THE SCORE MODELS FOR ANALYZING THE BANKRUPTCY RISK. SOME SPECIFIC FEATURES FOR THE CASE OF ROMANIA*

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Abstract: The paper presents some of the most relevant score functions developed worldwide, used to assess the bankruptcy risk. Among these, we mention the Altman model, developed in 1968, the model elaborated by the Central Bank of France, by Conan and Holder, or by Ohlson. Also, we present the models developed in Romania, with the specific features that such score functions have for the Romanian theory and practice. We also emphasize the limits of using the score functions in analyzing the bankruptcy risk and the difficulties of elaborating them for the case of Romania.

JEL classification: G32, G33

Key words: critical; statistical methodology; discriminant analysis; bankruptcy risk; failure; financial distress; score function.

1. Introduction

The risk of bankruptcy is the most important component of the risks an enterprise faces. It is closely related to all the categories of risks that arise in a business and its appearance causes major implications that go beyond the company and affect all the business partners.

The study of companies in financial distress is particularly important for banks, concerned about the quality of the credit portfolios they hold, for shareholders, investors, employees, customers and suppliers. Directly or indirectly, all of them will suffer losses due to the bankruptcy of the company they are in contractual relationships with.

The bankruptcy is a defining feature of the market economy. At the macroeconomic level, the failure is a normal phenomenon and has the role to make the economic system more efficient, by eliminating the companies that can not properly adapt to the market conditions. Obviously, this positive role occurs when the number of failures does not exceed a critical level that would disrupt the economic relations and would lead to the emergence of major economic crisis.

The assessment, the analysis and the prediction of the bankruptcy risk a company is exposed to is a constant concern for managers. The determination in

advance of the risk of failure allows identifying the causes and the disturbances that affect the business, the errors arising in the business management and making appropriate measures to eliminate or to reduce them.

Predicting bankruptcy and understanding the causes of failure are based on financial reasons. The bankruptcy involves direct costs with legal fees, with wages for accountants, lawyers and bailiffs etc., but these costs are small as compared to the losses of the investors (shareholders and creditors), as the company's value decreases and it is unable to repay the debts and to pay the interest. At the same time, the bankruptcy involves indirect costs such as losses to managers, employees, state etc. Sometimes, they can reach a significant size. All these costs justify the efforts to identify the causes of bankruptcy and to predict it.

2. Objectives

The specialized literature provides a variety of tools for assessing and predicting the risk of bankruptcy. The basis for these instruments are, mainly, the statistical methods. They are especially used when studying the financial rates that reveal the financial position of a company. The large variety of tools developed and of measures that may be used could cause difficulties when selecting the appropriate models, but also some differences in the interpretation of the results obtained with their help.

Among the methods of analyzing the bankruptcy risk elaborated so far, we mention:

- the static analysis, based on the balance sheet;
- the functional analysis, based on functional balance;
- the dynamic analysis, carried out with the financing table;
- the discriminant analysis, relying on which there were created several methods of evaluation and prediction of bankruptcy.

Further on, we'll present the most relevant score functions developed with the help of the discriminant analysis, both worldwide and in Romania.

3. Analyses

The specialized economic literature, both foreign and Romanian, shows a variety of score functions, developed by researchers from a variety of countries. We'll further present the most representative score models, which were imposed in theory and practice due to the results obtained in the prediction of bankruptcy.

1) The Altman model was developed in 1968 on a sample of 66 enterprises, of which 33 healthy and 33 in financial distress. To build the model, there were tested 22 financial ratios, of which five have been kept as having a significant discriminating power.

By analyzing the companies with financial difficulties, Altman has identified five phases of a business failure:

1. appearance of initial signs of financial difficulties (slight decrease in profitability, in turnover, reduction of cash), but which are ignored by the company management;
2. a clear appearance of the financial difficulties that are not followed, however, by proper measures, hoping that they will disappear;

3. a strong degradation of the financial position, as the disturbance factors affect the entire business;
4. collapse, meaning a management failure to adopt appropriate measures to solve the situation;
5. intervention, either by recovery measures, either by declaring bankruptcy.

The score function developed by Altman in 1968 takes the following form:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + X_5 ,$$

where:

X_1 = Working capital (WC) / Total assets;

X_2 = Retained earnings / Total assets;

X_3 = Earnings before interests and taxes (EBIT) / Total assets;

X_4 = Market value equity / Total liabilities;

X_5 = Sales / Total assets.

