METHODS FOR DETERMINING THE RISK OF BANKRUPTCY

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Abstract:
The risk of bankruptcy is the probability that an entity would incur such large losses that it will be unable to honor its contracts with beneficiaries, pay suppliers and repay loans to banks. Conducting a bankruptcy risk analysis is vital because it is carried out to highlight the strengths and weaknesses of a company, as well as the opportunities or dangers of the external environment, focusing also on the causes which unbalance or favor its activity and development.

Key words: cheie risk of bankruptcy, risk, Altman Model; Conan-Holder model; Model of the Bank of France;

JEL classification: M41, K22

Introduction

Companies are constantly facing an economic risk because they do not have satisfactory control over future revenues. But, along with this risk, there is another additional one, whenever loans are used, which involve financial expenses for the remuneration of debts (interest) and influence the profitability of the company - the financial risk.[3]

The business men must be aware and try to prevent the risk situations that lead to insolvency, to bankruptcy. It is required a continuous education in this area, a continuous training for the specialists in the risk domain, an assuming of investing strategies based on economical realities and not just hopes, enthusiasm and optimism.[4]

The business environment of Romania is clearly affected by the insolvency of economic entities, which leave the market without having met their obligations. The commercial security, which can be summarized in the creditor's confidence to receive payments when due, is strongly affected. A business entering the insolvency procedure indirectly affects the entire network in which it was included: its partners, customers, suppliers, and employees. Because of that, in the specialty literature the insolvency was compared to an *epidemics* spreading rapidly in the business environment[5].

According to some authors[6] *the risk of bankruptcy* can be defined as "the permanent incapacity of the company in an attempt to cover the obligations incurred by the activities of the company". Viewed from the perspective of financial analysis, the disruptions that announce the possibility of bankruptcy are multiple and can be grouped into two categories: serious disruptions in the conduct of operating activities and serious disruptions in the financing method.

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[4] Ghica, Elena Doina, Turnea, Adasena Iconia (2018). Insolvency risc prevention strategies, Economic Sciences Series,Timisoara, vol XXIII/2018, p. 60.
[5] Iancu, Lavinia (2019), The opening of insolvency proceedings. Theory vs Practice, Athens Jurnal of Law Volume 5, Issue 1 January 2019 The Athens Institute for Education and Research, pp. 189
[6] Păvăloaia, Vasile-Daniel. (2013). „Studiu privind posibilităţile de informatizare a modelelor de predicţie a riscului de faliment", Revista Audit financiar nr. 11/2013, Revista editată de Camera auditorilor financiari din România, Bucureşti, pp. 47-48)

From a legal point of view, insolvency is the absence of funds to pay due debts. Cessation of payments is explained by the material and external fact of not paying the due debts of certain importance, but also by the fact of continuing the payments by resorting ruinous sources or fraudulent means.[7].

To avoid bank insolvency, the National Bank of Romania ensures the prudential supervision of credit institutions. From a micro-prudential perspective, supervision involves monitoring possible risks to credit institutions. In the supervision activity are used instruments in the form of capital, liquidity and governance requirements at the level of each credit institution[8].

The main criteria underlying the determination of insolvency and, implicitly, bankruptcy are *lack of solvency and degree of indebtedness*.

Bankruptcy risk analysis can be performed by liquidity and solvency analysis; financial balance analysis and through models for statistical analysis of bankruptcy.

"The scoring method is an external diagnosis method that aims to measure the risk to which the investor, creditor and the company itself expose themselves in future activity"[9].

There are several models developed worldwide, especially in developed countries: USA (Beaver, Altman, etc.), Great Britain (Taffler), France (Conan and Hoder, Bank of France, etc.), Japan (Shirata) and others.

Among the most used *score functions* are the following: [10]

    a) The Altman Model;
    b) The Conan-Holder model;
    c) The Bank of France model;

According to some authors[11] "the models for determining the risk of insolvency and bankruptcy by the Scoring method are based on the same algorithm, namely:

1. The financial indicators that best reflect the financial health of a company are chosen.

2. The evolution of the indicators chosen on two categories of companies from the same field of activity is compared, some in difficulty and others financially healthy.

