2 APPLICATION OF DISCRETE SETS IN THE RISK THEORY

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Abstract

The paper presents an application of the fuzzy sets theory and of the subtle sets in order to evaluate the bankruptcy risk of an organization. The main influence factors of the two antithetical concepts: the gain and the risk of an organization are set. Then, the membership degree of firm activity to gain, respectively to risk is evaluated and the comparison is made. Thus, it results either a favorable condition or a risk of bankruptcy. A numerical application is presented, with a view to understand the described method.

Key words: systematic risk; fuzzy theory; dynamic index; average index; discrete sets theory

JEL Classification: C35, C73

1. Introduction

In order to evaluate the size of the bankruptcy risk, it may be defined as a discrete set that has, as a main characteristic, particularly the risk dimension. If the factors of influence and their aggregation way are known, we certainly can determine the risk dimension. Moreover, if in opposition to the risk we determine even the gain chance size of the organizations, then we can arrange this organizations from the point of view of bankruptcy risk, in increasing order, only by the difference between the gain chance and risk sizes.

Below, we shall analyze the decreasing possibilities of the number of organizations with high bankruptcy risk. To this purpose, we suggest to operate some changes in the influence factors, which generate high risks or low profit. In the discrete sets theory, there is an act operator, and its main effect will be noticed further, namely the risks decreasing. On this basis, we can predict the final effects.

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2. The evaluation of risks and gain chance factors of influence

There are two ways to find out the influence factors: static and dynamic. The most important static influence factors are:

- which is the ratio of the annual loss p_h to the annual profit P_h, respectively: $\frac{p_h}{P_h}$;
- which is the ratio of the debts CR to the turnover CA, respectively: $\frac{CR}{CA}$;
- which is the ratio of the annual loss p_h to the annual profit P_h, respectively: $\frac{p_h}{P_h}$;
- which is the ratio of the debts CR to the turnover CA, respectively: $\frac{CR}{CA}$;
- which is the ratio of the annual outstanding debts d_h to the annual profit P_h, respectively: $\frac{d_h}{P_h}$;
- which is the ratio of the non-quality management score PN to the quality management score PC, respectively: $\frac{PN}{PC}$;
- which is the ratio of the average index of annual increasing of raw materials, materials and semi-finished materials prices $\overline{I_{ms}}$ to the average index of prices increasing, in finished products $\overline{I_{pf}}$, respectively: $\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$.

Each of these factors determined for a year may become a dynamic index for a determined period of time T (usually this period is of 5 years).

From the predictions about the examined organizations, we get some data which we denote as follows: Δp_h, ΔP_h, ΔCR, ΔCA, Δd_h, ΔPN, ΔPC, $\Delta\overline{I_{ms}}$, $\Delta\overline{I_{pf}}$.

For each influence factor we may consider a fuzzy set called subset in a discrete sets theory. As an example, a fuzzy set will result for the ratio $\frac{p_h}{P_h}$. Its membership degrees are shown in the following equation:

$$\mu\left(\frac{p_h}{P_h}\right) = e^{-k_1^{'}\cdot\frac{p_h}{P_h}}; \qquad (1)$$

when $P_h \geq P_{h_{\min}}$.

In this equation:

– $k_1^{'}$ is a coefficient that depends on the examined criteria importance.

– $P_{h_{\min}}$ is the minimum profit considered by experts.

– This membership degree is a reflection of the organizations' ability to get a profit. For the dynamic index:

$$\frac{\Delta p_h}{\Delta P_h} \Rightarrow \Delta\mu_c\left(\frac{\Delta p_h}{\Delta P_h}\right) = e^{-k_1^{''} \cdot \frac{\Delta p_h}{\Delta P_h}}, \tag{2}$$

where $\Delta P_h \geq \Delta P_{h_{\min}}$.

In this equation:

$k_1^{''}$ is an importance coefficient for the dynamic index;

$\Delta P_{h_{\min}}$ is the profits minimum increase.

