysis. Discriminant analysis is a multivariate statistical method, which aim is to classify the statistical units (objects) into two or more pre-defined groups according to the statistical characteristics of these analysed units (Hendl, 2004). This way, the discriminant analysis belongs to the group of statistical methods investigating dependence between a group of independent quantitative variables (discriminants p) and one dependent qualitative variable (Meloun & Militký, 2002).

For the purpose of the financial distress prediction model construction, the dependent qualitative variable is supposed to be a statement whether the company possibly faces to financial distress or not. Then, the discriminants are selected economic indicators, especially the financial rations used in financial analyses. The number of discriminants should not be higher than 8, while from the set of all discriminants possible only those which are sound enough are selected. The discriminants selection procedure is proceeding in the way that for the best discriminant the second best one is found as it is proved whether the discrimination would be of the same quality if one of discriminants is eliminated. Statistical significance of the discriminants is tested then by the F-test (Meloun & Militký, 2002). On the discriminant analysis, e.g. Altman's Z-score model, Taffler's index of IN indexes are based (Altman, 2002; Taffler, 1984; Neumaierová & Neumaier, 2002).

Nevertheless, construction of the financial distress prediction models is possible to be based also on even simple methods like e.g. comparative-analytical methods that are also bases of Argentini's model etc. It is also possible to employ simple mathematic-statistical methods like e.g. method of (weighted) sum, method of (weighted) ratio, scoring methods or method of distance for a fictive point. Currently, on the opposite side of the spectrum, it is possible to find even sophisticated approaches to financial distress prediction using generic algorithms or neural networks (see e.g. Mackevicius & Sneidere, 2010).

Generally, standard models of the financial distress prediction are based on selected financial ratios which are weighted by their importance presented by a number. The authors investigate both, frequency of a ratio occurrence in various model as well as the weights of these ratios in the analysed models. The statistical sample counts 20 models of financial distress prediction which are applicable in the circumstances of the Czech Republic.

Indicators of Potential Financial Distress of a Company

In general, the basis of the financial position and performance evaluation is accounting data which are fundamentally considered as input variables of standard financial ratios in financial analysis (Salehi & Abedini, 2009). Nevertheless, certain models, such as Ohlson's model, include e.g. an index of

I: *Most frequent financial ratios*

Ratio	Frequency	Weighted Average of Ratio's Weight
Sales / Assets	11	0,70685
Retained Earnings / Assets	8	0,19000
EBIT / Assets	8	0,41347
Working Capital / Assets	8	0,21496
Current Assets / Current Liabilies (Current Ratio)	5	0,58575
Equity / Debts	5	0,06155
EAT / Assets (ROA)	4	0,39575
Debts / Assets	3	–0,09562
EBT / Current Liabilities	2	0,32895
EAT / Sales (ROS)	2	0,32893
EBT / Assets	2	0,21176

Source: authors' elaboration

gross national product (Ghodrati & Moghaddam, 2012).

Perhaps the most famous and globally used model is Altman's ZETA model, which exists in several versions to the present (e.g. 1968, 1983 and 1995 etc.). The first of the Altman's model were applicable only to listed enterprises, because one of the components of this model was also market capitalization as an indicator of simple view on company value, respectively the ratio of market capitalization to debts. In the models that followed the Altman's and in other models of prof. Altman as well, effort to broader applicability of models already appears while in most cases these models include standard ratios of financial analysis.

Within the elaborated analysis of secondary data, the authors examined a sample of twenty bankruptcy models which are frequently used in the Czech Republic. Within these twenty models frequency of occurrences of each ratio have been defined in these models. Then, there were established weighted average of coefficients, which are assigned to these indicators. Their overview is presented in Tab. I.

