

## RISK ASSESSMENT AND MANAGEMENT IN ECONOMIC ENTITIES THROUGH THE USE OF DISCRIMINATORY ANALYSIS MODELS

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**Abstract:** *Economic developments may be unpredictable for the actors of the economic environment given the fact that, during the life of an economic entity, tough situations may occur whose manifestation can be difficult to anticipate or predict. Usually, the damage to a large segment of economic entities often occurs as a result of an economic and financial crisis, but anticipating its emergence through standardized signals or indicators may not always be feasible. Such a crisis can be the result of extraordinary, unprecedented events. Given that it is impossible to accurately assess all the risks that an economic entity may face, it would be advisable for economic entities to consider ensuring the ability to adapt quickly to changes in the economic environment. Of course, a rapid adjustment requires, among other things, that economic entities regularly carry out analyzes based on the information provided by the accounting. Therefore, it is necessary to assess the risks, in addition to conventional methods, by methods of high complexity. Therefore, through this research we aimed to address the analysis and management of risks within economic entities by using models of bankruptcy risk analysis based on the score method.*

**Keywords:** *accounting, results management, performance, risk, Z score, financial analysis*

**JEL classification:** *C40, G32, G33.*

### 1. Introduction

The specialized literature brings into discussion various theoretical frameworks that want to standardize the acceptance of failure of a business. However, some of the proposals lead to an insufficiently well-defined concept, which is why researchers are converging towards a broader definition, namely the situation in which an economic entity can no longer meet its financial obligations.

Such an understanding, expounded by the authors Crutzen and Van Caillie (2008) shows that “the failure of the enterprise represents a continuous deterioration of the structure of its resource portfolio, as well as a deterioration of the organizational process, which is reflected, after a certain period of time in the degradation of its financial indicators”.

To the extent that we consider economic performance only as an indicator of potential bankruptcy, it would be difficult to theorize a predictive financial model of failure. Economic performance is closely related to the payment capacity of an economic entity, which is why the identification of predictive models of failure can have as a starting point this relationship of interdependence.

In the literature were highlighted three levels of analysis to determine the absolute performance of an economic entity, respectively: analysis of individual factors; analysis of macroeconomic factors; analysis of intrinsic factors.

From a strictly economic point of view, the causes for which an economic entity reaches the bankruptcy zone can vary depending on several considerations, the researchers succeeding in developing theorems that allow the issuance of assessments regarding the risk of an economic entity being in danger of bankruptcy.

Some of them focused mainly on analyzing the evolution of the results recorded over the years, while others focused on identifying a potentially critical situation that may occur at some point, regardless of previous or future results.

Regardless of the methods applied, a common aspect is that they aim to provide systematic indicators of the financial stability of an economic entity. However, it is necessary to start from conservative premises, in the sense that, regardless of the selected model or if the results of several models converge towards the same conclusion, it is not necessary for the bankruptcy to occur in a short time.

The role of these models should be a warning one, so that the management of an economic entity may take corrective measures that eliminate or considerably reduce the probability of bankruptcy. These models are in themselves only guides that highlight areas for improvement.

## 2. Scoring Methods for Assessment of Bankruptcy Risk

In the last decade, the financial diagnosis has known a significant development as a result of the accentuated use of statistical methods for analyzing the evolution of economic entities, having as starting point a series of rates.

One method used is that of scores, a method that seeks to apply predictive models to determine the probability of bankruptcy of an economic entity. The method involves, by using statistical techniques specific to discriminant analysis, the evaluation of a sample of economic entities that fall into two distinct categories, namely a category of economic entities with financial difficulties and a category of entities with strong economic performance.

Subsequently, certain rates are defined for each category, establishing the best combination of rates to facilitate the distinction between the two categories of economic entities. Applying the method will lead to obtaining, for each entity, a score obtained by applying the function below.

$$Z = a_1 x_1 + a_2 x_2 + a_3 x_3 + \dots + a_n x_n,$$

where: a - represent the weighting coefficient of the rates;

x - represents the rates used in the analysis.

Further, we will present a series of models for determining the risk of bankruptcy existing in the specialized literature, with their exemplification by reference to the data taken from the financial statements of an economic entity active in the production segment.

## 3. Taffler Model

The Taffler model was developed in 1977 and later published in 1983 (Taffler). This model focuses on a combination of 4 installments, based on the conclusions of research conducted on economic entities listed on the London Stock Exchange. The name and calculation formula of the indicators underlying the model built by Taffler are presented in the table below.