The ranges of values of the function are:

-   $Z < 1.81$ - the company is bankrupt, being in phase 4 or 5;
-   $1.81 < 2.90 \leq Z$ - the company is in financial distress, meaning the phases 2 or 3;
-   $Z > 2.90$ - the company may be considered economically healthy.

2) Altman, Haldeman and Narayanan built in 1977 another model, known as Zeta model with some modifications against the model in 1968. The sample of companies considered consisted of 53 bankrupt companies and 58 non-bankrupt pursued during 1969-1975. The three researchers tested 27 financial variables representing profitability, liquidity, capitalization, variability of earnings, debt and other indicators. Finally, seven financial ratios were chosen, namely:

X_1 - return on assets; X_2 - the stability of earnings; X_3 - debt service;

X_4 - cumulative profitability; X_5 - liquidity; X_6 – capitalization;

X_7 - company size.

The ZETA weighting coefficients have not been published by the authors.

3) The score function used by the **Central Bank of France** was developed based on a sample of industrial enterprises that pay income tax, with less than 500 employees. The enterprises were classified into three components: bankrupt, ordinary and vulnerable.

According to this model, a company is bankrupt when it follows a judicial procedure for bankruptcy. These companies are observed over a period of three years before bankruptcy.

The authors proposed a number of 19 ratios, covering four key areas of activity:

-   the financial structure;
-   the dynamic of the business;
-   the profitability;
-   the current management.

In some circumstances, a financial rate can have excessive values or can become incalculable (the denominator is zero). In order to preserve the quality of the results, instead of eliminating the companies with such rates, it was defined, for each rate, a range between certain limits and the value will be adjusted to one of the limits if it exceeds the default values.

The bankruptcy risk analysis model elaborated by the Central Bank of France actually includes three score functions, which are used in two stages.

a) The score function Z

To characterize the financial health of a company, the first score function is used, which was constructed by comparing the bankrupt companies against the ordinary ones. This is the function Z, which includes eight financial ratios, with the following expression:

$$Z = -1.255\,R_1 + 2.003\,R_2 - 0.824\,R_3 + 5.221\,R_4 - 0.689\,R_5 - 1.164\,R_6 + 0.706\,R_7 +$$
$$+ 1.408\,R_8 - 85.544.$$

The eight ratios of the function Z are:
- R_1: Financial expenses / EBITDA;
- R_2: Financing of invested capital: Long term capital / Invested capital;
- R_3: The repayment capacity: Self-financing capacity / Total liabilities;
- R_4: Gross operating margin: EBITDA / Turnover;
- R_5: The duration of supplier credit:
$$\frac{\text{Average balance of commercial debts}}{\text{Purchases with VAT}} \times 360\,;$$
- R_6: The growth rate of value added $(Va_1 - Va_0) / Va_0$;
- R_7: The duration of customer credit:
$$\frac{\text{Average balance of commercial receivables}}{\text{Sales with VAT}} \times 360\,;$$
- R_8: The rate of physical investment: Average value of physical investment/Va.

The highest representative rate is R1, as depending on its level the companies are split in the second phase.

The ranges of values depending on which the companies are divided are:
- $Z < -0.25$ - the enterprise is at risk, without being able to say with certainty that it is bankrupt;
- $-0.25 < Z < +0.125$ - one can not make assessments about the state of the enterprise (uncertain state);
- $Z > 0.125$ - the company is normal, but can't be offered guarantees that it won't be ever in distress.

b) The score functions Y_1 and Y_2

This step aims analyzing the companies that have previously obtained a negative score, less than -0.25, which are likely to have a high risk of bankruptcy. These companies are divided into two categories, depending on the value of the rate Financial expenses / EBITDA. To separate the companies with a low score from those who are very close to bankruptcy, it will be used two additional scoring functions, Y1 and Y2.

The first group includes the companies with EBITDA of zero or negative and those with a ratio Financial expenses/EBITDA greater than or equal to 215%. The second group includes the enterprises whose rate Financial expenses/EBITDA is between 0 and 215%.

For the companies in the first group, it is calculated the score function Y_1, which contains seven financial ratios. The Y_1 score is calculated for a period of two years in order to capture the evolution of the financial position. The companies in this group are the most risky and have a high probability of filing for bankruptcy in the

future.

For the companies in the second group, the score function Y_2 is determined based on 13 financial ratios. These companies have a weak financial position, but better than the companies in the first category.