Most frequent indicator observed in the analysed sample is the assets turnover ratio, i.e. ratio of sale to assets, which occurs with different weights in 11 analysed models. Average weight of coefficients of this indicator calculated as simple arithmetic average has value of 0,498 while weighted average is considered as more suitable for this purpose. The weighted average of coefficient has the value of 0.7068 then. Moreover, this value is also the highest in the set of bankruptcy models analysed. The economic theory (e.g. Kislingerová, 2010) states that value of this indicator should be higher than one. It means that sales generated by total capital of company should be the at least on the same level as value of total capital is. In the context of sales, it is necessary to evaluate also company's ability to cash them because the sales recognition itself does not mean any threat company's financial distress. Then, it is possible to suppose that this indicator should be supplemented with evaluation of liquidity. Within 11 models where the assets turnover ratio occurs, there is only one model that includes also the evaluation of liquidity on the level of current ratio.

Frequency of the next three indicators occurrence in the analysed set is the same while it is 40 per cent. These indicators are the ratios of retained profit to assets, EBIT to assets, and working capital to assets. Within these there indicators, the highest value of the weighted average of coefficient goes to the indicator of the gross production power of company, i.e. EBIT/Assets, that has the value of 0.4135. Nevertheless, if any profitability ratio is used in order to predict a financial distress of business entity it is not any solution with regard to the fact that profit is just an accounting fiction which is quite easy to manipulate by application of accounting methods. Moreover, in this case the profit is in EBIT variant, i.e. the profit that is not reduced for the cost of debts that would be very significant in companies facing the financial distress because right in this context the cost of debts start to increase for the cost of financial distress. According to the weighted value of coefficients, the next indicator is the ratio of working capital to asset with the weighted value of coefficients of 0.2150. To some extent, this indicator can be supposed to represent a certain form of liquidity, i.e. working capital as the difference between current assets and current liabilities. On the other side, it is a ratio that is quite difficult to interpret. In its core, it is just a share of current asset covered by long-term capital resources on total assets. Nevertheless, if the working capital is considered as some "security reserve" in company's ability to pay, this ratio could be regarded as a rate of liquidity provision. In 8 of the 20 bankruptcy models analysed, the ratio of retained profit to assets occurs as well, i.e. the share of retained profit as of the internal financial resource on total capital employed. Nevertheless, retained profit is mainly a reflection of past development of a company and its results but its explanatory power in connection to concurrent state of a company is quite low. The

real value of retained profit is necessarily changing in a course of time in relation to company's results regardless its book value presented in balance sheet. Weighted average of coefficient of this ratio within the analysed set of bankruptcy models has the value of 0.19.

In 25 per cent of the models analysed, the ratio of financial leverage and current ration are included. Weighted average of coefficients of current ration in the analysed set has the value of 0.5857 which is the second highest value of weighted coefficients average. By application of the current ratio, it is possible to evaluate potential financial distress a company quite successfully, but only if short-term assets are used in calculation instead of total current assets that is the biggest problem of automatic substituting values into formulas.

Financial leverage that reflects the capital structure of a company, and also evaluates a financial risk this way, is characterized with the weighted average of coefficient of 0.0616 within the analysed sample of the models. This value could lead to an assumption that financial leverage is an indicator of quite low importance in assessment of potential financial distress. Nevertheless, it is always necessary to take interval of possible values of a ratio into account. If the financial risk of a company is low, i.e. equity exceeds debts and financial leverage is lower than 1, than the decrease to the 6 per cent of the value is not necessary to be a subject of heavy discussion. But if the financial risk is growing and this way, financial leverage exceeds 1, a problem could appear because of positive values of the coefficient and subsequent classification of a business entity into one of defined intervals interpreting the result. Then, the logic can be found here just in case of negative financial leverage, i.e. in the situation when equity of a company is negative that means the absolute inability.

