

BANKRUPTCY RISK PREDICTION USING STATISTICAL METHODOLOGY AND ITS IMPACT ON BUSINESS PROFITABILITY

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Abstract: The main objective of the study is to analyse the bankruptcy risk and its impact on business profitability. Depending on the risks faced by the entities, the most relevant economic and financial indicators project the extent to which profitability is affected. In the context of risks generated by the financial-accounting activity (risks improperly managed), their consequences lead to the instability of the entity, affecting the overall profitability.

To predict the bankruptcy risk, we will use statistical techniques, which help to provide accurate, reliable financial information, both within companies and external users. Based on financial ratios that accurately reflect the likelihood of bankruptcy, a sample of companies listed on the Bucharest Stock Exchange for the period 2015-2019 is analysed. The models used in carrying out this study are: Ion Anghel's model and Altman's model. The results obtained aim at the analysis of the bankruptcy risk from two perspectives and at the same time can represent a landmark in the substantiation of managerial decision-making for the Romanian entities.

JEL classification: M41, M16

Key words: bankruptcy risk, financial ratios, statistical methods, discriminant analysis, profitability.

1. INTRODUCTION

A series of financial ratios are calculated for the analysis of bankruptcy. Proper management of this type of risk is a key element in substantiating managerial decision-making.

The threats to which the companies are exposed due to risks require the permanent knowledge by managers of the financial-accounting statements. They need to identify and manage as accurately as possible the threats that could impede the proper functioning of the entity and the creation of a successful business profile.

This paper aims to predict the bankruptcy risk by means of the discriminant analysis that will include the Altman and Ion Anghel's models, which with the help of interpretations given by the calculation of the most relevant economic-financial indicators reveal the likelihood of identifying the bankruptcy risk. At the level of the study, the financial ratios with the highest level of predictability are taken into account,

based on which the Z-score of each company can be calculated, thus being able to classify it as bankrupt or non-bankrupt.

The financial distress faced by entities is determined by calculating these tools which are assessed using statistical methods, and the results obtained are correlated with the indicators for measuring profitability, with the help of which we can measure to what extent the entity has been affected or not by risks. The percentage in which the risks influence the profitability of the analysed companies is estimated with the help of the indicators in the profit and loss account.

2. OBJECTIVES

The purpose of this research is to assess the risk of bankruptcy faced by Romanian companies through statistical methods. This method is based on the discriminant analysis, which involves a combination of the most discriminant ratios, respectively which best separate healthy companies from those in financial distress. Among the financial ratios retained in the study, we can mention: rate of return (RoR), debt-to-equity ratio (D/E), economic activity rate (EAR).

Financial ratios are a traditional way of analysing the financial position of an entity. They offer the possibility to compare risk and stability, and return, in companies distinct in terms of size and branch of economic activity. With the help of ratios, we can create a business profile of these companies, of their economic peculiarities. In addition to this, they help: in estimating the financial standing of the company; in making forecasts regarding its financial results.

3. METHODOLOGY

Bankruptcy risk prediction is a necessity both within a company, and at the level of lending institutions or related entities, respectively, suppliers, customers, etc.

The scholarly literature generally addresses the company's creditworthiness and bankruptcy risk differently, without considering the various situations of insolvency based on analysis.

As far as it regards the Romanian literature, in terms of financial analysis, it puts in principle the sign of equality between the concept of "bankruptcy" and that of "insolvency" (Lala Popa I., Miculeac M., 2009).

Thus, according to the opinion expressed by the author Stancu I. (1996, 614) bankruptcy is defined as "the inability of the company to meet its commitments to third parties as they fall due".

According to the Law no. 85/2014 (art. 5 point 29) - insolvency "represents that state of the debtor's patrimony which is manifested by the insufficiency of the funds available for the payment of certain, liquid and due debts".

In the opinion of the author Holt Gh. (2009, 4), the concept of risk is very closely related to the financial strategy of the entity, to the cost of own or borrowed capital; it can be analysed by the operating risk or the financial risk that characterizes a state of distress by the fluctuation of the profitability (productivity) to the variations of the volume of activity. In addition to these risks, which can be mitigated by sound financial-accounting decisions, respectively by reducing the operating leverage (fixed expenses) and the financial leverage (by achieving an optimal financial structure), for certain reasons, companies in distress face the risk of bankruptcy that is sometimes imminent.