3. The predictive Z function is developed by combining those financial indicators that have had a strong and permanent action.

4. Determining the intervals of the Z function based on the observations made regarding the manifestation or not of the risk of bankruptcy."

1. Bankruptcy risk analysis using the Altman Model

The Altman model[12] also called the **"Z" model**, is a bankruptcy forecasting model developed by Professor Edward I. Altman (b. 05.06.1941) in the USA in 1968.[13]

It is the first scale model for determining the risk of insolvency and bankruptcy both in literature and in practice, as evidenced by its continued use for over 50 years since its publication.

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[7] Iancu, Lavinia (2013) Răspunderea civilă pentru apariția stării de insolvență, Vol. I Condițiile, Editura Eurstampa, Timișoara, p.21

[8] Daniela Haranguș, Banking Regulation and Prudential Supervision in Romanian Banking System, in Anale Seria Științe Economice, Universitatea „Tibiscus" din Timișoara, Vol. XXIII / 2017, Editura, Eurostampa, Timișoara, e-ISSN 1582 – 6333

[9] Sabău, C., Uher, Marina, Nagy, Cristina, Mihaela. (2015). „Contabilitatea reorganizării și lichidării întreprinderii". Editura Eurostampa, Timișoara. p. 168

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[11] Sabău, C, Uher, Marina, Nagy, Cristina, Mihaela (2015) „Contabilitatea reorganizării și lichidării întreprinderii " Editura Eurostampa, Timișoara, p .182

[12] Altman, E.I. (1968). „Financial Rations, Discriminant Analysis and Prediction of Corporale Bankruptcy", Journal of Finance.

[13] Holt, Gheorghe. (2009). „Riscul de faliment – punct central în diagnosticul financiar-contabil", Analele Universității „Constantin Brâncuși" din Târgu Jiu, Seria Economie, nr. 3/2009, p. 328.

It is interesting and important to mention that major international financial-economic rating agencies, such as Standard & Poor's (S&P), establish their hierarchies in the sphere of production companies using the Z-score function of the Altman Model. These ratings are perceived by brokers and stock market investors as recommendations to sell or purchase of shares in those companies.

Altman "gives his model a predictive power limited to 1-2 years before bankruptcy. The same author also points out that Altman has demonstrated that the method of financial rates can accurately forecast bankruptcy. This is also the argument that in practice any analysis of the risk of bankruptcy performed for a company by the scoring method is accompanied by an analysis based on the financial rates of the same company and for the same time period."[14]

The Altman model is most commonly used in developed countries for the assessment of entities active in market economies.

Altman has shown that bankruptcy can be accurately anticipated by resorting to financial rates. "**The *Altman Model* ("Z" Model)** is a bankruptcy forecasting model developed by Professor Altman in the United States of America in 1968."[15] He combined the information provided by five rates (variables) by constructing a "score" function of following the form:

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

where:

Variable X1 is a structure rate of the asset that reflects the flexibility of the company and is determined as the ratio between working capital (current operating assets - current operating liabilities) or working capital and total assets:

$$X_1 = \frac{current\ assets}{total\ assets} \quad \text{or} \quad X_1 = \frac{working\ capital}{total\ assets}$$

Variable X2 represents the rate of self-financing of total assets and is determined as the ratio between reinvested profit (net result for the year - dividends granted to shareholders) and total assets: $X_2 = \dfrac{reinvested\ profit}{total\ assets}$

Variable X3 represents the rate of economic return, measuring the performance of the patrimonial asset and is calculated as the ratio between the gross result for the year (gross profit) and the total asset: $X_3 = \dfrac{gross\ profit}{total\ asset}$

Variable X4 highlights the company's indebtedness and is calculated as a ratio between market capitalization and long-term debts: $X_4 = \dfrac{market\ value\ of\ equity}{long-term\ obligations}$

Variable X5 measures the return on assets and is calculated as the ratio between turnover and total assets: $X_5 = \dfrac{turnover}{total\ assets}$

In building his model, Altman chose 33 industrial companies with financial problems and as many healthy companies, which he analyzed between 1946-1965.

