MODELS FOR THE ASSESSMENT OF THE ENTREPRISE BANKRUPTY RISK IN CRISIS SITUATIONS

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Abstract:
The complex nature of the aspects involved by bankruptcy risk also explains the diversity of the diagnosis and analysis models, of which we mention: the liquidity - chargeability analysis, the functional analysis, the rate analysis, the financial flow analysis, etc, therefore, bankruptcy risk analysis can be developed in a static manner, using the analysis of the balance sheet financial balances, or in a dynamic manner, using the analysis of the flows depicted in the financing chart.
Based on specialty literature, this paper will outline the national and international contributions in the field of discriminatory analysis and bankruptcy prediction, also known as the so-called score functions.
Several researchers and financial organisations have been concerned with developing a bankruptcy risk prediction method, starting from a small group of rates, closely linked to the he alth or vulnerability of the enterprise. The procedure used is the statistic technique of discriminatory analysis of the financial features (calculated using rates) of the normal functioning enterprises and of those experiencing difficulties in their econo mic and financial management. Most bankruptcy risk analysis methods are based on the score function which helps determine if an enterprise will go bankrupt or will have irrelevant economic results during a period immediately following the analysis (two years max).
Thus, this paper introduces the main scoring methods for estimating bankruptcy risk, also underlining the main analysis schools, the Anglo-Saxon and the continental school respectively, and also outlining the national development in the field, the contributions of the Romanian school of economic-financial analysis.

Keywords: bankruptcy risk, discriminatory analysis and bankruptcy prediction, score functions, solvability, models for the assessment of the enterprise bankruptcy

JEL Classification: M49

INTRODUCTION

Bankruptcy risk is related to the difficult state of the enterprise, considered as a permanent financial crisis situation. From a juridical viewpoint, an enterprise is in difficulty when it is in an arrested payment situation, no longe r being able to meet the due debts and, in this case, the law stipulates the reorganisation or dissolution of the enterprise.

Bankruptcy risk can be estimated in the static and dynamic analysis of the financial balance that outlines the former performanc e of the enterprise, but a global evaluation of its future becomes all the more interesting for the management of the enterprise and especially for its business partners (banks, clients, capital investors, etc). As a consequence of the rapid degradation in time of the results of the enterprise, there is a more obvious need to develop certain bankruptcy risk prediction models.

The impossibility of an enterprise to honour its due debts, leads to the insolvency risk and consequently to bankruptcy risk. The presence of certain permanent difficulties in honouring its debts can lead to a reduction of the activity, dismissal of employees, organisational restructuring and, eventually, bankruptcy.

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The analysis of the causes that have determined the bankruptcy of certain enterprises has revealed their diversity and has, at the same time, fuelled the idea that bankruptcy is not a sudden

phenomenon caused by conjuncture, but is determined by the progressive degradation of the financial situation and of the health of the enterprise. But there are examples of bankru ptcy caused by external shocks, for example the petrol crisis in the 70's and after that the raw mate rials and energy crisis or the loss of exclusive markets because of the severed economic and diploma tic relations between countries and also the current economic crisis caused by the difficulties of banking system. So far it has been demonstrated that most cases of bankruptcy are caused by errors in the internal management of the material and financial resources of the enterprise

Bankruptcy risk is closely connected to the solvency state and especially to the payment ability state which reflects the possib ility that the enterprise may not pay its due debts in time.

A rise in the number of bankruptcy cases in competing economies has rushed public authorities and financial analysts to find prediction methods for bankruptcy risk in order to assist in the recovery of enterprises in difficulty.

In the economic life of an enterprise there may be moments of regress and even failure, moments that can lead to financial supervision, reorganisation, restructuring and, eventually, to dissolution.

CAUSES OF BANKRUPTY RISK

The analysis of bankruptcy cases tends to emphasize the role of two large categories of generating factors such as factors related to the weakness and internal errors and economic environment factors, both categories having a convergent effect in t he degradation process. Therefore, an enterprise whose organisational and management system has severe weaknesses will also have difficulties in adapting to the unfavourable evolutions of the environment.