If $P_h < P_{h_{\min}}$ then relation (1) becomes:

$$\mu_c\left(\frac{p_h}{P_h}\right) = e^{-k_1^{'} \cdot \frac{p_h}{P_{h\min}}}, \tag{1`}$$

In the same way, if $\Delta P_h < \Delta P_{h_{\min}}$, relation (2) becomes:

$$\Delta\mu_c\left(\frac{\Delta p_h}{\Delta P_h}\right) = e^{-k_1^{''} \cdot \frac{\Delta p_h}{\Delta P_{h\min}}},\ \Delta P_h < \Delta P_{h_{\min}} \tag{2”}$$

In the same manner, we shall proceed for all the considered criteria, and finally we shall pursue the aggregation of all these ones, by using a multiplying procedure. The final result will be the ability total membership degree for gaining a profit, μ_c. This result will be presented as follows :

$$\mu_c = \sqrt[10]{e^{-k_1^{'} \cdot \frac{p_h}{P_h}} \cdot e^{-k_1^{''} \cdot \frac{\Delta p_h}{\Delta P_h}} \cdot e^{-k_2^{'} \cdot \frac{CR}{CA}} \cdot e^{-k_2^{''} \cdot \frac{\Delta CR}{\Delta CA}}} \cdot \sqrt[10]{\cdot e^{-k_3^{'} \cdot \frac{d_h}{P_h}} \cdot e^{-k_3^{''} \cdot \frac{\Delta d_h}{\Delta P_h}} \cdot e^{-k_4^{'} \cdot \frac{PN}{PM}} \cdot e^{-k_4^{''} \cdot \frac{\Delta PN}{\Delta PM}}} \cdot \sqrt[10]{\cdot e^{-k_5^{'} \cdot \frac{\overline{I_{ms}}}{I_{pf}}} \cdot e^{-k_5^{''} \cdot \frac{\overline{\Delta I_{ms}}}{\overline{\Delta I_p}}}} \tag{3}$$

Furthermore, by using the same method, we can determine the loss risk. This is possible by using the inauspicious influence factors of the organization. They can be reached through reversal of the ratios that we used in the gain chances determination. Using these factors, we shall get in a similar way to equation (3) the total membership degree of loss risk:

$$\mu_r = \sqrt[10]{e^{-k_1^{'} \cdot \frac{P_h}{p_h}} \cdot e^{-k_1^{''} \cdot \frac{\Delta P_h}{\Delta p_h}} \cdot e^{-k_2^{'} \cdot \frac{CA}{CR}} \cdot e^{-k_2^{''} \cdot \frac{\Delta CA}{\Delta CR}}} \cdot \sqrt[10]{\cdot e^{-k_3^{'} \cdot \frac{P_h}{d_h}} \cdot e^{-k_3^{''} \cdot \frac{\Delta P_h}{\Delta d_h}} \cdot e^{-k_4^{'} \cdot \frac{PC}{PN}} \cdot e^{-k_4^{''} \cdot \frac{\Delta PC}{\Delta PN}}} \cdot \sqrt[10]{\cdot e^{-k_5^{'} \cdot \frac{\overline{I_{pf}}}{I_{ms}}} \cdot e^{-k_5^{''} \cdot \frac{\overline{\Delta I_{pf}}}{\Delta I_{ms}}}} \tag{4}$$

By comparing the 3rd and the 4th equations, which means the membership degrees of organizations ability to obtain gain μ_c and the membership degrees of organizations ability to stand on loss risk μ_r, four situations may result :

a) $\mu_c >> \mu_r$ – that means the organization is very profitable;

b) $\mu_c > \mu_r$ – meaning that the organization is profitable and there is a low risk for it to evolve through bankruptcy. This does not mean that, under certain circumstances, it cannot evolve in that way.

c) $\mu_c \cong \mu_r \cong 0{,}5$ – meaning that there is a danger of bankruptcy, and also there is a big question mark if it will manage to avoid this situation. We can compute a trust degree g_{sf} about conditions evaluation of the organization:

$$g_{sf} = \begin{cases} 1 - e^{-\lambda(\mu_c - \mu_r)}, \mu_c \geq \mu_r \\ 1 - e^{-\lambda(\mu_r - \mu_c)}, \mu_r > \mu_c \end{cases} \quad (5)$$

where: λ is a coefficient established by the experts.

We can see that $g_{sf} \to 0$ if $\mu_c \cong \mu_r$, which means that when the two coefficients are equal the trust degree goes to zero.

d) $\mu_c < \mu_r$ – meaning that the organization is in great danger of bankruptcy. As one may see from the 5th equation, as long as the difference between μ_r and μ_c is larger, the confidence degree in this statement is higher.