The research was carried out based on 22 indicators, from which in the end the 5 presented above were chosen.

The studied companies were analyzed and classified according to the value of the Z score, establishing two limits and an area of uncertainty as follows:

Z < 1,8 – bankruptcy within a year;

$1.81 \leq Z \leq 2{,}675$ – area of uncertainty with high risk of bankruptcy;

$2{,}675 \leq Z \leq 2{,}99$ – area with low risk of bankruptcy;

[14] Sabău, Lucian Ioan. (2014) „Studiu privind rolul informaţiilor contabile în luarea deciziilor strategice" Editura Eurostampa, Timişoara, p. 45
[15] Holt, Gheorghe (2009). „Riscul e faliment – punct central în diagnosticul financiar-contabil", Analele Universităţii „Constantin Brâncuşi" din Târgu Jiu, Seria Economie, nr. 3/2009, p. 328.

Z > 2,99 – area without the threat of bankruptcy.

The Altman model includes indicators that characterize the short-term and long-term financial balance, the internal management mode and the economic profitability whose share is close to that of the other 4 indicators taken together." Since the model was only applicable to listed companies, the author replaced the market value of the capital with the size of equity.

After Altman carried out his study, this type of analysis has not stopped developing, with other discriminatory models being developed for assessing the risk of bankruptcy by different schools such as the Anglo-Saxon, Continental - European or Japanese.[16]

Over time, the coefficients of the Z-score function of the Altman model have undergone changes that have allowed the model to be applied in the analysis of the risk of bankruptcy of companies from as many spheres of economic activity as possible, as is shown in the Wikipedia page of the model.[17]

The most significant change to the Z-score function is that which allows the model to be applied to privately owned companies, other than those listed on the exchanges that are covered by the model in its original form.

The Z-score function of the Altman Model used nowadays in current practice has the following form:

$$Z^{'}=0.717*X_1+0.847*X_2+3.107*X_3+0.420*X_4+0.998*X_5$$

The significant change in the rate coefficients is due to the replacement of the initial calculation formula of the rate with the following expression of long-term indebtedness degree: $X_4 = \dfrac{equity}{long-term\ obligations}$

Altman himself gives his model a predictive power limited to 1-2 years before bankruptcy. The same author also points out that Altman has demonstrated that the method of financial rates can accurately forecast bankruptcy. This is also the argument that in practice any analysis of the risk of bankruptcy for a company by the scoring method is accompanied by the analysis based on the financial rates of the same company and for the same time period.[18]

According to Professor Altman, the decline of a society progresses in five phases[19]:
1. "the appearance of signs of decline which, however, are disregarded (decrease in profitability, decrease in turnover, increase in debt, decrease in liquidity);
2. the existence of clear signals for which no action is taken, in the hope that they will disappear without any intervention;
3. strong action of declining factors with serious aggravation of the financial situation;
4. collapse, the impossibility of the management team to ensure corrective measures;
5. intervention, either through remedial measures or by declaring bankruptcy."

2. Bankruptcy risk analysis through the Conan and Holder Model

"The Conan and Holder model was developed in 1987, being applicable mainly to industrial entities, and the score function is defined using five variables. The model is as follows"[20]:

$$Z = 0,24R_1 + 0,22R_2 + 0,16R_3 - 0,78R_4 - 0,10R_5$$

[16] Mitu, N. E., Mitu I. E. (2006). „Previzionarea riscului de faliment", Tribuna Economică, nr. 51 – 52, p. 103.
[17] https://en.wikipedia.org/wiki/Altman_Z-score
[18] Sabău, Lucian Ioan. (2014) „ Studiu privind rolul informaţiilor contabile în luarea deciziilor strategice" Editura Eurostampa, Timişoara, p. 45
[19] Ciolacu, Oana Ştefania (1996). „Analiza situaţiei economico-financiare a firmei", în Adevărul economic, nr. 32-33, p. 4.
[20] Iosif, Gh. N., Rotaru, Mariana (2007). Sistemul de indicatori ai activităţii economice a firmei: modele structurale şi factoriale, Tribuna Economică, Bucureşti, p. 278

where:

$R_1 = \dfrac{gross\ operating\ result}{total\ debts}$; shows own capacity to finance debts;

$R_2 = \dfrac{equity}{total\ liabilities}$; shows patrimonial solvency;

$R_3 = \dfrac{cash\ and\ investments}{total\ assets}$; measures the performance of patrimonial assets;

$R_4 = \dfrac{financiar\ expenditure}{turnover}$; shows the level of financial expenditure;

$R_5 = \dfrac{staff\ expenditure}{added\ value}$; measures the degree of staff remuneration.

The weighting coefficients have similar values except for the "Level of financial expenditure" which is more significant, so the importance of the indicators is relatively close.

The authors retained three areas of Z's classification, and the method has a 75% degree of accuracy in predicting bankruptcy.

Z < - 0,2 – 100% probability of bankruptcy
Z = 0,068 – 50% probability of bankruptcy
Z > 0,164 – 10% probability of bankruptcy

For "wholesale" companies the correspondence between the values of the Z function and the probability of bankruptcy is shown in Table 1.

Table 1. The correlation between the values of the Z function and the probability of bankruptcy in "wholesale" companies

Value of the Z score	Situation of the company	Risk of bankruptcy (%)
Z ≥ 0,20	Good	< 40
- 0,03 < Z < 0,20	Alert	35 - 65
Z < - 0,30	Danger	> 65
-0,05 < Z < 0,04	Very high danger	65 - 90
Z < -0,05	Failure	91-100

Source: Own processing

3. Bankruptcy risk analysis through the Balance Sheet Center of the Bank of France Model

"The Balance Sheet Center of the Bank of France Model (score function) is one of the most elaborated models within the Central Bank of France, which predicts the risk of bankruptcy and is based on 8 variables representing economic and financial profitability rates. The 8 rates were chosen from the 26 rates observed in French companies following the observations made between 1977 and 1979 on companies with less than 500 employees. The first two rates of the Bank of France model give 50% of the discrimination power of these entities under normal and deficient conditions. The indicators considered provide information on the financial structure, internal management and efficiency of the activity carried out."[21]

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[21] Barbier, A., Prontad, J. (1990). „Traitepratiqne de Vanalysefinanciere a Vusage des banques", La revue banque, Paris

$$Z = -1,255R_1 + 2,003R_2 - 0,824R_3 + 5,221R_4 - 0,689R_5 - 1,164R_6 + 0,706R_7 + 1,408R_8 - 85,54$$

Based on the model presented, the Bank of France determines the score in two stages:

1. a separation is made of normal entities, which have $Z > 1,25$ from those in difficulty, with $Z < -0,25$

2. the entities in difficulty are separated into the bankrupt and the only vulnerable ones at the time of the analysis, according to the indicator

$$\frac{financial\ expenses}{gross\ operating\ result}$$

The values of the Z function show:[22]

$Z < -0,25$ – area with difficulties

$-0,25 < Z < 0,125$ – area of uncertainty

$Z > 0,125$ – favorable area

The score thus obtained represents a support in the management act, because it can warn of the risk of bankruptcy, but the information must be used with great caution.

"An analysis of the evolution of the score over several years and its comparison with the average score obtained by sector of activity, along with other classical methods of analysis can substantiate decisions regarding the financial health of a company."[23]

In conclusion, the scoring method widely used by banks and financial institutions for their own credit assessments, allows the rapid positioning of the risk of bankruptcy posed by borrowed companies.