The causes of bankruptcy are numerous and are dire cted at a reduction of the activity, a reduction of the margins and profitableness rates, treasury problems, management problems, as well as accidental causes related to the bankruptcy of certain clients, a reduction of the outlets, chain lock-ups, etc.

The specialty literature mentions several methods and instruments that allow the identification of causes and the approach of the different shapes taken by bankruptcy risk.

Bankruptcy risk is determined by several causes:
a)   *External causes:* loss or bankruptcy of an important client; bankruptcy of a key supplier; bankruptcy of the bank where the enterprise has its main account; aggressive policy of the competition that leads to the removal of the enterprise from the market; failure to keep up with the technological change, leading to less competitive products and market removal; not taking into account certain provisions of environmental protectio n issued in time, etc.
b)   *Internal causes:* inappropriate management in the investment policy, leading to productio n capacities whose product undergoes several updates as a result of a change in consumer preferences; operating low productivity machinery and equipment that overcharges the production quality management; repeated losses in the operating activity; inappropriate indebtedness policy during unstable economic periods; the deterioration of the rotation of circulating assets; erroneous policy in the field of commercial credit.

The study of bankruptcy causes has lead to the conclusion that it is not a brutal phen omenon due to conjectural fluctuations but a result of a progressive degradation of the financial situation of the enterprise as insolvency risk can be predicted a few years before stopping payments.

MODELS OF ESTIMATING BANKRUPTY RISK

Several studies have been conducted, especially in the United States and France, in order to analyse and classify enterprises according to their degree of difficulty, based on statistical surveys, with samples of enterprises in difficulty, thus establishing highly predict ive indices.

The studies developed in France and the US have shown that in order to predict the bankruptcy of an enterprise, accounting methods can be used (quantitative and analytical methods – used in comparative analyses to estimate the future evolutio n of the company) and banking methods (that suggest an early detection of vulnerability and bankruptcy risk by means of synthetic risk notes resulted from statistical methods of discriminatory analysis, allowing the calculation of a score function).

The calculation of the score function requires the prior awareness of certain rates that help determine the bankruptcy risk of an enterprise and the early protection by correcting measures. A note (Z), called score, is given for the enterprise, representing a l inear combination of rates and, varying with the value of the score, enterprises are classified as vulnerable, bankrupt and healthy.

Most score functions used to determine the probable bankruptcy state of the enterprise, have used as statistical technique the discriminatory analysis, the latter being highly recommended , especially when we want to extract from the multitude of calculated financial indices, the ones that most clearly explain the bankruptcy risk of an enterprise.

Several researchers and financial organisations have been keen on developing a method of predicting bankruptcy risk, starting from a small group of rates, linked to the health or vulnerability of the enterprise. The procedure used is the statistic technique of discriminatory analys is of the financial features (calculated using rates) of the normal functioning enterprises and of those experiencing difficulties in their economic and financial management. Most bankruptcy risk analysis methods are based on the score function which helps determine if an enterprise will go bankrupt or will have irrelevant economic results during a period immediately following the analysis (two years max).

The main scoring methods for estimating bankruptcy risk was established, as well as analysis schools of the Anglo-Saxon and the continental school respectively, and also outlining the national development in the field, the contributions of the Romanian school of economic -financial analysis (Table no. 1.).