Relative frequency of the next ratio, the return on assets again, now in the net entity value, i.e. EAT to assets, is 20 per cent while the weighted average coefficient of this indicator in the models analyses has the value of 0.3958. But with regard to the employment of profit in this indicator, net production power of assets is quite problematic. Nevertheless, this ratio could be considered as more suitable for financial distress prediction than the gross production power which is calculated based on EBIT that does not enable to explicitly identify potentially occurring cost of financial distress of a company. Then, with regard to employment of net profit in this ratio it would be preferred to join this indicator with evaluation of ability to pay in a model. Combination of net production power of assets and evaluation of liquidity is really included in all the analysed models where this ratio is employed, while the company's ability to pay is mostly evaluate through debt payment period ratio that is the indicator based on cash-flows, this was observed in three models, while in the rest of this group of model analysed, it was the indicator of current ration.

In the twenty bankruptcy model analysed, the debt ratio occurs in three of them. In the opposite to all of above mentioned ratios frequently employed in the bankruptcy models having the coefficients of a positive values, this ratio in every model has the coefficient of the value which is negative, i.e. the total score decreases with the indebtedness of a business entity. The weighted average of coefficient of the debt ratio is –0.0956 in the sample analysed.

The minus of ratio's coefficient has its logic consequence. In the short-time, high indebtedness of a company does not need to mean a financial distress. It can be also connected for example with an expansion of company that is funded by debts which would be covered by economic benefit of this expansion in future. But if the high indebtedness joined with high financial ratio lasts in a long-time period then company is likely to face a financial distress because it is probable that company would not be able to pay these debts at their maturity. This way, it would be also suitable to complete the prediction model with evaluation of liquidity again which is however included in in each model analysed where the debt ratio was observed; it is especially the indicator of current ratio that is employed there.

In 10 per cent of the models analysed the indicators of EBT to assets, with the value of weighted average of coefficient 0.2118, of EAT to sales, with the value of weighted average of coefficient 0.3289, and the EBT to current liabilities, with the value of weighted average of coefficient 0.3290, are included. The last one mentioned, i.e. the ratio of earnings before taxation to current liabilities, have however the highest value of coefficients within these three indicators, but its explanatory value is potentially the lowest because this indicator cannot be supposed as one evaluating company's ability to pay its liabilities. The ratio only shows to what extent the current liabilities are covered with profit, moreover with the profit before taxation. Over and above, only in the Taffler's model, this ratio is completed with employment of liquidity evaluation here it is but the ratio of total debts coverage with the current assets. Return on sales, i.e. EAT to sales or also the profit margin has undoubtedly the reason in the financial distress prediction and recognition because it is possible to suppose that business entity facing financial distress would temporarily decrease its profit margin in order to attract new demand followed by positive cash-flows. Nevertheless, it is necessary to take this ratio cautiously on the other side because business branched of generally low profit margin exist in economy. Such a branch is for example food industry which is right the object of author's research. The last one here, the earnings before taxation to assets ratio is another form of assets production power presentation. The profit before taxation is employed here while it would be possible to make the same critics as in the cases of two previous indicators of production power of assets.

All the other indicators, including e.g. an important ratio of profitability – return on equity, have been included just in one of the models analysed. In total, 32 indicators once represented indicators were observed in the bankruptcy models sample analysed.

DISCUSSION OF RESULTS

For the purposes of this paper, the authors analysed twenty bankruptcy models whose application considered to be appropriate in the circumstances of the Czech Republic, such as the modified Altman's model, Taffler's model, index IN 95 Gurčík's model, Zmijewsky's model, R-model, and more (Gručík, 2002; Koleda & Lace, 2009). The results obtained were compared with the results of an extensive study (Bellovary, Giacomino & Akers, 2007). These authors analyzed the history of bankruptcy models since 1930. Then they specified, within the list of bankruptcy models, the most common indicators in the following order (Bellovary, Giacomino & Akers, 2007):

1. Net income/Total Assets (in 54 models);
2. Current Ratio (in 51 models);
3. Working Capital/Total Assets (in 45 models);
4. Retained Earnings/Total Assets (in 42 models);
5. EBIT/Total Assets (in 35 models);
6. Sales/Total Assets (in 32 models), etc.