Consequently, the organizations arrangement from the point of view of bankruptcy risks criterion can be done in strict relation to the decreasing order of the differences between the membership degrees of the organizations abilities to stand on loss risk μ_r or to make profit μ_c.

Implementation possibilities of act operator in bankruptcy risk analysis

According to the above-mentioned, we can draw one conclusion , namely, the bankruptcy risks analysis is a priority for those organizations which have a large difference between μ_r and μ_c (if it is larger than a standard established by the experts). In the 2nd paragraph we have talked about the influence factors. If we denote by "i" the range of one of these factors, then we can analyze the differences: $0{,}5 - \mu_r^i$ and $\mu_c^i - 0{,}5$. Hence, we can conclude that the priorities are those organizations where this difference $\mu_c^i - \mu_r^i$ is the highest. This difference is an expression of a total incompatibility between the two membership degrees. Therefore, the higher risk can be explained by its two causes:

μ_c^i is to low; μ_r^i is to high.

This means that the two membership degrees μ_c^i and μ_r^i are out of the normal limits, so that the act operator A_0 must operate two change calculations in order to adapt the membership degrees to normal. This means:

$$Tr(\mu_c^i) = \mu'^i_c > \mu^i_{c_{adm}} > \mu_c^i \quad (6)$$

$$Tr(\mu_r^i) = \mu'^i_r > \mu^i_{r_{adm}} > \mu_r^i \quad (7)$$

where $\mu^i_{c_{adm}}$ and $\mu^i_{r_{adm}}$ are the limiting values of the two membership degrees that are set by the experts and T_r (): transformation operator. We can formally put this in other mode:

$$A_0(\mu_c^i \notin [\mu_{c_{adm}}^i, 1] \cap \mu_r^i \notin [0, \mu_{r_{adm}}^i]) = \text{incomp.}$$

$$\Rightarrow T_r(\mu_r^i) = \mu_c^i \cap T_r(\mu_r^i) = \mu'^i_r$$

Furthermore, the act operator will act on the other factor, and so on. Obviously, the problem is not as simple as it looks, because there can appear new incompatibilities between the new levels of $\mu_c'^i$ and $\mu_r'^i$ and the other determining factors. Thus, we have to eliminate the new incompatibilities. Furthermore, it is a request to define the measures that will allow the changes into the membership degree levels, according to equations (6), (7), and the risk decreasing.

As an example, if "i" is about the $\frac{CR}{P_h}$ ratio, then these are the measures that can be taken:

- debts CR decreasing through unblocking some circuits, setting of debts, choosing a more appropriate customer, etc;
- profit P_h increasing through a lower specific consumption and a better management.

3. Application

Five organizations have been analyzed for a period of 5 years according to the methodologies and notations mentioned above. The following initial data have been collected:

Enterprise 1 Table 1

Entr.	Index values (mill. lei)				
	p_h	P_h	CA	CR	d_h
1	1,500	7,500	30,000	4,000	8,000
2	1,450	7,000	25,000	5,000	8,500
3	1,000	7,500	35,000	4,800	9,000
4	1,100	6,800	28,000	4,200	8,100
5	2,000	7,000	32,000	5,000	7,500
	PN	PC	$\overline{I_{ms}}$	$\overline{I_{pf}}$	
	30	70	1.20	1.15	
	30	70	1.15	1.15	
	35	65	1.17	1.10	
	40	60	1.21	1.17	
	42	58	1.12	1.10	

Entr.	Importance index (static form)				
	$k_1^{'}$	$k_2^{'}$	$k_3^{'}$	$k_4^{'}$	$k_5^{'}$
1	0.20	0.20	0.10	0.30	0.20
2	0.20	0.10	0.20	0.40	0.10
3	0.10	0.10	0.30	0.30	0.20
4	0.20	0.30	0.10	0.30	0.10
5	0.30	0.20	0.20	0.30	0.10
	Importance index (dynamic form)				
	$k_1^{''}$	$k_2^{''}$	$k_3^{''}$	$k_4^{''}$	$k_5^{''}$
	0.10	0.30	0.20	0.30	0.10
	0.20	0.20	0.10	0.30	0.20
	0.00	0.20	0.20	0.30	0.30
	0.10	0.20	0.20	0.30	0.20
	0.20	0.10	0.20	0.30	0.20