Tabel no. 1. **International and national models of estimating bankrupty risk**

No. crt.	*Anglo – saxon schools*	*Continental school*	*Romanian school*
1.	**Model Credit – men or Security – analysis;**	Model Yves Collongues (1976);	Model Mânecu and Nicolae (1996);
2.	**Model unidimensional W.H. Beaver;**	Model Conan Holder (1979);	**Model Cămoiu - Negoiescu**
3.	**Model E. Altman;**	Model's Balances of the Central Bank of France;	**Model B – Băileteanu (1998);**
4.	**Model Edmister (1972);**	Model of French trade credit (CCF);	**Model I – Ivonciu (1998);**
5.	**Model Diamond (1976);**	Model accountants agree (CA Score 1987);	**Model I. Anghel (2000);**
6.	**Model probabilistic of Deakin (1977);**	Model Scor Function AFDCC 2 (1999).	Model of Romanian trade Bank
7.	**Model Sprinkate (1978);**		
8.	**Model Koh and Killough (1980);**		
9.	**Model Ohlson (1982);**		
10.	**Model Zavgren (1983);**		
11.	**Modelul Fulmer (1984);**		
12.	**Model Koh (1992);**		
13.	**Model Shirata (1999).**		

We'll continue with a detailed account of the most used and well -known prediction models for bankruptcy risk.

MODELS OF ANGLO-SAXON SCHOOL

The first research on bankruptcy risk analysis has been developed in the USA in the 30'. The method was called *„credit - men"* and it aimed at making assessments on the financial situation of an enterprise by means of a synthetic note, t hus establishing the position of an enterprise as compared to that of a typical enterprise in the same industry. The method has long been abandoned, as it used arbitrary chosen ratios and introduced a financial structure as an ideal structure, something which is not possible even today, despite all the progress of the financial theory. The purpose of this model was to study risk in credit granting, including an extension of risk analysis by including certain variables linked o the human factor and the globa l economic environment.

The subsequent prediction models are based on the discriminatory analysis which was used for studying the evolution of several enterprises in the field, divided into two categories: with a good and with a difficult financial situat ion, on a long period and using different rates. The rates considered as significant have been attached to ratios that reflected their influence on the financial situation of the enterprise and, by combining them, came out the score, the Z function, as a l iner function of several variables, thus:

$$Z = a_1 \times R_1 + a_2 \times R_2 + \ldots + R_n + b \qquad (1)$$

where:

$a_1, a_2 \ldots a_n$ – medium weighing ratios (positive or negative in order to assess the favourable or unfavourable impact on the financial situation);

$R_1, R_2 \ldots R_n$ – rates (or financial structure, dyna mism, management profitableness), taken into account;

b   - constant (just in case).

The score thus established divides the enterprises in the two categories (healthy and vulnerable), sometimes even into intermediate categories.

The Altman Model (USA, 1968)

The development and conclusions of the model are based on the examination of 66 enterprises for a period of 20 years (1946-1965), of which 35 enterprises have gone bankrupt during the specified interval, with data referring to a year before the bankruptcy.

These enterprises are compared to an equal number of healthy enterprises, randomly chosen and considering the existing heterogeneity in terms of size and industry corresponding to enterprises in difficulty. The examination in evolution has b een conducted for 22 financial indices (financial rates), calculated based on the accounting data. Of these indices, only 5 have been considered as significant while the aggregated index took the following form:

where:

R1= FRN/ Total asset;

(2)

R2= Reserves/ Total asset;

(3)

R3= Gross profit/ Toatal asset;

(4)

R4= Stock exchange capitalization (equity capital)/ Total debts;

(5)

R5= .Turnover(CA)/ Tatal asset.

(6)

As rates that measure the weight of the total asset from equity capital and medium and long term debts, or the asset profitableness, or the financial autonomy and the rotation of the asset, whose positive significance means as high a value as possible, it comes out that the Z score must also have as high a value as possible.

The analysis of the financial situation based on this model is conducted as follows:
- when Z   1,8, imminent bankruptcy situation;
- when $1,8 < Z$ 3, the financial situation is difficult, with diminished performance and the lower the points, the closer is the enterprise to bankruptcy. The improvement of the situation is possible by applying the right strategy;
- when $Z > 3$, good financial situation, solvent enterprise.

The Altman model can be applied to enterprises quoted on the stock exc hange in countries where the stock exchange has a balanced functioning, i.e. the exchange rate is mainly based on the relation demand/supply.