4. The French Commercial Credit Method

This method is applicable to medium-sized enterprises with credits operating in the industrial sector. The assessment of vulnerability or balance and efficiency is based on two indicators and a constant that is added to the Z function as follows:

$$Z = 6,47 - 9 \times \frac{financial\ ecpenditure}{gross\ operating\ result} - 1,1 \times \frac{loans + interest}{equity}$$

The assessment is made without considering other average values of Z or limits, but only the level $Z = 0$ separates the analyzed companies into good and with foreseeable difficulties in the future.

5. Mânecuţă and Nicolae model

In Romanian theory and practice there have been and still are constant concerns on defining and adapting the scoring method to the needs of the Romanian economy. Romanian specialists and practitioners have shown a special interest (mainly as a result of research and studies coming from the university area), molding themselves on the structure of the Romanian economy and especially of the industry.

This first Romanian model was proposed for the metallurgical industry and was developed by Mânecuţă and Nicolae in 2006, two specialists at the National Forecasting Commission.

The proposed model is based on a solution matrix needed to construct a score function, using Pearson's empirical coefficient for choosing discriminant financial rates.

The financial variables considered are presented in Table 2.[24].

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[22] Dumitrescu, Gheorghe. (2010). „Studii de cercetare cu privire la riscul de faliment, Modele şi metode de previzionare", Romanian Statistical Review nr. 4/2010, p. 7.

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[24] Mânecuţă, C., Nicolae, M. (2006). Construirea şi utilizarea funcţiei scor pentru diagnosticarea eficienţei agenţilor economici, Revista Finanţe, Credit şi Contabilitate, nr. 5/2006

The determination of the weighting coefficients based on the correlation between the fixed variable and the objective function was based on solving a system of equations with 14 unknowns.

Table no. 2. The financial variables considered for the Mânecuţă and Nicolae model

Ref. No.	Retained variable
1.	Rate of financial expenses
2.	Invested capital coverage rate
3.	Debt repayment capacity rate
4.	Gross operating margin rate
5.	Average rate of supplier credit
6.	Overall indebtedness rate
7.	Term indebtedness rate
8.	Commercial receivables rate
9.	The rate of physical investment
10.	Average term of the credit
11.	Influence of working capital needs
12.	Inventory rate

Source: Mânecuţă C., Nicolae M. – Construirea şi utilizarea funcţiei scor pentru diagnosticarea eficienţei agenţilor economici, Revista Finanţe, Credit şi Contabilitate, nr. 5/2006

Solutions were obtained, respectively the coefficients of the considered economic rates, after solving the system of equations. The Z function results for the Romanian companies operating in the metallurgical industry:

$$100Z = -0,02395\ R_1 - 0,54604\ R_2 + 0,01263\ R_3 + 0,33901\ R_4 + 0,04745\ R_5$$

$$+ 0,01752\ R_6 + 0,02194\ R_7 + 0,71249\ R_8 - 1,15459\ R_9 - 0,09855\ R_{10} + 0,02751\ R_{11} -$$

$$0,48437\ R_{12} - 0,08536\ R_{13} + 0,03609\ R_{14}$$

In order to delimit the favorable and unfavorable areas, an average level of the obtained score function was considered in the conditions of a sample of 59 companies, respectively - 1,56. Thus, the authors manage to establish the decision rule of the score function:

Z > - 1,56 – companies without financial problems;
Z > - 1,56 – "deficient" companies.

6. The B – Băileşteanu Model

Starting from traditional studies (Altman, Argenti, Conan and Holder, etc.) Băileşteanu considers that "the occurrence of bankruptcy is determined by the following factors:
- impossibility to pay current obligations;
- lack of financial sources for credit reimbursement;
- collection with great delay of the counter value of the delivered products;
- recording losses."[25]

Băileşteanu proposes the following variables:

G_1 (general / current liquidity) $= \dfrac{current\ assets}{current\ liabilities}$

