Chapter 31
Application of Methods of Comprehensive Evaluation of a Company in the Conditions of the Visegrad Group's Countries

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Abstract For groups of users of business information, from owners through potential investors, management, or employees, it is important to find out the financial situation of the company and its future development. The financial health of a company can be determined in many ways, most commonly through financial analysis indicators. The aim of this chapter is to evaluate the applicability of methods for comprehensive assessment of the financial situation of Visegrad Group companies. The basis for the evaluation of the applicability of the methods of enterprise assessment will be the analysis of the applicability of bankruptcy models. The results of the bankruptcy models will be compared with the real numbers of bankruptcies of enterprises. The sensitivity analysis showed that the IN05 index was the most suitable for practical use on businesses in the Visegrad countries.

Keywords Financial distress · Bankruptcy models · Sensitivity analysis · Visegrad Group countries

31.1 Introduction

The financial situation of a company can be determined in many ways, most often through indicators of financial analysis. A company's financial distress arises in situations where the company has serious payment difficulties that cannot be resolved other than by a radical change in its activities or structure. The criterion for financial distress is usually defined not only by a capital restructuring of the firm or large-scale redundancies but also by the failure to pay dividends on preference shares, default on bond obligations, accumulated losses of the firm, or repeated

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negative cash flow. According to Baker and Powell (2005), financial distress occurs in a firm when it has difficulty meeting contractual obligations associated with debt financing. In this case, there is a general weakening of the firm's financial condition caused by enormous debt, with bankruptcy being the extreme case of financial distress.

However, the process of financial analysis, as a basic tool for assessing the financial health of a company, requires relatively lengthy and demanding procedures, and ultimately, its results may not provide sufficient information.

Bankruptcy models are an appropriate way of interpreting the results obtained in a comprehensive and comprehensible way to assess the health of a company. They are able to predict with a certain degree of probability the future financial performance assessment of an undertaking. In particular, they can determine whether or not an enterprise is heading toward a zone of potential financial distress.

Bankruptcy models (the Altman bankruptcy model, the Taffler bankruptcy model, or the IN credibility indices) are used as early warning systems of potential financial distress, capturing events typical of a firm's future bankruptcy. Through bankruptcy or creditworthiness prediction models, it is possible to model whether a firm will meet its obligations in a timely and sufficient manner. The formulas and financial ratios developed are used to predict whether a company is heading toward bankruptcy or is thriving. The bankruptcy prediction can be determined several years before the actual bankruptcy.

The aim of this paper is to evaluate the applicability of methods for comprehensive assessment of the financial situation of Visegrad Group companies. The basis for the evaluation of the applicability of the methods of enterprise assessment will be the analysis of the applicability of bankruptcy models. The results of the bankruptcy models will be compared with the real numbers of bankruptcies of enterprises. The expected finding will be whether the models fulfill the basic function of predicting potential financial distress of enterprises. The period under study is the period between 2008 and 2016 based on data availability. The mutual relationship will be analyzed at the national level for the Visegrad Group countries (Czechia, Hungary, Poland, Slovakia).

The remainder of this chapter is organized as follows. The relevant literature is reviewed in Sect. 31.2. The data and the methodology used in this chapter are introduced in Sect. 31.3. The results of the empirical estimation are reported in Sect. 31.4. The conclusions and summary of the main findings are contained in the Conclusion part.

31.2   Literature Review

Altman (2006) or Senbet and Wang (2012) have addressed the root causes of corporate financial distress. According to them, the most common reasons for financial distress are insufficient legislation, macroeconomic factors, deregulation in key industries (financial services, aviation, healthcare, energy industry), or growing

international competition and globalization. The basic models for predicting financial distress and corporate bankruptcy based on financial ratios are those of Beaver (1966) and Altman (1968). The prediction models are based on the hypothesis that a firm's financial distress can be identified by the values of its financial ratios before it actually manifests itself. The Taffler bankruptcy model (Taffler, 1983) was also developed on this basis. The first step in constructing this model was to calculate more than 80 selected ratios of all industrial firms between 1968 and 1976 and 46 randomly selected solvent industrial firms. The predictive ability of the Taffler model over the years has been confirmed by Agarwal and Taffler (2007).