MODELES OF CONTINENTAL SCHOOL

The Conan and Holder model (France, 1979)

This study has been conducted by C.E. R.E.G. (Centre de Recherche de l'Universit   de Paris – Dauphine) in view of analysing the degradation of the financial situation of small and medium sized enterprises and the model has the advantage of simple calculations, a reason why it is still being used today.

The formula and the conclusions of the model are based on the analysis of 31 rates, for 190 small and medium sized enterprises of different industries: industry, commerce, services, transport. Of the 190 selected enterprises for the period 1970 -1975, 95 enterprises were bankrupt and another 95 were healthy but whose size and activity was similar to those of bankrupt enterprises. Models specific to the sectors of activity have been developed, thus 5 rates have been retained and the function had the following form:

$$Z = 0,24 \times R_1 + 0,22 \times R_2 + 0,16 \times R_3 - 0,87 \times R_4 - 0,10 \times R_5$$

(7)

R1= EBE/ Total debts;
(8)
R2= Permanent capital/ Total asset;
(9)
R3= Circulating assets (stocks)/ Total asset;
(10)
R4= Financial expenses/(credit cost)/ Turnover(CA);
(11)
R5= Personal expenses/ Value added (VA);
(12)

The model shows that the first three rates have a positive impact, the higher their value, on the financial situation, while the last two represent, by growth, a degradation of the financial situation, R_4, the weight of the financial expenses in the turnover, with a significant negative value, illustrated by the high negative value of the ratio.

The enterprise is considered at risk, varying with the score value, as follows (Table no 2):

Table no. 2 Types of enterprises depending on the score value

Score value	Situation of the enterprise	Bankruptcy risk
Z > 0,16	Very good	Lower than 10%
0,10 < Z < 0,16	Good	From 10% - 30%
0,04 < Z < 0,10	Alert	From 30% – 65%
-0,15 < Z < 0,04	Danger	From 65% – 90%
Z < - 0,05	Failure	Higher than 90%

The contribution of this function can be found in the decision making rule as the probability of error in classifying an enterprise is higher if the value taken into consideration in the calculation of the function for this enterprise is closer to the decision threshold.

The Conan-Holder model usually generates important results in predicting the short -term evolution of trading companies. Such a model is accurate only where the bankruptcy rule operates, when the hidden subsidies are cancelled, commercial credit is well managed and where statistics are adequate.

The CBBF Model (The Balance Sheet Central Office of the Bank of France, 1984)

The model has been developed by observing a number of 26 rates, on a sample of 3000 industrial enterprises, with less than 500 employees, classified as normal and scanty, for an interval of 3 years, prior to bankruptcy (1975 -1980).

For an increased accuracy of the model, three categories of enterprises have been established using this model: bankrupt enterprises; normal enterprises, vulnerable enterprises.

The model predicts bankruptcy risk for a time span of 3 years with 8 rates (variables) whose combination in the score function takes the following form:

(13)

$$100 \times Z = - 1{,}255 \times R_1 + 2{,}003 \times R_2 - 0{,}824 \times R_3 + 5{,}221 \times R_4 - 0{,}689 \times R_5 - 1{,}164 \times R_6 + 0{,}706 \times R_7 + 1{,}408 \times R_8 - 85{,}544$$

where:
R_1 = Financial expenses/ EBE;
(14)
R_2 = Permanent capital/ Invested capital;
(15)
R_3 = CAF/ Total debts;
(16)
R_4 = EBE/CA;
(17)
R_5 = (Suppliers*360)/Supply;
(18)
R_6 = (VA1-VA0)/VA0;
(19)
R_7 = ((Spn-Acl+Cl)*360)/ PEc;
(20)
R_8 = Corporal investment/ VA(added value).
(21)

where:
Spn – unfinished production stocks;
Acl – advance payment clients;
Cl – clients;
PEc – corrected exercise production: [PV ± SPS + ½ (Pl + SE)];
(22)
PV – sold production;
SPS – the inventory balance;

PI – immobilised production;

SE – operating subsidies.

