

## **BANKRUPTCY PREDICTION OF SMALL AND MEDIUM-SIZED INDUSTRIAL COMPANIES IN CZECHIA**

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### **Abstract**

Managing a company successfully, making the right decisions that ultimately lead to the company's effective functioning requires a comprehensive overview of the company's situation and a continuous assessment of the results of its business activities. The future of each company, as such, is determined mainly by decisions taken by the company management. These decisions should, therefore, be based on up-to-date, objective, and reliable information based on financial analysis. It is a set of methods enabling to determine and consequently influence the position of the company on the market based on the review of its economic situation. This fact was the main reason for choosing this topic, and the aim was to process a database of industrial companies with the necessary data to verify financial health using a bankruptcy model. In the first part, author pay attention to the importance of managers to pay regular attention to the economic situation to avoid problems and possibilities of predicting financial stability as well as authors who deal with this issue in detail. Financial analysis is a useful diagnostic tool that reflects the company's 'financial health' as well as a document recapitulating its results for the period under review, which it then assesses. At the same time, it identifies and analyses the factors that defined them, and then predicts the development to date. The results achieved and summarize it in a proposal of measures to achieve business goals. With the increasing availability of high-performance computing, sophisticated statistical methods have become more widely used in the field of economics and, in the area of financial health predictions. When creating the database and subsequent processing various software for processing the issue was used.

**Keywords:** prediction model, financial distress, financial health, bankruptcy.

## **1 INTRODUCTION**

Bankruptcy prediction is a topic that affects the economic prosperity of all countries (Vojtovic, 2016, p. 30-45). It is essential for all businesses, especially small and medium-sized enterprises (SMEs), to have an accurate predictive model of the company that can detect the symptoms of financial distress in a timely manner (Gordini, 2014, p. 6433-6445). bankruptcy prediction has been a popular and demanding area of research for decades. Most prediction models are based on financial data, stock market data, and specific

variables (Tobback, et al., 2017, p. 69-81). The viability of the company is influenced by passivity and not solving various crises into which they are exposed. It is essential to seek and control tools for a quick and objective assessment of the financial situation. Predictive models are among the tools that should be able to recognize the risk of future bankruptcy or bad financial health of a company promptly (Kliestik, et al., 2018, p. 791-803). According to an analysis carried out in 2018, 649 commercial companies bankrupt, and another 5418 business bankruptcies in the Czech Republic were announced, with the sectors most affected by CZ NACE, Industrial Manufacturing, and Construction. The number of bankruptcies of companies fell by 16% in 2018 compared to 2017. The number of bankruptcy proposals dropped by 21%. The number of bankruptcies of entrepreneurs decreased year-on-year by 15%. The number of proposals for the bankruptcy of natural person entrepreneurs decreased by 19% in 2018.

This research paper focuses on 1634 manufacturing companies in the Czech Republic to identify the financial health of the companies and subsequently to verify the results of the selected methods. Business management is based on decision making under conditions of relatively high uncertainty (Carter and Yeo, 2018, p. 11-38). The quality of choice depends on the information that is available and is effectively processed and interpreted (Lazaroiu, 2018, p. 58-63). An essential part of corporate governance is financial management, whose information base is financial analysis (Valaskova, et al., 2018, p. 2144).

Early warning systems should respond to financial distress, a state of the business that is the opposite extreme of financial health. Among these extremes, there are a large number of conditions, which are referred to by different names. Financial distress is generally defined as the state of a business where the business is experiencing severe payment problems (Kovacova, Kliestik, 2017 p. 775-791).

## **2 METHODOLOGY**

This section defines how the data was collected and how the financial health of manufacturing companies in the Czech Republic was assessed. The data were processed from 1634 production companies in the Czech Republic.

### **2.1 Data selection for financial analysis**

The financial analysis requires a large amount of quantitative data from various information sources. The complexity of the analysed data is strongly emphasized as it significantly influences the results of the financial health assessment. In this case, data from the AMADEUS database were processed. AMADEUS contains financial information on more than 200,000 European businesses, including 15,000 from Central and Eastern Europe.

### **2.2 Chosen models for predicting bankruptcy**

The **Altman model** is one of the bankruptcy models that was chosen to predict the financial health of companies.