Given that the paper is focused on the V4 countries, studies will be presented that dealt with the application of bankruptcy models to these countries. Opinions on the applicability of bankruptcy models vary widely. However, a common feature of the monitored studies dealing with the practical application of bankruptcy models is the opinion on the need for their combination.

According to Neumaierová and Neumaier (2005), the specifics of Czech financial statements and the economic situation in the Czech Republic are reflected in the IN credibility index. Similarly to previous bankruptcy models, this index contains an analysis of activity, profitability, debt, and liquidity ratios. Based on these analyses, four variants of the index were sequentially constructed. The IN95 index is a bankruptcy model created from a creditor's perspective, and unlike the Altman model, its indicators do not include the market value of the company. This modification is suitable for conditions of a poorly liquid capital market. In contrast, the IN99 index is a creditworthiness model constructed from the perspective of the owner. This index was constructed by applying a discriminant analysis to revise the weights of the IN95 indicators. These two models were then followed by the so-called comprehensive analysis IN01, which combined the previous two models. Subsequently, in 2005, a modified comprehensive index IN05 was created to assess the financial situation of an enterprise using a single number. According to Neumaierová and Neumaier (2005), the IN05 index is similarly successful in identifying the threat of bankruptcy as the Altman bankruptcy analysis in predicting potential bankruptcy.

The financial situation of firms, especially the prediction of financial distress and bankruptcy, was the subject of a study by Lizal (2012) using the Czech Republic as a case study. In the Czech Republic, the main factors affecting the probability of bankruptcy in the period 1993–1999 were analyzed. The basic bankruptcy models are compared on the basis of neoclassical theory, financial ratios, and corporate governance indicators. It is the evaluation of financial ratios that has proved to be the most appropriate for monitoring corporate activities. Thanks to them, enterprises that were at risk of financial distress during the period under review were identified. The importance of the practical use of bankruptcy models in the Czech Republic is also highlighted by Škerlíková and Rudolfová (2015), where the instability and risk of the overall economic environment in recent years have emphasized the need for accurate tools for predicting bankruptcy and assessing the overall performance of enterprises. In their article, they also draw attention to the threat of late filing for insolvency proceedings.

Karas and Režňáková (2014) and Basovníková et al. (2018) analyzed the practical application of Altman's bankruptcy model in the condition of Czechia. They point out that while the Altman model is suitable for use in predicting potential financial distress, they also recommend monitoring other financial ratios, in particular return on equity. Machek (2014) or Čamská (2016) dealt with the comparison of individual models and their ability to identify a company in financial distress in the Czech Republic. In his article, Machek (2014) analyzed Kralick's Quick test, Taffler's bankruptcy model, IN99 and IN05 indices, and Altman's Z′score in the case of Czech companies from 2007 to 2010. Based on the results of individual models, which predicted the company's financial distress, he found that the most suitable models for the practical use of the prediction of financial distress are Altman's Z′score and the indices IN99 and IN05. On the contrary, Kralick's Quick test is the least suitable. Although Taffler's model was able to draw attention to companies in financial distress, its predictive power was low compared to other bankruptcy models. In her article, Čamská (2016) compared the predictive power of both bankruptcy and creditworthiness models in the manufacturing industry during the global financial crisis. The bankruptcy models that achieved the highest telling values were IN01, IN05, or Altman's Z′score, thus confirming Machek's (2014) conclusions.

Based on previous research in the Slovakian context, Gavurová et al. (2017a) and Gavurová et al. (2017b) established a portfolio of four models (Altman model, Ohlson model, and indices IN01 and IN05), which were validated on a sample of 700 Slovakian firms. They assessed the accuracy of financial distress prediction at three levels. Based on the results, they showed that the most suitable model applicable to the Slovak business environment is the IN05 index. The prediction of financial distress of enterprises in Poland was the goal of Gruszczynski (2014). Based on the results of each model, they concluded that the sudden increase in the ratio of short-term liabilities to total assets should be continuously monitored and thoroughly investigated. The study also confirmed the high predictive ability of bankruptcy models in the short term.