**Table no. 1. Indicators used in the application of the Taffler model and interpretation**

Symbol	Indicator name	Calculation formula
X <sub>1</sub>	Rate of return on current assets	Gross result / Current liabilities
X <sub>2</sub>	Overall liquidity rate	Current assets / current liabilities
X <sub>3</sub>	Current financial dependency rate	Current liabilities / Total assets
X <sub>4</sub>	The time interval in which the economic entity can finance its production activity with the help of its own assets without collecting the invoices	Sales revenue / Total assets

issued	
$Z_4 = 0,53X_1 + 0,13X_2 + 0,18X_3 + 0,16X_4$	
$Z \leq 0,2$	high risk of bankruptcy
$Z \geq 0,3$	reduced risk of bankruptcy

Source: projection according to the specialized literature

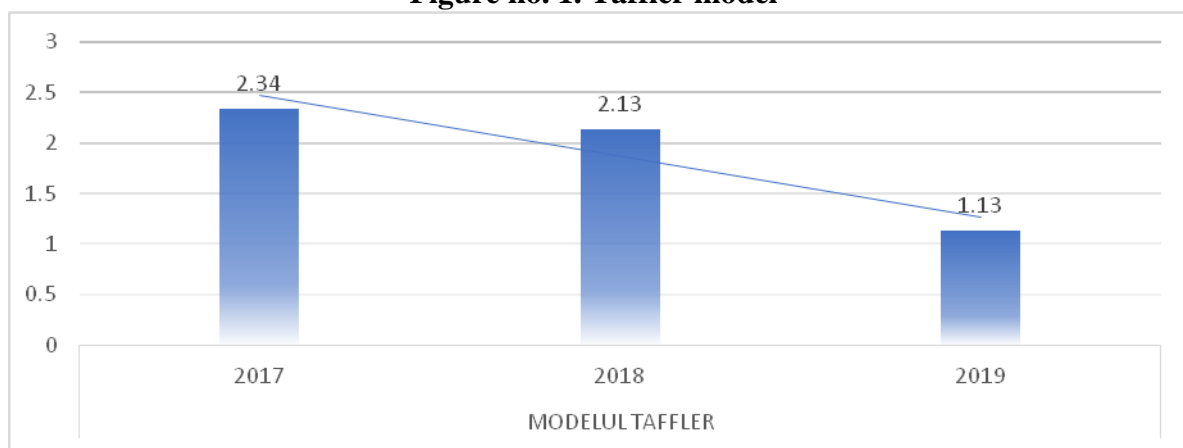
By applying the Taffler model in the case of the selected economic entity, the following results were obtained, summarized in table no. 2.

**Table no. 2. Bankruptcy risk assessment using the Taffler model**

No.	Indicator	u.m.	2017	2018	2019
1	Gross result	mii lei	6618	11391	7673
2	Current debts	mii lei	2152	4119	6374
3	Current assets	mii lei	5072	10153	10031
4	Total debts	mii lei	2740	4756	6953
5	Total assets	mii lei	8945	14941	15348
6	Sales income	mii lei	23688	31520	21888
7	$X_1$		3,07	2,77	1,20
8	$X_2$		1,85	2,14	1,44
9	$X_3$		0,24	0,28	0,42
10	$X_4$		2,65	2,11	1,43
11	Z		2,34	2,13	1,13

Source: own processing

**Figure no. 1. Taffler model**



Source: own processing

Analyzing the value of the Z score we can conclude that the economic entity has a very good situation with low risk of bankruptcy. At the same time, we notice a decreasing trend of this value which must be adjusted by a closer monitoring of the results obtained from the activity carried out.

#### 4. Springate Model

The model developed by Gordon LV Springate, was developed in 1978. Springate conducted a study on 40 economic entities after which he chose 4 indicators for the design

of the model. This model of bankruptcy risk assessment is important for creditors and investors, as it has an accuracy of 92.5%.

The calculation method of the indicators used and their interpretation is presented in table no. 3.