The function created by the Cerntral Bank of France was subsequently updated, by creating more functions, differentiated by industries: BDFI for industrial enterprises, BDFC for trade companies and BDFT for transport companies.

The BDFI score function, developed in 1995, whose formula is kept secret, is based on the financial indebtedness (importance, structure and cost of borrowing), which makes it especially attractive for bankers. The score function is based on three elements:

- the business, assessed by a letter (from A to X), depending on turnover;
- profitability and financial structure;
- short-term solvency.

The best score is set at 37 and 69 the worst.

4) Conan and Holder have developed several scoring functions, differentiated on sectors, namely the industrial sector, the wholesale sector, the transportation sector.

For the industrial enterprises, the score function is as follows:

$$Z = 0.24 X_1 + 0.22 X_2 + 0.16 X_3 - 0.87 X_4 - 0.10 X_5,$$

where:

X_1 = EBITDA / Total liabilities;

X_2 = Long term capital / Total capital;

X_3 = (Cash + Receivables) / Total Assets;

X_4 = Financial expenses / Turnover;

X_5 = Wages / Value added.

According to this function, the businesses can fall into one of the following categories:

- good state, when $Z > 9$, and the probability of bankruptcy is less than 30%;
- caution, when $4 \leq Z < 9$, and the probability of failure is between 30% and 65%;
- danger, when $Z < 4$, and the probability of bankruptcy is more than 65%.

5) In 1980, **Ohlson** developed a model for analyzing the bankruptcy for listed companies that went bankrupt during the period 1970-1976. The score function takes the following form:

$$O = 6.03 X_1 - 1.43 X_2 + 0.08 X_3 - 2.37 X_4 - 1.83 X_5 + 0.285 X_6 - 1.72 X_7 - 0.52 X_8 - 1.32,$$

where:

X_1 - Total debts / Total assets;

X_2 - Current assets / Total assets;

X_3 - Current liabilities / Current assets;

X_4 - Net Profit (Np) / Total assets;

X_5 - Profit before taxes plus depreciation / Total debts;

X_6 - An indicator equal to 1 if the net profit in last two years is negative and 0 otherwise;

X_7 - An indicator equal to 1 if total liabilities exceed total assets and 0 otherwise;

$$X_8 = (Np_t - Np_{t-1}) / (\left| Np_t \right| - \left| Np_{t-1} \right|).$$

In Romania there have been also efforts to develop score functions for analyzing the risk of bankruptcy. But these attempts occurred much later in comparison with the researches carried out worldwide.

6) C. Mânecuţă and M. Nicolae developed in 1996 a score function for the analysis of the bankruptcy risk, based on 14 financial ratios, considering a sample of 59 companies from the metallurgy industry.

7) In 1998, **G. Băileşteanu** created a model for analyzing the risk of bankruptcy, based on four variables. According to the author[49], the specter of bankruptcy is emphasized by the occurrence of the following states:

- the impossibility of paying the current debts;
- insufficient financial resources for repayment the medium and long-term debts;
- delays in collecting the receivables;
- lack of profit.

The financial ratios taken into account by Băileşteanu are:

- the current liquidity: $G_1 = \dfrac{\text{Current assets}}{\text{Current debts}}$;

- the solvency: $G_2 = \dfrac{\text{Net profit} + \text{Depreciation}}{\text{Long and medium term debt service}}$;

The debt service includes the installments on medium and long term loans and the interest. In this form, the ratio actually expresses the coverage of medium and long term debt service.

- the turnover of customer credit: $G_3 = \dfrac{\text{Sales}}{\text{Commercial receivables}}$;

- the profit rate: $G_4 = \dfrac{\text{Pr ofit}}{\text{Cost}} \times 100$,

and the model has the following expression:

$$B = 0.444\,G_1 + 0.909\,G_2 + 0.0526\,G_3 + 0.0333\,G_4 - 1.414.$$

The function parameters were determined based on the utility theory.

The maximum and minimum values of the function are 4 and -1.4, and the ranges of values to classify the companies are:

- $B < 0.5$ – imminent bankruptcy;
- $0.5 < B < 1.1$ - limited area;
- $1.1 < B < 2$ - intermediate zone;
- $B > 2$ - favorable area.