The available research shows that the suitability of applying the bankruptcy models differs in terms of the country where the analyzed firms operate. While in the case of Altman's models and IN indices the opinions on their applicability prevail, the opposite is the case for Taffler's model. In terms of the observed applicability, it will then be possible to recommend an appropriate model. For the preparation of the analysis, the necessity to combine available bankruptcy prediction models when assessing the financial situation of firms, to compare the resulting values of the bankruptcy models with each other, and to focus in particular on the comparison with the actual values of the number of bankrupt firms is taken into consideration.

31.3 Data and Methodology

The first phase of the research involved the creation of a database of corporate data and selected macroeconomic factors of the V4 countries. The corporate data used are taken from the annual reports of companies recorded in the corporate data databases of Bureau van Dijk (BvD) Orbis or Amadeus. For reasons of data availability and to obtain a sufficient time series, both databases were used. Based on the BvD company identification number and by using advanced functions in MS Excel, it was possible to link the two available databases. In the second phase of the research, bankruptcy models were processed using MS Excel, which yielded the results of the assessment of the financial situation of V4 enterprises in the years under study. In the Czech Republic, a total of 3736 enterprises were monitored as part of the analysis. In Hungary, a total of 1502 enterprises are monitored, in Poland a total of 4006 enterprises are monitored, and in Slovakia a total of 985 enterprises are monitored.

The main focus of this study is on models that are able to predict possible financial distress early. As Sedláček (2001) argues, bankruptcy models can be classified as ex ante analyses that point to possible threats to the financial health of firms and can predict the future course of the firm over the next 3–5 years. The basic method for predicting financial distress is the Altman bankruptcy model. Edward I. Altman in 1968 first constructed a model for equity companies traded on capital markets based on multiple discriminant analysis (called the Z'score). For the purpose of predicting financial distress, he selected five indicators with the highest predictive ability from the original 22 financial analysis indicators and assigned weights according to their significance using a computer algorithm. The original Altman's Z'score is expressed according to Altman (2006) as follows:

$$Z'\text{Score} = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.42X_4 + 0.998X_5 \qquad (31.1)$$

where:

X_1 = (current assets – current liabilities)/total assets.
X_2 = retained earnings/total assets.
X_3 = earnings before interest and taxes/total assets.
X_4 = book value of equity/total equity.
X_5 = sales/total assets.

The resulting qualification of the company will be done according to the following:

Z'score > 2.9 enterprise is in a good situation.
$1.2 < Z'\text{score} < 2.9$ gray zone of unresolved results.
Z'score < 1.2 for bankruptcy is very likely.

The other variant of Altman's model is designed to evaluate firms operating in emerging markets (Z''EM Score). For the purpose of constructing the model, X_5

(sales/assets) is abstracted, and the coefficient weights are also adjusted. Due to the reduced number of indicators, the weights are increased compared to previous models, with the weight of net working capital/assets being increased the most. In order to be able to compare the resulting value of the bankruptcy model for companies operating in emerging markets with the US bond rating, a constant of 3.25 was added to the model for non-manufacturing companies. The resulting values of the Z″EM model for assessing the financial health of non-US firms and for emerging markets allow the monitored firms to be assigned an adequate rating that indicates the ability of the entity to meet its obligations in a timely manner. According to Altman (Altman, 2006), the different models are quantifiable as follows:

$$Z''\text{EM} = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4, \tag{31.2}$$

where:

X_1 = net working capital/assets.
X_2 = retained earnings/assets.
X_3 = EBIT/assets.
X_4 = market value of equity/debt.

Based on the changes in the construction of the model, it was also necessary to change the individual boundaries of the intervals. The boundary points of the intervals in this case are 4.35 and 5.85.

Z″EM > 5.85 enterprise is in a good situation.
4.35 < Z″EM < 5.85 gray zone of unresolved results.
Z′score < 4.35 for bankruptcy is very likely.