**Table no. 3. Indicators used in the application of the Springate model and interpretation**

Symbol	Calculation formula
A	Working capital / Total assets
B	Gross profit before interest / Total assets
C	Gross profit / Current liabilities
D	Turnover / Total assets
$Z = 1,03A + 3,07B + 0,66C + 0,4D$	
$Z < 0,862$	high risk of bankruptcy
$Z > 0,862$	reduced risk of bankruptcy

Source: projection according to the specialized literature

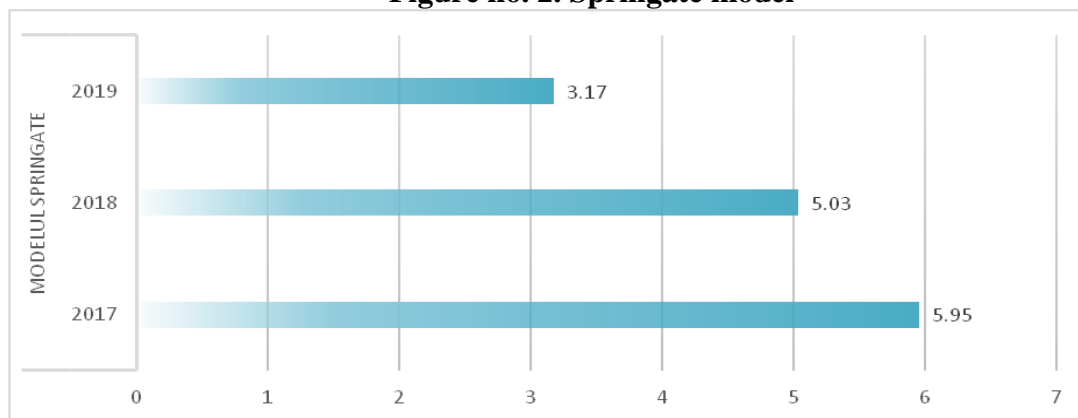
In the following table we have made an example of the Springate model in the case of the analyzed economic entity.

**Table no. 4. Bankruptcy risk assessment by using the Springate model**

No.	Indicator	m.u.	2017	2018	2019
1	Working capital	mii lei	2919	6034	3657
2	Total assets	mii lei	8945	14941	15348
3	Gross profit before interest	mii lei	7349	9473	7814
4	Gross profit	mii lei	6618	11391	7673
5	Current debts	mii lei	2152	4119	6374
6	Turnover	mii lei	23688	31520	21888
7	<b>A</b>		<b>0,33</b>	<b>0,40</b>	<b>0,24</b>
8	<b>B</b>		<b>0,82</b>	<b>0,63</b>	<b>0,51</b>
9	<b>C</b>		<b>3,07</b>	<b>2,77</b>	<b>1,20</b>
10	<b>D</b>		<b>2,65</b>	<b>2,11</b>	<b>1,43</b>
11	<b>Z</b>		<b>5,95</b>	<b>5,03</b>	<b>3,17</b>

Source: own processing

**Figure no. 2. Springate model**



Source: own processing

Analyzing the obtained data, we notice that the economic entity registers good performances, being solvent while the risk of bankruptcy is low. Even if it falls within the allowable limits, we notice a deterioration of indicators from one period to another. It is thus necessary for the management of the economic entity to take the necessary measures to change the dynamics of evolution in a positive way.

### 5. Ivonciu Model

Romanian economist Paul Ivonciu conducted a study based on data from over 50 economic entities in various fields of activity, based on which he designed in 1998 a model of the score function, consisting of six indicators. These indicators, as well as the calculation formulas, are presented in table no. 5.

**Table no. 5. Indicators used in the application of the Ivonciu model and interpretation**

Symbol	Indicator	Calculation formula
R1	Total asset turnover rate	Total revenue collected and receivable / Total assets (minus expenses in advance)
R2	Profitability of total income	Self-financing capacity / Total revenues collected and receivable
R3	Debt turnover rate	Total income collected and receivable / Adjusted receivables
R4	Debt repayment capacity	Self-financing capacity / Total debt
R5	Fast liquidity	(Adjusted receivables + Available) / Short-term debts
R6	Relative long-term stability margin	Working capital / Total assets (less expenses in advance)
$I = 0,333R1 + 5,555R2 + 0,333R3 + 0,714229R4 + 1,333R5 + 4R6 - 1,66032$		
	$I < 0,0$	imminent bankruptcy
	$0,0 < I < 1,5$	high risk of bankruptcy
	$1,5 < I < 3,0$	area of uncertainty
	$3,0 < I < 4,5$	medium risk of bankruptcy
	$4,5 < I < 6,0$	reduced risk of bankruptcy
	$I > 6,0$	very low risk of bankruptcy