These rates concern: the covering of the invested capital; the reimbursement capacity; the gross operating margin; the suppliers credit interval (in days); the variation rate of the added value; clients payment interval (in days); the physical investment rate.

The weight of the average rate for the enterprises with the ration determined in the model, for the sample taken into consideration, determines a value of the function $Z = 0$.

There is an uncertainty shadow around this average value of the score, as it is difficult to predict whether the enterprise is normal or scanty and the bankruptcy risk possibility amounts to 50%. The situation of the enterprises in relation to the score v alue and bankruptcy possibilities are presented in Table no. 3.

Table no 3. The situation of the enterprises in relation to the score value and bankruptcy possibilities

Score value	Bankruptcy risk	
$Z < -1,875$	100,0	
$-0,875 \quad Z < -0,875$	95,6	unfavourable area
$-0,875 \quad Z < -0,250$	73,8	
$-0,250 \quad Z < 0,125$	46,9	uncertainty area
$0,125 \quad Z < 0,625$	33,4	
$0,625 \quad Z < 1,250$	17,7	favourable area
$Z \quad 1,250$	9,5	

The method of the proper scores has the adva ntage of objectively testing the most efficient rate combinations in order to predict enterprise bankruptcy risk. The research that has lead to discriminatory functions determined the progress in analysing the behaviour of risky enterprises and the scores have proved to be extremely helpful in detecting risk, providing they are not used in a very mechanical way.

Important contributions of the scoring methods can be noticed for the financial analysis:
- they introduce a synthetic approach of the situation, b oth in a predicting perspective (referring to the prediction or detection of difficulties), and in a retrospective perspective;
- they allow an efficient estimation of bankruptcy risk by the external partners and especially by financing institutions;
- they allow the testing of the most efficient rates and rate combinations for predicting the difficulties of the enterprises;
- they contribute to solving the difficulties created by the multitude of financial balance indices;
- they provide a synthesis of the financi al information relative for the enterprise, but they cannot direct at the origin of the difficulties experienced by the enterprise.

There have been attempts to develop discriminatory analysis models in our country, although they have been slightly shifte d from the international development.

MODELS CONCERNING ROUMANIAN CONTRIBUTION SCHOOL

The MÂNECU   and NICOLAE model (1996) (specialists in the National Prognosis Committee)

This model, suggested for the metallurgic industry is based on a solving matrix, necessary for developing a score function by means of the empirical Pearson ratio for choosing the discriminatory financial rates.

The structure of the variables in the model is as follows: the financial expenses rate; the rate of covering the invested capital; the rate of debt reimbursement capacity; the rate of the gross operating margin; the average duration of the supplying credit; the global indebtedness rate; the

commercial claim rate; the physical investment rate; the average duration of the client credit; the influence of the need for working capital; the stock rate.

This model has used the matrix calculation, considering the number of enterprises in the sample (59) and the number of variables (14), as the matrix solved has 59 rows and 14 columns. Thus, the Z function takes the following form:

Z = - 0,02395 R1 – 0,54604 R2 + 0,01263 R3 + 0,33901 R4 + 0,04745 R5 +

0, 01752 R6 + 0,02194 R7 + 0,71249 R8 – 0,15459 R9 – 0,09855 r10 +

(23)

0,02751 R11 – 0,48437 R12 – 0,08536 R 13 + 0,03609 R14

The decision rule of the score function established by the authors is:
- Z > 1,56 results in enterprises without any financial difficulties;
- Z< - 1,56 results in scanty enterprises.