Enterprise 2 **Table 2**

Year	Increasing prevision (mill. lei)								
	Δp_h	ΔP_h	ΔCA	ΔCR	Δd_h	ΔPN	ΔPC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	280	650	2,400	350	450	0	1	0.10	0.11
2	340	1,300	4,500	400	520	1	1	0.11	0.12
3	350	1,900	6,700	470	700	2	2	0.13	0.13
4	380	2,550	9,000	500	750	1	3	0.14	0.10
5	430	3,250	11,000	600	900	2	2	0.15	0.15

Year	Index value prevision (mill. lei)								
	p_h	P_h	CA	CR	d_h	PN	PC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	1,730	7,650	27,400	5,350	8,950	30	69	1.24	1.24
2	2,070	8,950	31,900	5,750	9,470	31	70	1.34	1.35
3	2,420	10,850	38,600	6,220	10,170	33	72	1.46	1.46
4	2,800	13,400	47,600	6,720	10,920	34	75	1.45	1.34
5	3,230	16,650	58,600	7,320	11,820	36	77	1.59	1.47

Year	Calculation of index ratio					Calculation of index variation ratio				
	$\frac{p_h}{P_h}$	$\frac{CR}{CA}$	$\frac{d_h}{P_h}$	$\frac{PN}{PC}$	$\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$	$\frac{\Delta p_h}{\Delta P_h}$	$\frac{\Delta CR}{\Delta CA}$	$\frac{\Delta d_h}{\Delta P_h}$	$\frac{\Delta PN}{\Delta PC}$	$\frac{\Delta \overline{I_{ms}}}{\Delta \overline{I_{pf}}}$
1	0.226	0.195	1.170	0.435	0.997	0.431	0.146	0.692	0.000	0.909
2	0.231	0.180	1.058	0.443	0.995	0.262	0.089	0.400	1.000	0.917
3	0.223	0.161	0.937	0.458	1.000	0.184	0.070	0.368	1.000	1.000
4	0.209	0.141	0.815	0.453	1.084	0.149	0.056	0.294	0.333	1.400
5	0.194	0.125	0.710	0.468	1.082	0.132	0.055	0.277	1.000	1.000

Year	$e^{-k_1' \cdot \frac{p_h}{P_h}}$	$e^{-k_2' \cdot \frac{CR}{CA}}$	$e^{-k_3' \cdot \frac{d_h}{P_h}}$	$e^{-k_4' \cdot \frac{PN}{PC}}$	$e^{-k_5' \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$	$e^{-k_1'' \cdot \frac{\Delta p_h}{\Delta P_h}}$	$e^{-k_2'' \cdot \frac{\Delta CR}{\Delta CA}}$	$e^{-k_3'' \cdot \frac{\Delta d_h}{\Delta P_h}}$	$e^{-k_4'' \cdot \frac{\Delta PN}{\Delta PC}}$	$e^{-k_5'' \cdot \frac{\Delta \overline{I_{ms}}}{\Delta \overline{I_{pf}}}}$
1	1.046	1.040	1.124	1.139	1.221	1.044	1.045	1.149	1.000	1.095
2	1.047	1.018	1.236	1.194	1.105	1.054	1.018	1.041	1.350	1.201
3	1.023	1.016	1.325	1.147	1.221	1.000	1.014	1.076	1.350	1.350
4	1.043	1.043	1.085	1.146	1.115	1.015	1.011	1.061	1.105	1.323
5	1.060	1.025	1.153	1.151	1.114	1.027	1.005	1.057	1.350	1.221

Year	$e^{-k_1' \cdot \frac{P_h}{p_h}}$	$e^{-k_2' \cdot \frac{CA}{CR}}$	$e^{-k_3' \cdot \frac{P_h}{d_h}}$	$e^{-k_4' \cdot \frac{PC}{PN}}$	$e^{-k_5' \cdot \frac{\overline{I_{pf}}}{\overline{I_{ms}}}}$	$e^{-k_1'' \cdot \frac{\Delta P_h}{\Delta p_h}}$	$e^{-k_2'' \cdot \frac{\Delta CA}{\Delta CR}}$	$e^{-k_3'' \cdot \frac{\Delta P_h}{\Delta d_h}}$	$e^{-k_4'' \cdot \frac{\Delta PC}{\Delta PN}}$	$e^{-k_5'' \cdot \frac{\Delta \overline{I_{pf}}}{\Delta \overline{I_{ms}}}}$
1	0.956	0.962	0.890	0.878	0.819	0.958	0.957	0.871	0.000	0.913
2	0.955	0.982	0.809	0.838	0.905	0.949	0.982	0.961	0.741	0.832
3	0.978	0.984	0.755	0.872	0.819	1.000	0.986	0.929	0.741	0.741
4	0.959	0.959	0.922	0.873	0.897	0.985	0.989	0.943	0.905	0.756
5	0.943	0.975	0.868	0.869	0.897	0.974	0.995	0.946	0.741	0.819