Source: projection according to the specialized literature

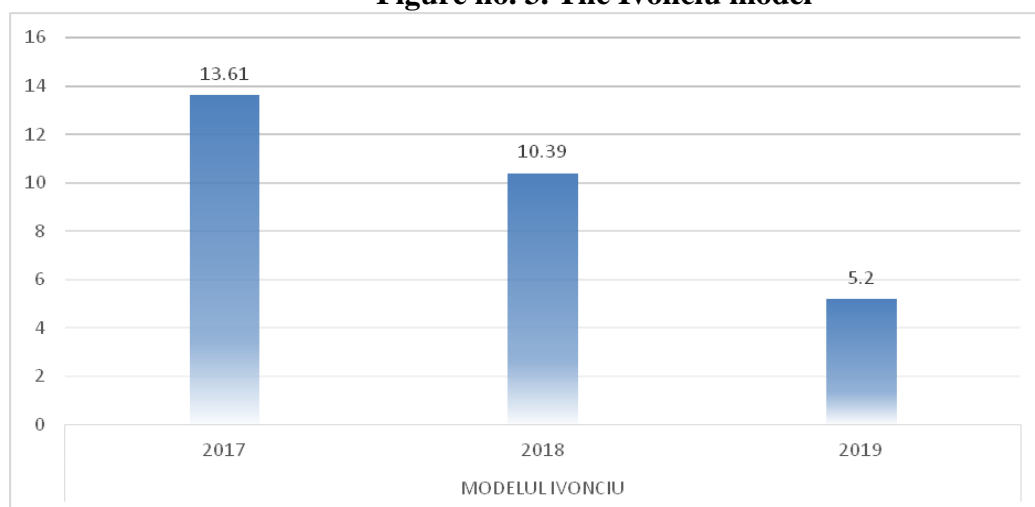
The analysis of the risk of bankruptcy by using the Ivonciu model led to the following results (table no. 6):

**Table no. 6. Assessing the risk of bankruptcy by using the Ivonciu model**

No.	Indicator	u.m	2017	2018	2019
1	Total revenue collected and receivable	mii lei	23688	31520	21888
2	Total assets (less expenses in advance)	mii lei	8945	14941	15348
3	Self-financing capacity	mii lei	6216	10266	7047
4	Corrected receivables	mii lei	1022	3102	6833
5	Total debts	mii lei	2740	4756	6953
6	Available	mii lei	2680	6164	2040
7	Short term debts	mii lei	2152	4119	6374
8	Working capital	mii lei	2919	6034	3657
9	<b>R1</b>		<b>2,65</b>	<b>2,11</b>	<b>1,43</b>
10	<b>R2</b>		<b>0,26</b>	<b>0,33</b>	<b>0,32</b>
11	<b>R3</b>		<b>23,17</b>	<b>10,16</b>	<b>3,20</b>
12	<b>R4</b>		<b>2,27</b>	<b>2,16</b>	<b>1,01</b>
13	<b>R5</b>		<b>1,72</b>	<b>2,25</b>	<b>1,39</b>
14	<b>R6</b>		<b>0,33</b>	<b>0,40</b>	<b>0,24</b>
15	<b>I</b>		<b>13,61</b>	<b>10,39</b>	<b>5,20</b>

Source: own processing

**Figure no. 3. The Ivonciu model**



Source: own processing

According to the data in the table above, in 2017-2018 the Ivonciu model places the economic entity in an area with a very low risk of bankruptcy, while in 2019 the economic entity experiences a decrease in the value of indicators which leads to increased risk of bankruptcy. However, the situation is not alarming, as the risk of bankruptcy is low.

## 6. Statev Model

In developing the Statev model we started from the particularities and restrictions imposed by the application of the technique of multiple linear discriminant analysis to determine the financial status of the enterprise (State, 2006). The study was conducted on two samples consisting of a total of 98 economic entities operating in the private sector, analyzing the information provided by their financial statements for four consecutive financial years.

To confirm the accuracy and capacity predictive of the designed discriminatory statistical model, a new validation was performed on another sample of economic entities. The indicators underlying this model, the score function, as well as their interpretation are represented in the table below.