A reaction to Altman's original bankruptcy model was the creation of the Taffler Index (Taffler, 1983). British economists Taffler and Tisshaw analyzed the financial situation of British companies on more than 80 ratios, from which they selected four key ratios and assigned them specific weights. The Taffler Index is known in two versions: the original and a modified version. The modified version of the model (Tfm) differs from the original by adjusting the last ratio X_4. In the modified version, the X_4 ratio captures the ratio of sales to total assets. The individual weights of the ratios remain unchanged. The modified version no longer considers the existence of a gray zone category, which includes firms that could not be classified as having a low or high probability of failure. The cutoff points in this variant are 0.2 and 0.3. The Taffler model (Tfm) is expressed by the following equation according to Taffler (1983):

$$\text{Tfm} = 0.53X_1 + 0.13X_2 + 0.18X_3 + 0.16X_4 \tag{31.3}$$

where:

X_1 = EBIT/current liabilities.

X_2 = fixed asset additions/depreciation.
X_3 = EBIT/markets.
X_4 = Sales/total assets.

Tfm > 0.3 – Low probability of financial distress.
0.2 < Tfm < 0.3 – gray zone of companies with potential threat of financial distress
Tfm < 0.2 high probability of the upcoming financial distress of the company.

The last methods is modified complex variant IN05. The IN05 index was developed in 2005 as an updated version of IN01. The modified version of IN05 focuses on the prediction of financial distress, but also on the ability to create value for owners:

$$IN05 = 0.13X_1 + 0.04X_2 + 3.97X_3 + 0.21X_4 + 0.09X_5 \qquad (31.4)$$

X_1 = total assets/foreign capital.
X_2 = EBIT/interest expenses.
X_3 = EBIT/total assets.
X_4 = sales/total assets.
X_5 = current assets/current liabilities.

The resulting qualification of the company will be done according to the following:

IN05 > 1.6 The company creates added value.
0.9 < IN01 < 1.6 Gray zone of unresolved results
IN05 < 0.9 Enterprise does not create added value.

31.3.1 Correlation Analysis

Correlation analysis is used to analyze the sensitivity of the evolution of lagged values of bankruptcy models and their comparison with the evolution of real bankrupt firms. Liou and Smith (2007) concluded that the number of bankruptcies increases during recessions, while the number of bankruptcies decreases. Correlation is a mutual relationship between changes in two variables that takes values in the interval $<-1;1>$.

$$r_{xy} = \frac{\sum (x_i - \overline{x})(y_i - \overline{y})}{(n-1)\, s_x s_y}. \qquad (31.5)$$

31.4 Results

31.4.1 Czechia

Figure 31.1 shows that the largest number of Czech firms at risk of financial distress by model was in 2009. Conversely, the number of bankruptcies suggests that 2009 was an accelerating year for the number of bankruptcies, with a peak in the maximum number of businesses that went out of business only seen in 2012. Another year where an increased number of businesses in financial distress can be observed was 2013. The number of bankruptcies for the Czechia between 2008 and 2016 ranged between 7.51% and 9.58%.

When comparing the number of bankruptcies with the results of bankruptcy prediction models, it is clear that only the Taffler model classified fewer firms as financially distressed than actually exited over the entire period. From this perspective, it can be argued that its use is not appropriate in the Czech Republic. A similar number of firms in financial distress as actually went bankrupt can be observed in the results of the original Altman Z′score. The other two models, Altman's Z″EM Score and IN05, classified more firms as potentially financially distressed than actually went bankrupt. From this perspective, it can be concluded that it is the Z″EM and IN05 that fulfill their function as an early indication of financial distress.