As author Siminică M. (2019, 1) states, “the risk of bankruptcy is determined by a series of other manifested risks, and these correlated at some point can cause a state from which the economic agent can no longer get out”.

Some authors (Watson D. and Head A., 2007) have highlighted the correlation between two essential elements within an entity, namely return and risk. These depend very much on the financial decisions made by the manager of any company. They are basically in a relationship of proportionality. Thus, if the predicted return is higher, then the risk will have the same level; it will grow in the same direction. We believe that the maximization of return is the major goal of any business, as this element can be severely affected if risks are not properly managed.

The concept of risk is very closely linked to that of profitability. Risk assessment is very important for making the right decisions regarding the use of financial capital, for making investment decisions, for partners who want to be informed about the level of performance that the entity has.

According to the authors Cîrciumaru D., Drăcea R., Tănasie A. and Siminică M. (2015, 1), “there should be a strong correlation between return and risk”. Although there are tools to assess both profitability and risk, according to the authors, the analysis of the profitability-risk correlation is not very easy to carry out, because return usually refers to the past performance of the company’s business operations, while risk refers to the future.

In the opinion of the authors Carp A. and Mirea M. (2017, 3) “profitability represents the capacity of an entity to generate profit as a result of the business operations it carries out”. The analysis of profitability is very important because it reflects the entire economic and financial activity of the entity, all processes that take place (are performed) in the company.

According to Solomon D.C. and Munteanu M. (2018, 1) in their study, at the level of a company’s business operations, risk and return represent two interdependent aspects; thus, any manager must assume a certain level of risk in order to achieve the desired profitability.

The risk that an entity faces can affect both the return on economic assets and the return on invested capital. Risk assessment is an issue that can generally be addressed both in terms of business, of owners who want to increase production, profit, as well as of external financial investors, who are interested in making the best investment.

In the analysis carried out in his study, Chiladze I. (2018, 2) argues that the main limitation of profit analysis is that this complex indicator cannot characterize the performance of the company. Therefore, it is necessary to study the return indicators. There are many theoreticians who have worked on establishing a correlation between return and the factors affecting it; the author quoted above states that a company’s profit is its positive financial result and the absolute indicator of economic efficiency. As is well known, profit is the difference between income and expenses. In principle, an increase in the volume of expenses decreases the profit; but without the necessary expenses, no income can be created and therefore no profit. Consequently, “making a profit implies that the income should exceed the expenses and not that there should be no expenses” (Chiladze, 2018, 276).

As the authors Dușescu A. and Stroie C. (2018, 2) state in their study, “the failure or decline of a company is generally defined by the concepts of bankruptcy / liquidation or by the failure to achieve its objectives”. The authors believe that the survival of a

company in distress is of great importance both to its owners and to the maintenance of trade relations.

Profitability indicators are the expression of business operations carried out by an entity in order to make a profit. In this study, the most important indicators of profitability are related to the net profit margin, which highlights the profitability of the overall business operations of an entity in terms of percentage. The higher the percentage level, the more stable the company is and has a good financial standing in terms of profitability. The net profit margin consists of the ratio between the net profit of the entity and turnover, expressed as follows:

$$M_{pn} = \frac{\text{Net profit (Pn)}}{\text{Turnover (CA)}} * 100, \text{ where:}$$

M_{pn} – net profit margin.

The discriminant analysis allows a distinction to be made between vulnerable and stable entities using a set of financial indicators. The score “as a completion of the discriminant analysis” (Ion Anghel, 2002, 36) represents an external diagnostic method that consists in estimating and interpreting the risk which the entity, but also investors or creditors are exposed to.

The first researchers to conduct business bankruptcy prediction studies were Beaver (1966) and Altman (1968). Their statistical models use financial ratios to form functions that predict bankruptcy.