At comparing these results with those presented in the Tab. I, it is visible that most frequent ratio in the authors' study is just on the 6th place in the study of Bellovary, Giaomino & Akers (2007), and other difference are possible to be find as well. Nevertheless, these authors are not presenting the wages of ratios used in the model analysed by them. That is also the reason the Pearson's pair coefficient of correlation has been subsequently used in order to investigate whether the value of ratio's weight in a model is connected to the frequency of the ratio employment in a model. The value of the Pearson's correlation coefficient here is 0.8665 while the T-test, on the level $\alpha = 0.05$, has proved this correlation as statistically significant. This way, it is possible to conclude that the statistic dependence between the frequency of ratio usage and it's weigh in a model exists.

CONCLUSION

Objective of this article was to define the set of basic indicators that indicate a potential threat to of financial distress in a business entity, and to identify their critical aspects. Within the analysed sample of twenty bankruptcy models which are ranked as an appropriate for application within the circumstances of the Czech Republic, the sales to asset ratio was identified as the most frequent ratio applied. Among statistically significantly indicators, the ration of return on sales was identified as well. Both of these indicators are rather problematic due to the authors' focus on prediction of financial distress of business entities in the food industry, which is characterized by low profitability on every level.

Nevertheless, in the frames of the analysis and the result provided in this paper, there are also other ratios employed in the sample of models suitable for the Czech companies. The sample defined this way will be a background for future research focused on determination of one-dimensional model of financial distress prediction which would subsequently become a basis for construction of multi-dimensional prediction model.

SUMMARY

In recent years, financial distress of enterprises was a frequently discussed topic. Bankruptcy models are relatively fast and easy to use tools for indication of potential financial problems, i.e. financial distress of a company. Prediction of financial distress is generally understood as a method based on estimating whether a company is in financial distress, i.e. company potentially facing to bankruptcy. Objective of this article is to define the set of basic indicators that indicate a potential threat of financial distress in a business entity, and to identify their critical aspects. For this purpose, the authors applied mainly the secondary research within the existing financial distress prediction models. Subsequently, they identified essential common characteristics of these models, which are subjects of critical analysis. Within the elaborated analysis of secondary data, the authors examined a sample of twenty bankruptcy models which are frequently used in the Czech Republic. Within these twenty models frequency of occurrences of each ratio have been defined in these models. Then, there were established weighted average of coefficients, which are assigned to these indicators.

Most frequent indicator observed in the analysed sample is the assets turnover ratio, i.e. ratio of sale to assets, which occurs with different weights in 11 analysed models. The weighted average of coefficient has the value of 0.7068. But in the context of sales, it is necessary to evaluate also company's ability to cash them because the sales recognition itself does not mean any threat company's financial distress. Then, it is possible to suppose that this indicator should be supplemented with evaluation of liquidity. Within 11 models where the assets turnover ratio occurs, there is only one model that includes also the evaluation of liquidity on the level of current ratio. The same problem is found in the case of indicators calculation with any form of a profit. The most frequent of them observed are EBIT, respectively earnings before or after to assets, retained earnings to assets, or return on sales while these ratios are not very often combined with solvency indicators. Then, also financial leverage and

total indebtedness are applied quite often. Liquidity evaluation is contained in 25 per cent of models analysed.

For the purposes of this paper, the authors analysed twenty bankruptcy models whose application is considered to be appropriate in the circumstances of the Czech Republic. Pearson's pair coefficient of correlation has been subsequently used in order to investigate whether the value of ratio's weight in a model is connected to the frequency of the ratio employment in a model. The value of the Pearson's correlation coefficient here is 0.8665 while the T-test, on the level $\alpha = 0.05$, has proved this correlation as statistically significant. This way, it is possible to conclude that the statistic dependence between the frequency of ratio usage and it's weigh in a model exists.

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