Enterprise 3 **Table 3**

Year	Increasing prevision (mill. lei)								
	Δp_h	ΔP_h	ΔCA	ΔCR	Δd_h	ΔPN	ΔPC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	290	650	2.400	390	370	-2	0	0.12	0.12
2	330	1,300	4,500	450	420	1	1	0.13	0.14
3	300	1,900	6,600	530	500	2	2	0.13	0.13
4	380	2,500	8,600	550	550	3	1	0.15	0.14
5	450	3,100	10,800	700	650	2	3	0.16	0.15

Year	Index value prevision (mill. lei)								
	p_h	P_h	CA	CR	d_h	PN	PC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	1,290	8,150	37,400	5,190	9,370	33	65	1.28	1.20
2	1,620	9,450	41,900	5,640	9,790	34	66	1.40	1.32
3	1,920	11,350	48,500	6,170	10,290	36	68	1.51	1.43
4	2,300	13,850	57,100	6,720	10,840	39	69	1.51	1.36
5	2,750	16,950	67,900	7,420	11,490	41	72	1.65	1.48

Year	Calculation of index ratio					Calculation of index variation ratio				
	$\frac{p_h}{P_h}$	$\frac{CR}{CA}$	$\frac{d_h}{P_h}$	$\frac{PN}{PC}$	$\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$	$\frac{\Delta p_h}{\Delta P_h}$	$\frac{\Delta CR}{\Delta CA}$	$\frac{\Delta d_h}{\Delta P_h}$	$\frac{\Delta PN}{\Delta PC}$	$\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$
1	0.158	0.139	1.150	0.508	1.063	0.446	0.163	0.569	0.000	1.000
2	0.171	0.135	1.036	0.515	1.056	0.254	0.100	0.323	1.000	0.929
3	0.169	0.127	0.907	0.529	1.056	0.158	0.080	0.263	1.000	1.000
4	0.166	0.118	0.783	0.565	1.114	0.152	0.064	0.220	3.000	1.071
5	0.162	0.109	0.678	0.569	1.115	0.145	0.065	0.210	0.667	1.067

Year	$e^{k_1' \cdot \frac{p_h}{P_h}}$	$e^{k_2' \cdot \frac{CR}{CA}}$	$e^{k_3' \cdot \frac{d_h}{P_h}}$	$e^{k_4' \cdot \frac{PN}{PC}}$	$e^{k_5' \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$	$e^{k_1'' \cdot \frac{\Delta p_h}{\Delta P_h}}$	$e^{k_2'' \cdot \frac{\Delta CR}{\Delta CA}}$	$e^{k_3'' \cdot \frac{\Delta d_h}{\Delta P_h}}$	$e^{k_4'' \cdot \frac{\Delta PN}{\Delta PC}}$	$e^{k_5'' \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$
1	1.032	1.028	1.122	1.165	1.237	1.046	1.050	1.121	1.000	1.105
2	1.035	1.014	1.230	1.229	1.111	1.052	1.020	1.033	1.350	1.204
3	1.017	1.013	1.313	1.172	1.235	1.000	1.016	1.054	1.350	1.350
4	1.034	1.036	1.081	1.185	1.118	1.015	1.013	1.045	2.460	1.239
5	1.050	1.022	1.145	1.186	1.118	1.029	1.007	1.043	1.221	1.238