Altman's model is one of the best-known predictive models of financial analysis. It tries to predict the bankruptcy of the company, to testify about its financial health, it trustfully predicts bankruptcy for the next two years. It can predict the bankruptcy of the company for a longer time horizon, but less likely. This model is also termed the Altman index, Altman test, Altman Z-score, or Altman trust index. E. I. Altman created it in 1968 based on a multidimensional financial analysis and since then has been modified and adapted to the conditions for different types of businesses. The Altman index is based on Beaver's univariate method. He evaluated 66 enterprises in the form of analysis, of which 33 were prosperous and another part of problem enterprise, where Altman used 22 ratio indicators, from which he chose only the five most important indicators, which crystallized as the most important over time (Grice and Ingram, 2001, p. 53-61).

There are several types of Altman models that have been created for multiple kinds of businesses, at different times, for a specific group of entities:

- models for listed companies,
- a model for non-publicly issuing businesses,
- a model for non-manufacturing and start-ups,
- Altman ZETA model.

Altman established a discriminatory function separately for undertakings with publicly traded shares and individually for other companies, while the author also created a model for non-productive, commercial, and start-ups (Altman, et al., 2017, p. 131-171). Altman's Z-score for publicly traded enterprises is calculated

according to the relation:

$$\mathbf{Z\text{-score} = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5} \quad (1)$$

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.

If the Z-score is higher than 2.99, then the company's financial situation is good. Between 1.81 and 2.99, it is the so-called grey zone where bankruptcy is possible. If the company achieves a Z-score of less than 1.81, then the financial situation is critical, and bankruptcy is very probable. Altman's model and its modifications are a frequently used method of financial analysis and prediction of the financial health of an enterprise to predict the direction of the company. The model has its advantages and disadvantages and among the weaknesses of the part, for example, that the analysis is done on a specific date, which can lead to a distorted reflection of the financial situation. In most ratios, the total asset component is found, which may also lead to a false picture of the entity as the model does not deal more closely with the quality of the asset (Altman, et al., 2014, p. 47). The advantage of these models, however, is the simplicity of calculations and relatively quick determination of results. The model is easy to apply to individual businesses and is still a convenient tool for knowing and forecasting the financial situation of companies (Kljucnikov, et al., 2017, p. 45-61).

**Anghel** developed a **model** based on discriminatory analysis, based on data from 276 businesses grouped into non-bankrupt (60%) and bankrupt (40%). Enterprises belonged to 12 industries of the national economy. He analysed the period between 1994 and 1998 (Craciun, et al., 2013, p. 375-383). First, 20 economic-financial indicators were used, but later, after the selection phase, four financial rates were set for the evolution of the score function:

$$\mathbf{Anghel\ model = 5.676 + 6.3718 X1 + 5.3932 X2 - 5.1427 X3 - 0.0105 X4} \quad (2)$$

where:

X1 = income profitability rate.

X2 = cash-flow debt covering rate.

X3 = asset indebtedness rate.

X4 = period of paying off the obligations.

If Anghel's model value were less than zero, it would mean bankruptcy or a failure situation for the business. The grey zone, where it is not clear what the financial situation in the company is exactly, occurs when the value of this model ranges from 0 to 2.05. The company achieves financial stability at values higher than 2.05 of the selected model. This model also has its limitations models taking into account the small number of rates that are considered the most significant. However, financial health is influenced by a number of factors.

### 3 RESULTS

This section demonstrates the results of the analysed enterprises. The entire database contains 1634 companies. To be able to interpret the data graphically, a random sample of 50 companies was selected, and financial analysis was carried out using two bankruptcy models. These models were compared and interpreted with each other and verified. Subsequently, the results of the whole database were processed.