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[25] Băileşteanu, Gh. (2005) Diagnostic, risc, şi eficienţă în afaceri, Editura Mirton, Timişoara; & Dumitrescu ,Gheorghe (2010). Studii de cercetare cu privire la riscul de faliment, Modele şi metode de previzionare, Romanian Statistical Review nr. 4/2010, p. 8 (Băileşteanu, Gh. (2005). Diagnosis, risk, and business efficiency, Mirton Publishing House, Timisoara; & Dumitrescu, Gheorghe (2010). Research studies on bankruptcy risk, Models and forecasting methods, Romanian Statistical Review no. 4/2010, pp. 8)

$$G_2 \text{ (solvency)} = \frac{net\ profit + depreciation}{credit\ reimbursement\ rate + interest}$$

$$G_3 \text{ (customer recovery)} = \frac{turnover}{customers}$$

$$G_4 \text{ (cost effectiveness)} = \frac{profit}{cost} \times 100$$

Parameters a and b are calculated according to the following calculation formulas:

1. for indicators that are optimized by minimum:

$$a = \frac{1}{x_{max} - x_{min}} \qquad b = \frac{-x_{max}}{x_{max} - x_{min}}$$

2. for indicators that are optimized by maximum:

$$a = \frac{1}{x_{min} - x_{max}} \qquad b = \frac{-x_{max}}{x_{min} - x_{max}}$$

Where:

X_{min} = minimum indicator value (bankruptcy status)

X_{max} = value of the indicator when the risk of bankruptcy is minimal

The financial rates retained are shown in Table 3.

Table no. 3. Permitted limits for optimizing the bankruptcy indicator

Indicators	Symbol	Value		a	b
		min	max		
Current liquidity	G_1	0,75	3,0	0,444	- 0,333
Solvency	G_2	0,9	2,0	0,909	- 0,818
Customer recovery	G_3	5	24	0,053	- 0,263
Profitability	G_4	0	30	0,033	0

The function is: **B = 0,444 G_1 + 0,909 G_2 + 0,0526 G_3 + 0,0333 G_4 +1,414**

B has a maximum value equal to 4 and a minimum value equal to –1,4.

Depending on the value recorded, it is considered:

B < 0,5 - imminent bankruptcy

0,5 < B < 1,1 - limited area

1,1 < B <2,0 – intermediate area

B > 2,0 – favorable area

Conclusions

The notion of ”bankruptcy risk” seems to be specific to insolvency proceedings, the analysis of bankruptcy risk being part of the report prepared by the liquidator to observe the evolution of the company for 3 years before the opening of the insolvency proceedings, but in reality it should be used regulary by the management of any company to avoid the occurence of financial difficulties. Unfortunately, although even the insolvency law comprises solid principles and rules that facilitate the business reorganization, it is minimally used in practice because company managers use the protection provided by the law of insolvency only when the financial situation is irremediably compromised and the activity can no longer by reorganized, thus that the

bankruptcy procedure must be initiated.[26].

      We believe that although there are a multitude of indicators and models to be followed in determining the risk of insolvency or bankruptcy, the calculation of these indicators is not carried out at an early stage of financial difficulty, not all methods can be applied to any type of company, and its object has a strong influence in their analysis, for example for financial institutions the indicators on the analysis of treasury or financial solvency are eloquent, to the detriment of indicators on the structure of liabilities.

      The scoring method is an early detection tool for the risk of bankruptcy, and the informative value of the score should not be overestimated, because discriminatory analysis reduces basic information by selecting the most significant rates considered constant over time and companies are an economic system that operates in an environment with many more variables that can be used to determine its health or weakness. As a precaution, it is recommended to follow the evolution of the score in companies in the same economic sector, as well as to complete the diagnosis with classical methods of analysis (analysis of financial balance, profitability performance, financial flows and ultimately of the global risk).

      Based on the literature, we found that the most used method of bankruptcy risk analysis is the Altman model.

      Each administrator must quantify the risk involved in engaging in a particular business with the assessment of resources. On the other hand, once the investment is completed, he must constantly monitor the recovery of the investment from the revenues collected, in order to prevent possible risks.

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