**Table no. 7. Indicators used in the application of the STATEV model and interpretation**

Symbol	Calculation formula
V <sub>1</sub>	Need for working capital / Total assets
V <sub>2</sub>	Total reserves / assets
V <sub>11</sub>	Staff costs / Value added
V <sub>15</sub>	Net turnover / Total assets
V <sub>28</sub>	Current assets / Total assets
V <sub>32</sub>	Value Added / Total Assets
V <sub>47</sub>	Short-term debts / Total liabilities
$M_{Statev} = 0,872V_1 + 0,360V_2 + 0,257V_{11} + 0,467V_{15} - 0,592V_{28} + 0,592V_{32} + 0,526V_{47}$	
$M_{Statev} \leq 1,25$	Bankruptcy financial condition
$M_{Statev} > 1,25$	Good financial condition

*Source: projection according to the specialized literature*

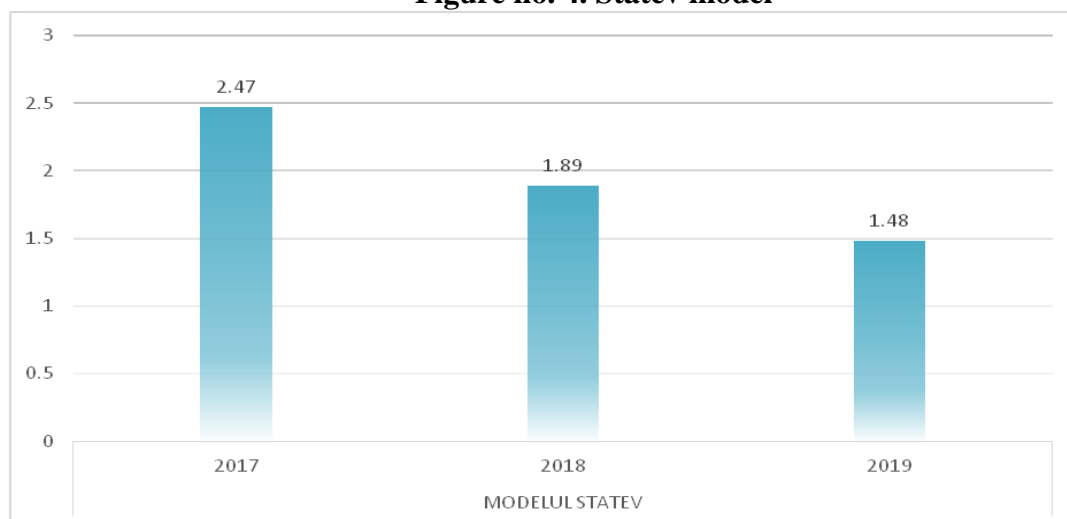
The analysis of the bankruptcy risk in the case of the economic entity selected by using the Statev model led to the obtaining of the results presented in table no. 8.

**Table no. 8. Bankruptcy risk assessment using the Statev model**

No.	Indicator	U.M	2017	2018	2019
1	Working capital need	mii lei	534	1248	3513
2	Total assets	mii lei	8945	14941	15348
3	Reserves	mii lei	263	263	263
4	Salary expenses	mii lei	6264	7140	5020
5	Added value	mii lei	19684	25621	18244
6	Turnover	mii lei	23688	31520	21888
7	Current assets	mii lei	5072	10153	10031
8	Short term debts	mii lei	2152	4119	6374
9	Total liabilities	mii lei	8945	14941	15348
10	$V_1$		0,06	0,08	0,23
11	$V_2$		0,03	0,02	0,02
12	$V_{11}$		0,32	0,28	0,28
13	$V_{15}$		2,65	2,11	1,43
14	$V_{28}$		0,57	0,68	0,65
15	$V_{32}$		2,20	1,71	1,19
16	$V_{42}$		0,24	0,28	0,42
17	$M_{Statev}$		2,47	1,89	1,48

Source: own processing

**Figure no. 4. Statev model**



Source: own processing

The value of the M<sub>Statev</sub> score in the analyzed period highlights a very good situation of the economic entity, registering a low risk of bankruptcy. However, at the same time, there is a decreasing trend of this value, which needs to be diminished by various recovery actions established by the management of the economic entity.

## 7. Conclusions

Bankruptcy risk assessment is of major importance for crisis management and is considered an important objective. However, for the management of the economic entity,



the primary objective of this analysis is not to diagnose the crisis but, based on its results, to substantiate and implement the right decisions, necessary to prevent the crisis or reduce its impact.

Score-based models have the following advantages:

- allow a synthetic estimate of the financial situation from both a forward-looking and a retrospective perspective, providing an image of the risk of bankruptcy for stakeholders;
- facilitates the resolution of the difficulties generated by the financial imbalance through objective assessments.

From the analysis performed in this article we find that all four models used offer the same perspective on the financial situation of the analyzed entity, placing it in a solvency zone, with low risk of bankruptcy.

However, even if all indicators fall within the allowable limits, there is a tendency for them to deteriorate from one period to another, which could lead to an unstable situation to the extent that the management of the economic entity will not act accordingly.

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