At the same time, it can be observed in Table 31.1 that, according to the sensitivity analysis, there is a correlation between the lagged values of Z″EM and IN05 and the actual number of bankruptcies. A similarity can also be observed between the actual Z′score values and the real numbers of bankruptcies.
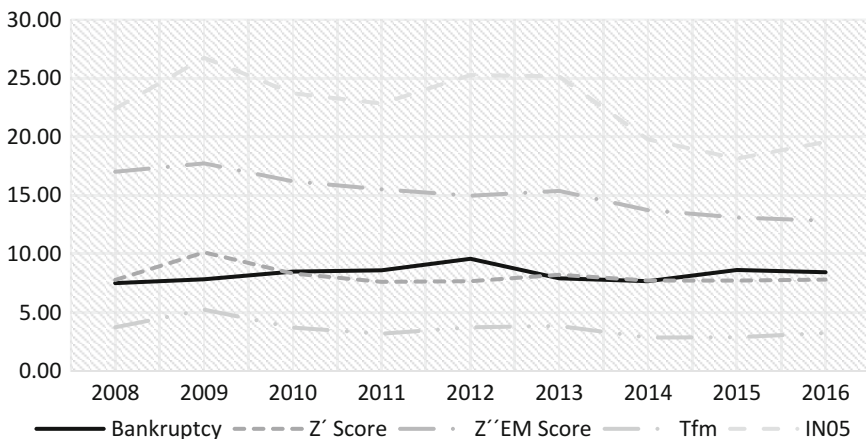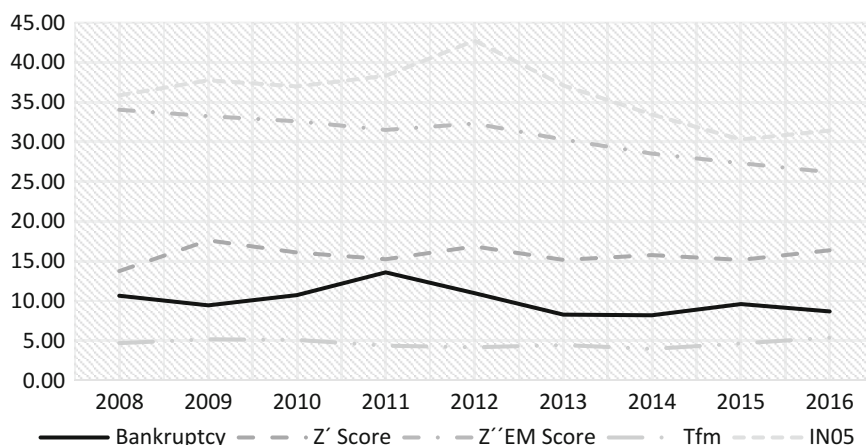

Fig. 31.1 Resulting values of the number of bankruptcies and firms in financial distress in Czechia in %. (Source: Creditreform 2018, Author's calculations)

Table 31.1 Sensitivity analysis between values of real bankruptcies and selected models in Czechia

Czechia	Z′score	Z′′EM	Taffler	IN05
Bankruptcy	0.318	0.519	−0.108	0.598

Source: Author's calculations

Fig. 31.2 Resulting values of the number of bankruptcies and firms in financial distress in Hungary in %. (Source: Creditreform 2018, Author's calculations)

31.4.2 Hungary

Compared to the evolution of the number of business bankruptcies in the Czech Republic, the highest number of bankruptcies in Hungary was already in 2011, when the indicator reached 13.6%. The number of bankruptcies for Hungary between 2008 and 2016 ranged between 8.29% and 13.60%.

Looking at Fig. 31.2, it can be seen that only the Taffler model included a smaller number of enterprises with potential financial distress than actually went bankrupt. The other three models assigned more firms to the potential financial distress category than the number of bankruptcies, fulfilling their primary function of providing an early warning of firms in financial distress. It can also be observed that according to the sensitivity analysis, there is a correlation between lagged Z′score and IN05 values and the actual number of bankruptcies. A similarity can also be observed between the actual Z′′EM values and the real numbers of bankruptcies of firms in Hungary (Table 31.2).

Table 31.2 Sensitivity analysis between values of real bankruptcies and selected models in Hungary

Hungary	Z′score	Z″EM	Taffler	IN05
Bankruptcy	0.489	0.285	0.114	0.535

Source: Author's calculations
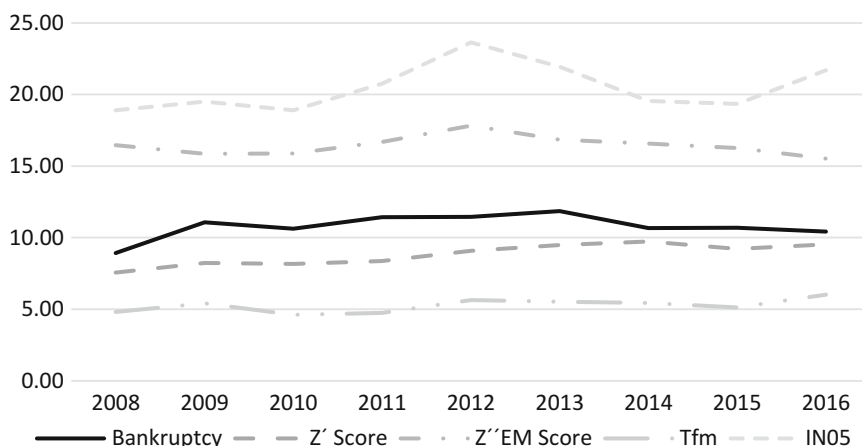
Fig. 31.3 Resulting values of the number of bankruptcies and firms in financial distress in Poland in %. (Source: Creditreform 2018, Author's calculations)