In predicting bankruptcy, the discriminant analysis can be *univariate* and *multivariate*. The one who paved the way for the univariate analysis was Beaver (1966, 71-111). The *methodology of the univariate analysis* consists in using a single financial ratio in a bankruptcy anticipation model. The author analysed the financial ratios separately (ratio by ratio), looking to test the most discriminatory indicators, more precisely those that classify companies the most correctly in the two categories: healthy, respectively in financial distress.

The methodology of the multivariate discriminant analysis is based on Altman’s original contribution (1968, 589-609). In the context of bankruptcy prediction, this type of analysis represents a combination of financial ratios in a single score function (Z-score), ratios which help in best distinguishing between the two categories, namely financially stable companies and companies at risk.

According to the author Siminică M. (2019, 1) such an analysis that involves a linear combination of certain ratios “can help identify and calculate a score indicator based on which the risk of bankruptcy of the concerned company can be assessed”.

Other successful authors who developed bankruptcy risk prediction models followed: Springate’s Model (1978), Fulmer’s Model (1984), Koh’s Model (1992), Măneacă and Nicoalae’s Model (1996), Ion Anghel’s Model (2002), Cîrciumaru’s Model (2012).

To predict this type of risk, we conducted a study on companies in the field of transport, respectively hotels and restaurants, for a period of five years. Two score functions were used in the research: Altman’s model (1968) and Ion Anghel’s model (2002). The score functions were applied to the following companies: Neptun Olimp; Nord; Palace; Dorna; Sif Hoteluri; BTT; Casa de Bucovina; Hercules; Socep; Sntgn; Transgaz. The study was conducted only on Romanian companies, listed on the Bucharest Stock Exchange, and the scores used were also from the category of foreign ones, a model that can also be used for the Romanian economy.

We consider that there is a direct correlation between the bankruptcy risk and profitability, which leads us to the following hypothesis:

H1 - there is a direct, positive correlation between the bankruptcy risk and profitability;
H2 - respectively, the alternative hypothesis in which there is no direct correlation between the bankruptcy risk and profitability.

For Ion Anghel's model, certain financial variables are retained, that achieve the best discrimination: rate of return (return on income); debt-to-equity ratio (cash flow-to-debt ratio; overall debt-to-equity ratio); the period of payment of obligations. The *economic activity rate* aims at revenue and has indicators of particular interest to business partners. Also, the period of payment of obligations or the period of recovery of receivables are given high importance, for example for a sound management. The *debt-to-equity ratio* highlights the level of dependence on borrowed capital. The *rate of return* is in principle used by shareholders; at the same time, the sound management depends very much on the financial rate of return.

The calculation relationship for this bankruptcy risk analysis model is:

$$A = 5.676 + 6.3718X_1 + 5.3932X_2 - 5.1427X_3 - 0.0105X_4, \text{ where:}$$

$$X_1 = \text{Net Profit} / \text{Income}$$

$$X_2 = \text{Cash Flow} / \text{Assets}$$

$$X_3 = \text{Debts} / \text{Assets}$$

$$X_4 = \text{Liabilities} / \text{Turnover} * 360$$

Table No. 1 Zones in which companies can be classified, depending on the score obtained:

A < 0	Bankruptcy / Failure
0 > A > 2.05	Zone of uncertainty
A > 2.05	Non-bankruptcy

Source: Own interpretation based on the information found in the paper of the author Ion Anghel (2002, 146)

Five variables are retained **for Altman's model**, and it has the following expression:

$$R = 3.3 * R_1 + 1.0 * R_2 + 0.6 * R_3 + 1.4 * R_4 + 1.2 * R_5, \text{ where:}$$

$$R_1 = \frac{\text{Gross Profit}}{\text{Total Assets}}$$

$$R_2 = \frac{\text{Turnover}}{\text{Total Assets}}$$

$$R_3 = \frac{\text{Permanent Capital}}{\text{Total Debts}}$$

$$R_4 = \frac{\text{Reinvested Profit}}{\text{Total Assets}}$$

$$R_5 = \frac{\text{Current Assets}}{\text{Total Assets}}$$

Among the indicators used in the elaboration of this model, we can noticed the existence of the economic rate of return (R1), calculated based on the gross profit and the value of total assets. Within the model, the economic rate of return is assigned a fairly high value of the weighting coefficient compared to the value of the other coefficients used in the weighting of ratios. The Z-score function includes other variables: asset turnover ratio (R2); financial autonomy (independence - R3); self-financing capacity (R4); share of working capital in total assets (it expresses the company flexibility - R5).