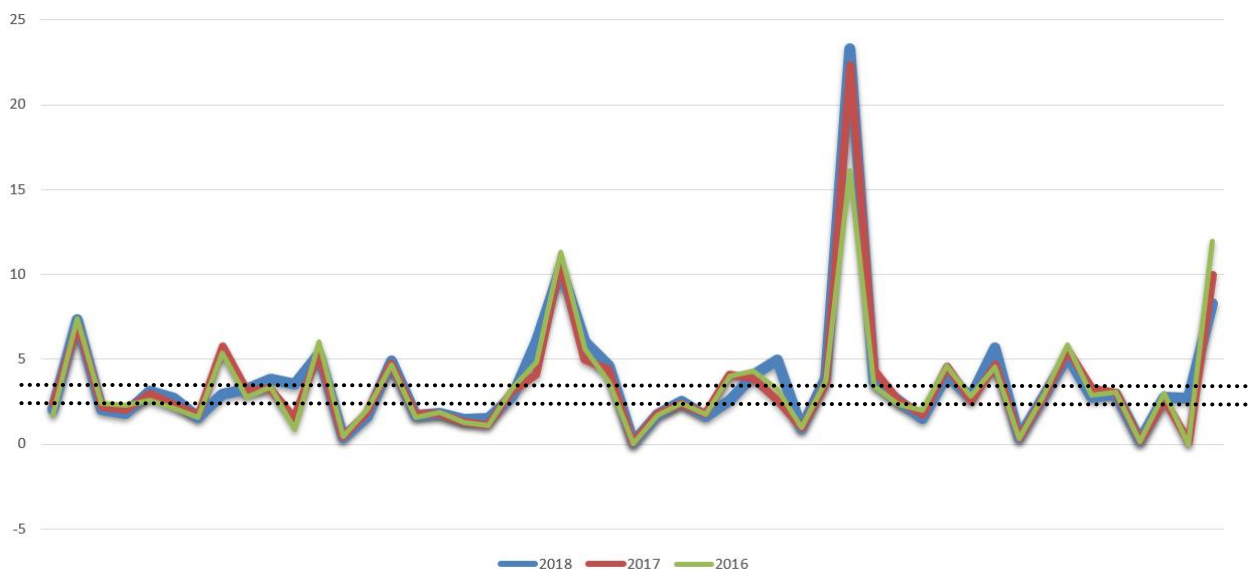


Fig. 1. Financial analysis of fifty small and medium sized manufacturing enterprises in the Czech Republic using Altman's Z-Score bankruptcy model.

Given the size of the processed data and the effort to demonstrate a part of the results graphically, as an example, is shown in Figure 1 results according to the Altman model Z-score of 50 enterprises in the Czech Republic within 2018-2016. Figure 1 illustrates how the business state is changing over the three years, for the more desirable or graver. The figure shows two dotted lines that divide companies into prosperous, bankruptcy, and companies in the grey zone. Enterprises with positive results under this model are above the top line. Businesses located between the lines are not classified as prosperous or non-prosperous and situated in the allegedly grey zone. Finally, companies below the bottom line are businesses close to bankruptcy or crisis.

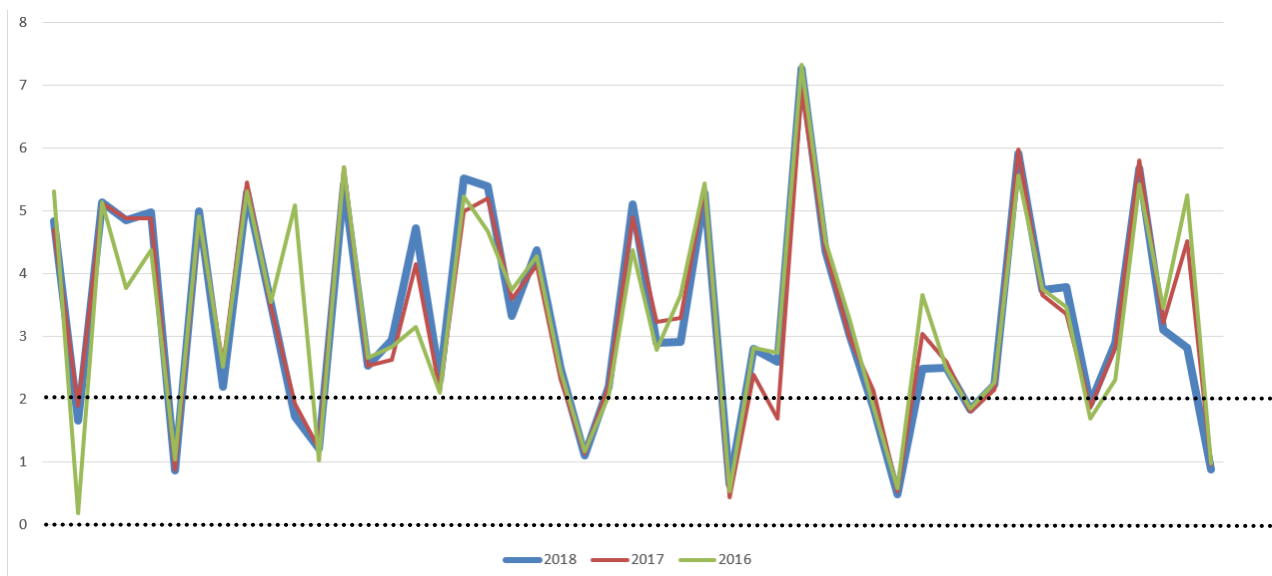


Fig. 2. Financial analysis of fifty small and medium sized manufacturing enterprises in the Czech Republic using Anghel bankruptcy model.