8) In 2002, **I. Anghel** carries out a complex study of the bankruptcy risk, creating a score function based on a sample of 276 enterprises. The proportions of companies in the sample were 60% non-bankrupt and 40% bankrupt, as they belonged to 12 industries. Anghel classified the financial ratios tested into five groups:

- turnover rates;
- rates of liquidity;
- rates of indebtedness;
- rates of return;

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[49] G. Băileşteanu, *Diagnostic, risc şi eficienţă în afaceri*, ediţia a III-a, Ed. Mirton, Timişoara, 2005, pag. 294

- other economic and financial information.

Anghel carried out a discriminant analysis of the financial ratios and finally kept four financial ratios in order to develop the score function: the return on revenue (X_1), the coverage of debts with cash-flow (X_2), the ratio of debts against the assets (X_3) and the period for payment the debts (X_4), which have been aggregated in the following score function:

$$A = 5.676 + 6.3718\,X_1 + 5.3932\,X_2 - 5.1427\,X_3 - 0.0105\,X_4.$$

Depending on the score obtained by applying this function, the companies can be classified into three groups:

- if $A < 0$ - bankruptcy / failure state;
- if $A \in [0; 2.05]$ - area of uncertainty;
- if $A > 2.05$ - non-bankruptcy state.

The development of scoring functions for the prediction and the analysis of bankruptcy for Romanian enterprises is difficult, because the bankruptcy process in Romania has different characteristics as compared with most countries where such models have been created. Thus, in Romania there is a large number of companies in financial distress, but very few against whom the legal proceedings for bankruptcy were initiated. Also, the possibility of manipulating the financial statements by the management of companies and the difficult access to sources of information hampers the development of new scoring functions.

4. Conclusions

The score methods allow an overall assessment of the risk of bankruptcy for the enterprises, based on a set of financial ratios that are affected by the degradation of the financial position. The scoring functions, being elaborated with the help of the statistics methodology, may be used for both the retrospective and the prospective analysis of the bankruptcy risk. This is possible as the degradation of the financial position usually occurs gradually over time and the evolution of the score of a company can point out its financial difficulties.

The scoring functions also allow the assessment of the bankruptcy risk by both the company managers and by the external stakeholders and in particular by the creditors. From this point of view, the scoring methods are among the few tools to evaluate the risk of bankruptcy that can be used by third parties, given their difficulty to access the information within a company.

Although used successfully for almost half a century, due to ease of implementation and the high degree of objectivity, the scoring method has some disadvantages, which limits its application in time and space. Thus, one of the limits is that is applicable only in the industry from which the sample is drawn and only as long as the economic conditions remain unchanged. The periods of economic instability affect, however, the correlations considered in determining the score function and require a regular updating of models in order to adapt them to the new economic and financial conditions.

Another limit of the research in this field is that the bankruptcy process has a legal connotation, meaning that its start more depends on lenders or banks and not on the company's financial statements. Moreover, the credit institutions may decide to continue the financial support of an enterprise with difficulties, which will prevent its bankruptcy. Under these circumstances, the losses that the investors may suffer as a

result of a wrong diagnosis of the position of an enterprise can be significant and irretrievable.

Another problem is the statistical methodology used to determine the bankruptcy prediction models. Most researchers have taken into account an equal share of bankrupt and viable enterprises in the sample, while in reality the bankrupt companies have a low share in the national economy.

A multitude of other factors such as the age of companies, their size, the industry, the difficulties in assessing some assets, the measures taken to solve the problems are among the variables that influence the risk of bankruptcy and which are not taken into account by the statistical methods. However, the errors of diagnostic induced by the models can lead to erroneous classification of a non-bankrupt enterprise as being bankrupt, which may lead to cutting the relationship with the creditors. Conversely, a business in distress classified as viable can lead to major financial losses for creditors, shareholders and the state.

At the same time, the financial rates taken into account in determining the models were chosen, often, on a subjective basis, depending on the rates most frequently used in the literature and considered as the most discriminating. These rates are derived, usually of the indicators published by companies in their financial statements and do not provide an objective information, considering the risk of manipulation by the company management in order to present a more favorable financial position.

To increase the relevance of the score functions, it should be developed more score functions, by taking into account the industry and the size of companies, large or small. As well, it is required a statistical testing of a large number of financial ratios to select those who are the most discriminant for the non-bankrupt and bankrupt companies. It should be also included in the model, in addition to the financial rates, other variables that influence the risk of bankruptcy, like the size (assessed by assets, output, number of employees etc.) or subjective variables, like the quality of management, of staff etc., which creates new problems related to their assessment and their integration into the model.

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