Table No. 2 Companies can be classified in the following zones:

$R \leq 1.8$	State of imminent bankruptcy
$R > 2.9$	Relatively good financial standing
$R \in [1.8; 2.9]$	Grey zone of uncertainty / Very difficult financial standing, close to bankruptcy (visibly diminished performance), but the entity can maintain a real balance if it has a sound management.

Source: Own interpretation based on the information found in the study of the author Holț Gheorghe (2009, 9)

4. ANALYSES

In order to demonstrate the strong correlation that exists between the profit margin and the two models, we will carry out an analysis using the Altman and Ion Anghel's models based on the discriminant analysis, which will highlight the influence that the risks have on the profitability of a company.

Table No. 3 Score values - Altman's model

Z-score ALTMAN'S MODEL	2015	2016	2017	2018	2019
NEPTUN OLIMP S.A.	55.48	94.40	85.73	57.12	61.69
PALACE S.A. SINAIA	6.64	5.40	3.74	3.91	6.25
DORNA TURISM S.A.	2.72	3.01	3.01	3.30	3.07
SIF HOTELURI S.A.	4.04	4.29	4.05	4.21	4.18
BTT S.A. BUCHAREST	15.67	10.65	38.51	14.95	6.09
CASA DE BUCOVINA	9.39	9.16	29.45	29.76	32.04
HERCULES S.A. BRĂILA	3.39	3.93	3.90	4.13	5.72
SOCEP S.A.	10.91	4.27	3.54	4.02	1.82
S.N.T.G.N. TRANSGAZ S.A.	7.96	9.17	9.10	5.50	3.59

Source: Author's own calculations from the financial-accounting statements of the companies listed on the Bucharest Stock Exchange

According to Altman's model, Neptun Olimp S.A., B.T.T S.A. Bucharest, Socep S.A., Transgaz S.A. registered in the analysed period a better standing between the years 2015 and 2017, which worsened considerably in the years 2018, 2019. However, the companies are not in a zone of imminent bankruptcy. At the same time, the companies Palace S.A. Sinaia, Dorna Turism S.A., Sif Hoteluri S.A., Casa de Bucovina, Hercules S.A. Brăila recorded better results between the years 2018 and 2019.

Table No. 4 Score values - Ion Anghel's model

Z-score ION ANGHEL'S MODEL	2015	2016	2017	2018	2019
NEPTUN OLIMP S.A.	8.70	15.57	12.76	18.33	8.25
PALACE S.A. SINAIA	7.12	6.92	6.57	6.76	7.39
DORNA TURISM S.A.	5.56	6.04	6.38	7.02	7.17
SIF HOTELURI S.A.	10.99	6.81	6.24	6.72	6.52
BTT S.A. BUCHAREST	5.81	28.32	6.88	9.90	7.07
CASA DE BUCOVINA	6.10	6.18	6.53	5.88	7.78
HERCULES S.A. BRĂILA	7.20	7.47	8.57	8.94	10.74
SOCEP S.A.	8.51	7.65	6.48	7.62	5.82
S.N.T.G.N. TRANSGAZ S.A.	12.28	12.52	13.30	12.28	10.57

Source: Author's own calculations from the financial-accounting statements of the companies listed on the Bucharest Stock Exchange

According to Ion Anghel's model, companies stand in a relatively good zone in every year submitted to analysis.

Through a comparative analysis of the two models by **Ed. I. Altman and Ion Anghel**, it can be seen that the standings of the companies vary from one year to another, in both cases heading to a relatively good zone with an extremely low bankruptcy risk.

In order to analyse the close correlation between bankruptcy risk and profitability, the following table presents the values of the net profit margin for the 9 companies in the period 2015-2019.