The second chosen bankruptcy model for predicting financial health is the Anghel model, which was applied to the same companies as the Z score. Encore, concerning the graphic demonstration, the same 50 production companies in the Czech Republic were selected, and the results in Figure 2 are graphically depicted for the same period 2016-2018. If the company achieves a value of less than zero, then it is a

bankrupt company or a company in crisis. The range from 0 to 2.05 is referred to as the grey zone, and enterprises are not unequivocally classified. On the other hand, those that result in values above 2.05 are classified as prosperous, financially stable enterprises. With reference to Figure 2, we can see that the model of 50 enterprises did not rank among the financially unstable enterprises.

If we summarized the results of the analysed 50 enterprises in 2018, based on the Altman model, 44% of enterprises are prosperous, 28% based on the results fall into the grey zone, and the remaining 28% do not have favourable financial results and risk bankruptcy.

With the second Anghel model for the year 2018, the analysed 50 same companies, up to 76% of them, would be considered to be financially prosperous. The other 24% of companies are in the grey zone, where it is not possible to clearly determine whether they are bankrupt or prosperous. No enterprise was included in the last bankruptcy group.

When verifying both model's results on a sample of 50 enterprises for 2018, the results of both models are the same as 42% of the entire set of enterprises.

In the first step, a sample of 50 enterprises was analysed, then a financial analysis using two bankruptcy models is applied to the entire created database of 1634 enterprises. The results are presented in Table 1. This table illustrates the transparent classification of enterprises in terms of financial health by model.

**Table 1. Results of analysis of bankruptcy models for Czech manufacturing companies**

	Z-score					Anghel model				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
<b>Financial stable</b>	30%	32%	30%	31%	30%	69%	71%	71%	71%	69%
<b>Grey Zone</b>	36%	35%	35%	35%	36%	19%	18%	16%	17%	19%
<b>Bankruptcy</b>	34%	33%	35%	34%	34%	12%	11%	12%	11%	12%

In the results of financial analysis, it is obvious what was above also confirmed on the smaller analysed sample. The Anghel model ranked more than half of the businesses in the period 2014-2018 prosperous. In the Altman model, on the other hand, companies are divided into different categories of prosperous, bankruptcy, and grey zones into uneven thirds. There were no significant year-on-year changes in each group within both models.

## **4 CONCLUSIONS**

All entities are exposed to the risk of bankruptcy. This risk may have adverse repercussions, with complex consequences both for the entire business of the entity and other entities with which it comes into contact. The risk of bankruptcy is the inability of a company to meet its payables arising either from ongoing operations the fulfilment of which is conditional on business continuity or from mandatory sampling. In recent years, due to the dynamics of companies' economic and financial activity, it has become more than necessary to obtain accurate information on the risk of bankruptcy in the future (Bordeianu and Paraschivescu, 2011, p. 284). Financial analysis should now be commonplace and should have its place in every business (Valaskova, et al., 2018, p. 105-121). The objective of this research paper was to analyse small and medium-sized enterprises in terms of their financial health in the Czech Republic. Two models were chosen for this purpose. One is the Altman model, and the other is the Anghel model. These are bankruptcy models that predicted the possible bankruptcy of selected companies, as well as their financial stability or grey zone. A total of 1634 manufacturing SMEs in the Czech Republic were analysed, and the results were interpreted. In the first phase, 50 enterprises were analysed, the results were interpreted, and the models were verified. The overall results provided by the models were different, which led to the conclusion that this issue should be further addressed. Each model takes into account various financial indicators, and based on the selected sample, it can be stated that the Altman model is more strict. The Anghel model may have omitted some important economic indicators. A drawback of all bankruptcy prediction models comes from the fact that bankruptcy is an example of a homogeneous observable

qualitative response while non-bankruptcy would be expected to be represented by a healthy firm (Baixauli and Modica-Milo, 2010, p. 1462-6004).

On the other hand, it is possible that the Altman model also includes those indicators that might not be included in the analysis. In any case, the data provided by enterprises also play an essential role, while many qualitative indicators are not quantified, which would have a significant impact on results. Prediction models are a topical issue that needs to be addressed, to define economic indicators, and to determine weights. Subsequently, the models need to be monitored in the longer term. Data for the last five years entered the analysis. The time horizon must be longer so that changes can be monitored, while at the same time cooperation with businesses and their objectively delivered results can significantly enrich this area.

## 5 ACKNOWLEDGEMENT

This research was financially supported by the project "Stabilization and development of SME in rural areas", reg. No. TL01000349, the TACR Éta programme.

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