The I. IVONCIU model (1998)

A similar development to the one presented above has been developed by Ivonciu (1998), and the author used a set of 6 financial rates. The Ivonciu model considers the following financial rates (Table no 5):

Table no. 5 The financial rates of Ivonciu model

Indicator	Symbol	Value	Value
		Min	Max
1. Asset rotation speed	R1	1,00	4,00
2. Income profitableness	R2	0,07	0,25
3. Claims rotation	R3	6,00	36,00
4. Debt reimbursement capacity	R4	0,10	1,50
5. Quick liquidity	R5	0,50	1,25
6. Financial steadiness margin	R6	0,00	0,25

The function introduced is:

I = 0,333 r1 + 5,555 R2 + 0,0333 R3 + 0,714229 R4 + 1,333 R5 + 4,0 R6 – 1,66032

(24)

The values of the I function are:
- a maximum value equal to 6;
- a minimum value equal to -1,66032.
   Thus:
- I< 0,0 imminent bankruptcy;
- 0,0 < I < 1,5 high bankruptcy risk;
- 1,5 < I < 3,0 uncertain state;
- 3,0 < I < 4,5 average bankruptcy risk;
- 4,5 < I < 6,0 low bankruptcy risk;
- I > 6,0 highly unlikely bankruptcy risk.

I. Anghel (2001) has developed a model based on discriminatory analysis, starting from a sample of 276 enterprises, grouped into non -bankrupt (60%) and bankrupt (40%), and belonging to a number of 12 industries of the national economy. The analysis covered the period 1994 -1998 and has initially used a number of 20 economic -financial indices.

After the selection stage, four financial rates have been established for the development o f the score function:
- the income profitableness rate (X_1);
- the cash-flow debt covering rate (X_2);
- the asset indebtedness rate (X_3);
- the period of paying off the obligations (X_4).

All the above rates have been aggregated in the following score function:

$$A = 5,676 + 6,3718 X_1 + 5,3932 X2 - 5,1427 X_3 - 0,0105 X_4$$
(25)

Varying with the value established for this function, enterprises are included in one of the following three situations:
- when A < 0, bankruptcy/failure situation;
- when 0   A   2,05, uncertainty situation demanding prudence;
- when A > 2,05, non/bankruptcy situation, i.e. a good financial situation.

The analysis of the previously presented models has revealed a certain facility in detecting bankruptcy in time, with the mention that these models also have certain limitations:
- the models consider a small number of rates, considered to be the most significant, but the financial health is influenced by a multitude of factors;
- the value of the ratios has been established in relation to the discriminatory power, to the separation into good and scanty enterprises through the analysis of the evolution of the rates during certain periods of time, while the conjectural influences and the environment conditions change at sometimes short intervals of time.

CONCLUSIONS

The development of certain score functions for predicting the bankruptcy of Romanian enterprises is an extremely difficult attempt; first of all because the bankruptcy process has entirely different coordinates in Romania as compared to most countries where such models have been develop. Thus, in Romania there is a high number of bankrupt enterprises, but very few with bankruptcy declared by law. The premises for the further development of such models are set by the settlement of the Romanian economy on a competitive environment and getting the status of economy on the functional market.

Therefore, the development of a correct diagnosis has required the score -function analysis with other models as well, where there is a critical approach on aspects related to the management of the enterprise, the organisation of the accounting and control systems, the means of adjustment to the latest technological advances and the evolution of the market requirements, and at the sam e presenting the risk factors and the bankruptcy symptoms.

Romanian enterprise practice, considering the fact that the stock exchange is not balanced yet, with a serious lack of available assets on the market and the results of the enterprise have been strongly influenced sometimes by a low supply, other times by low purchasing power, by losing certain markets (the former Soviet market), by a faulty work ethic and, even if there is a bankruptcy law, it is not applied accordingly. Moreover, there are no wel l-organised statistics concerning the activities on industries or branches, a comparison between competing enterprises being very unlikely to develop.

Nevertheless, banks have established certain score grids for the financial situation of the enterprises in view of granting or ceasing the credits, suppliers analyse the financial situation of the clients with instalments and investors are interested in the the financial situation of the enterprises they want to invest in.

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