31.4.3 Poland

The number of corporate bankruptcies in Poland has been mostly in the range of 10–12% during the period under review (Fig. 31.3). The highest increase compared to the previous year was achieved in 2009. After a slight decline in 2010, the number of bankruptcies gradually increased until a peak in 2013. Despite the subsequent decline, the percentage of bankrupted firms has not recovered to the pre-crisis level.

When compared with other models that predicted financial distress for firms that did not close down during the period under review, Tfm and Z′Score models classified less than 10% of firms at risk of financial distress. The other two models, Z′em Score and IN05, classify more than 15% of enterprises as being at risk. The Z″EM and IN05 models fulfil their function as early warnings of financial distress. At the same time, it can be observed in Table 31.3 that, according to the sensitivity analysis, there is a correlation between lagged Z″EM values and the actual number of bankruptcies.

Table 31.3 Sensitivity analysis between values of real bankruptcies and selected models in Poland

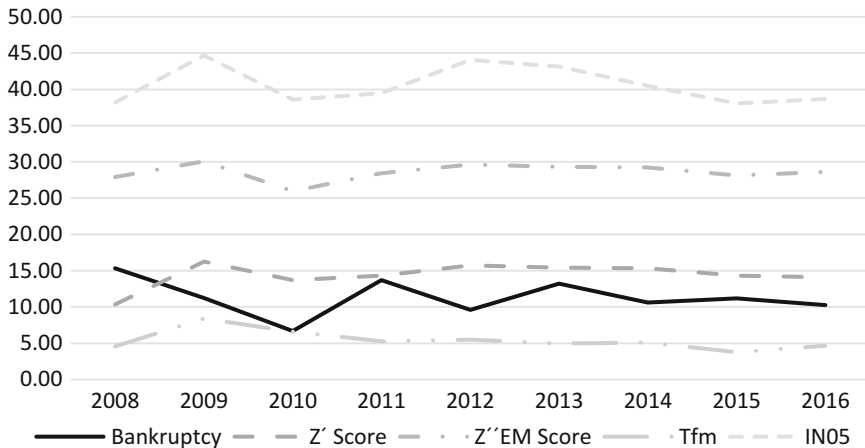| Poland	Z′score	Z″EM	Taffler	IN05
Bankruptcy	0.512	0.601	0.277	0.466

Source: Author's calculations

Fig. 31.4 Resulting values of the number of bankruptcies and firms in financial distress in Slovakia in %. (Source: Creditreform 2018, Author's calculations)

31.4.4 Slovakia

Slovakia is the only V4 country where the highest number of corporate bankruptcies was already recorded in 2008. A high fluctuation of the measured values in the number of bankrupt enterprises can be observed between 2008 and 2014. Figure 31.4 further shows a large difference between the measured values of the financial performance of enterprises. The number of bankruptcies for the Slovakia between 2008 and 2016 ranged between 6.70% and 15.35%.

The lowest number of enterprises in potential financial distress is recorded by the Tfm model. The bankruptcy model Z′score classified on average about 15% of enterprises in the distressed category in the period under review. The second observed Altman Z″EM score model classified 26–30% of enterprises as vulnerable in the period under review. The last model analyzed, IN05, classified between 38% and 45% of the enterprises as vulnerable. From this point of view, it can be concluded that Z′EM and IN05 are fulfilling their function as an early warning of financial distress. At the same time, it can be observed from Table 31.4 that, according to the sensitivity analysis, there is a correlation between the lagged values of Z″EM and IN05 and the actual number of bankruptcies.