Table No. 5 Net profit margin values

PROFITABILITY MEASUREMENT (net profit margin)	2015	2016	2017	2018	2019
NEPTUN OLIMP S.A.	48.44%	160.09%(*)	102.81%(*)	240.62%(*)	74.14%

PALACE S.A. SINAIA	9.36%	6.65%	4.72%	4.85%	5.56%
DORNA TURISM S.A.	4.80%	3.79%	2.11%	4.29%	1.25%
SIF HOTELURI S.A.	80.07%	18.35%	5.60%	9.78%	5.68%
BTT S.A. BUCHAREST	18.53%	395.21%(*)	29.79%	62.38%	21.91%
CASA DE BUCOVINA	7.35%	7.52%	8.14%	0.61%	28.58%
HERCULES S.A. BRĂILA	7.76%	4.47%	6.49%	1.18%	9.28%
SOCEP S.A.	17.65%	16.67%	5.88%	16.98%	25.98%
S.N.T.G.N. TRANSGAZ S.A.	30.90%	33.97%	32.42%	28.46%	18.82%

* In those years, values higher than 100% are justified by the sale of assets held by the company.

Source: Author's own calculations from the financial-accounting statements of the companies listed on the Bucharest Stock Exchange

As can be seen, the net profit margin varies from one year to another, having a higher percentage level in the last year analysed, which reveals that most companies have a better financial standing in terms of profitability in 2019.

To verify the hypothesis, we used the method of correlation between the Z-Score in Altman's model, the Z-score in Ion Anghel's model and the profit margin, respectively.

Table No. 6 Correlations

		Z-score ALTMAN'S MODEL	Z-score ION ANGHEL'S MODEL	PROFITABILITY MEASUREMENT (net profit margin)
Z-score ALTMAN'S MODEL	Pearson Correlation	1	.325(*)	.439(**)
	Sig. (2- tailed)		.029	.003
	N	45	45	45
Z-score ION ANGHEL'S MODEL	Pearson Correlation	.325(*)	1	.910(**)
	Sig. (2- tailed)	.029		.000
	N	45	45	45
PROFITABILITY MEASUREMENT (net profit margin)	Pearson Correlation	.439(**)	.910(**)	1
	Sig. (2- tailed)	.003	.000	
	N	45	45	45

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Taking into account the correlation between profitability and the factors influencing it, such as the bankruptcy risk analysed using the two models, with the help of SPSS software, we can affirm that there is a direct correlation from a statistical point of view with both Ion Anghel and with Altman's model.

Therefore, regarding the *validity of the hypothesis* used, it can be noticed that it is appropriate, considering that the correlation values are higher than the level of 0.01.

5. CONCLUSIONS

In this paper, two models were used to analyse the bankruptcy risk and the net profit margin for the analysis of profitability. One of the models (Altman) was not created for the Romanian economy, but it turned out to give as good results as the Romanian models.

Given the multitude of existing studies on bankruptcy risk assessment, we believe that the occurrence of this type of risk is determined by factors such as:

- Impossibility to pay current debts;
- High level of dependence on borrowed capital;
- Lack of financial sources for loan repayment;
- Very late recovery of receivables;
- Loss recording.

The aim of the study was to correlate risk and profitability of Romanian companies. Although the two models of bankruptcy risk based on the discriminant analysis assess the likelihood of the company going bankrupt in the near future, profitability indicators were calculated for the same period, thus proving the existence of very strong correlation.

Bankruptcy risk forecasting (through statistical methodology) is essential for the management of the company, because the economic entity could implement recovery strategies long before the bankruptcy occurs. Assessing and interpreting this type of risk is important, as it has major implications for business partners, shareholders, investors, and even the company's staff.

In order for the financial standing of companies to improve, it is necessary to implement strategies for the restoration of business operations by reducing operational costs and recovering receivables, etc. The predictability of these models allows decision makers to adopt a reorganization plan, measures and strategies to prevent bankruptcy long before it occurs.

Risk prevention measures are specific activities that any management team could undertake. In order to be able to assess the financial health of a company, it is necessary to assess first of all the risk diagnosis of that company. The concept of risk is compatible with the concept of return and flexibility; the greater the degree of flexibility in a company, the greater its stability over variability. Thus, in order for a company with business operations that may be unprofitable at the moment to become profitable in the future, it depends a lot on the management mechanisms implemented, which attest to the changes that have occurred and the measures taken in this regard.

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