Table 31.4 Sensitivity analysis between values of real bankruptcies and selected models in Slovakia

Slovakia	Z'score	Z''EM	Taffler	IN05
Bankruptcy	0.166	0.499	0.043	0.664

Source: Author's calculations

31.5   Discussion

For practical applicability, the Z''EM and IN05 models can be recommended from the analyzed models. The resulting assessment of the financial situation of enterprises based on the values of these models pointed to a worsened financial situation of more enterprises than actually closed their operations. As a result, they fulfilled their function of early warning of enterprises in a deteriorated financial situation in all V4 countries.

The Z'score model performed its function only in the case of enterprises operating in Hungary. In other cases, it was possible to accept the views of Gavurová et al. (2017a), who pointed out the inappropriateness of using this model. In particular, this bankruptcy model reflects the specificities of US firms. The difference with Altman's Z''EM model, adapted mainly to emerging economies, is mainly in the tracking of firms' liquidity through working capital. While the working capital to total assets ratio is assigned the fourth highest weight in the Z'Score model, it is assigned the second highest weight in the Z'EM model after EBIT/total assets.

Differences causing the different results in the two Altman models can also be found in the retained earnings/total assets ratio. Despite the higher coefficient in the Z''EM model, it is assigned only the third highest weight compared to the others. In the Z'score model, it is assigned the second highest weight and favors companies that have been on the market longer and have built up sufficient reserves. Thanks to these observations, we can also agree with the studies by Karas and Režňáková (2014); Basovníková et al. (2018); Csikosová et al. (2019); and other authors pointing out the appropriateness of using Altman's Z'EM.

The worst results in all V4 countries were achieved by the Taffler model. As pointed out by Machek (2014), this model does not fulfil the function of an early warning for firms at risk of financial distress. Due to its construction including only basic information about the firm as well as inappropriate thresholds for assessing the financial situation, it is not possible to recommend this model for practical use in the V4 countries.

The opposite results were found for the applicability of the IN05 model. The dissertation reaches the same conclusions as Machek (2014); Csikosová et al. (2019); or Dorgai et al. (2016), who recommend the model for practical use in the V4. The undeniable advantage of the model is its construction to the conditions of the business environment in the Czechia, where the focus is mainly on the ability to cover the company's own assets with its own profits or revenues. However, the results of the study recommend its application to other V4 countries.

31.6   Conclusion

There are countless methods and procedures for assessing the creditworthiness of companies and predicting possible bankruptcies. Financial institutions usually keep their procedures secret because they are about their know-how. However, financial indicators play a significant role in all models. Simpler approaches include various indicator systems allocating points. To the more complex ones, sophisticated statistical procedures work with historical data series and calculate different probabilities of company failure based on certain values of financial indicators. Comprehensive evaluation of financial indicators and construction of bankruptcy models proved their importance. The overall economic environment in recent years has highlighted the need for precise tools to anticipate financial distress and assess the overall financial situation of companies.

Bankruptcy models are used to evaluate the financial situation of companies. The construction of the models is based on the assumption that companies in financial difficulties experience certain anomalies several years before their bankruptcy. Their use is appropriate not only for current and future managerial decision-making but also for the assessment of companies by the banking sector. The aim of the chapter was to evaluate the applicability of bankruptcy models in the V4 countries.

Based on a literature review, four bankruptcy models suitable for analyzing the financial performance of companies were selected. In the practical part of the work is used the application of Taffler model, Altman model Z'score, Altman model Z''EM Score, and Credibility Index IN05.

The main tool for evaluating the suitability of the selected bankruptcy models is the statistical significance of the models obtained after performing a mutual sensitivity analysis. The individual results confirm the theory of the combination of the models for practical use. In addition to the differences within each of the observed categories, the results show that at least one model was always significant for a given country. While for Hungary and Poland the combination of Altman's bankruptcy models Z'score and Z'EM seems to be appropriate, the analyzed relationship in Czechia and Slovakia is best captured by the IN05 model. Unlike Altman's models, IN05 also focuses on the liquidity of enterprises and the ability to create value for the owners of the enterprise. When investigating the practical use of bankruptcy models, it was possible to notice the limited use of the IN05 model on Polish companies and the Z''EM model on Slovak companies.

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