Year	$e^{-k_1' \cdot \frac{p_h}{P_h}}$	$e^{-k_2' \cdot \frac{CR}{CA}}$	$e^{-k_3' \cdot \frac{d_h}{P_h}}$	$e^{-k_4' \cdot \frac{PN}{PC}}$	$e^{-k_5' \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$	$e^{-k_1'' \cdot \frac{\Delta p_h}{\Delta P_h}}$	$e^{-k_2'' \cdot \frac{\Delta CR}{\Delta CA}}$	$e^{-k_3'' \cdot \frac{\Delta d_h}{\Delta P_h}}$	$e^{-k_4'' \cdot \frac{\Delta PN}{\Delta PC}}$	$e^{-k_5'' \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$
1	0.969	0.973	0.891	0.859	0.808	0.956	0.952	0.892	1.000	0.905
2	0.966	0.987	0.813	0.814	0.900	0.950	0.980	0.968	0.741	0.831
3	0.983	0.987	0.762	0.853	0.810	1.000	0.984	0.949	0.741	0.741
4	0.967	0.965	0.925	0.844	0.895	0.985	0.987	0.957	0.407	0.807
5	0.952	0.978	0.873	0.843	0.895	0.971	0.994	0.959	0.819	0.808

Year	$\mu_{earning}$	μ_{risk}
1	2.332	0.429
2	3.175	0.315
3	3.821	0.262
4	5.023	0.199
5	2.662	0.376
Total:	17.012	1.580

Enterprise 4 **Table 4**

Year	Increasing prevision (mill. lei)								
	Δp_h	ΔP_h	ΔCA	ΔCR	Δd_h	ΔPN	ΔPC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	310	690	2.400	420	430	-2	3	0.13	0.12
2	370	1,300	4,500	450	480	1	0	0.14	0.13
3	320	1,900	6,500	550	600	2	1	0.15	0.14
4	400	2,500	8,600	600	700	1	2	0.15	0.16
5	420	3,100	9,600	700	900	2	1	0.16	0.17

Year	Index value prevision (mil. lei)								
	p_h	P_h	CA	CR	d_h	PN	PC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	1,410	7,490	30,400	4,620	8,530	38	63	1.33	1.27
2	1,780	8,790	34,900	5,070	9,010	39	63	1.45	1.38
3	2,100	10,690	41,400	5,620	9,610	41	64	1.59	1.50
4	2,500	13,190	50,000	6,220	10,310	42	66	1.58	1.44
5	2,920	16,290	59,600	6,920	11,210	44	67	1.72	1.58

Year	Calculation of index ratio					Calculation of index variation ratio				
	$\frac{p_h}{P_h}$	$\frac{CR}{CA}$	$\frac{d_h}{P_h}$	$\frac{PN}{PC}$	$\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$	$\frac{\Delta p_h}{\Delta P_h}$	$\frac{\Delta CR}{\Delta CA}$	$\frac{\Delta d_h}{\Delta P_h}$	$\frac{\Delta PN}{\Delta PC}$	$\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$
1	0.188	0.152	1.139	0.603	1.043	0.449	0.175	0.623	-0.667	1.083
2	0.203	0.145	1.025	0.619	1.051	0.285	0.100	0.369	0.000	1.077
3	0.196	0.136	0.899	0.641	1.058	0.168	0.085	0.316	2.000	1.071
4	0.190	0.124	0.782	0.636	1.100	0.160	0.070	0.280	0.500	0.938
5	0.179	0.116	0.688	0.657	1.090	0.135	0.073	0.290	2.000	0.941

Year	$e^{k'_1\cdot\frac{p_h}{P_h}}$	$e^{k'_2\cdot\frac{CR}{CA}}$	$e^{k'_3\cdot\frac{d_h}{P_h}}$	$e^{k'_4\cdot\frac{PN}{PC}}$	$e^{k'_5\cdot\frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$	$e^{k''_1\cdot\frac{\Delta p_h}{\Delta P_h}}$	$e^{k''_2\cdot\frac{\Delta CR}{\Delta CA}}$	$e^{k''_3\cdot\frac{\Delta d_h}{\Delta P_h}}$	$e^{k''_4\cdot\frac{\Delta PN}{\Delta PC}}$	$e^{k''_5\cdot\frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$
1	1.038	1.031	1.121	1.198	1.232	1.046	1.054	1.133	0.819	1.114
2	1.041	1.015	1.228	1.281	1.111	1.059	1.020	1.038	1.000	1.240
3	1.020	1.014	1.310	1.212	1.236	1.000	1.017	1.065	1.822	1.379
4	1.039	1.038	1.081	1.210	1.116	1.016	1.014	1.058	1.162	1.206
5	1.055	1.023	1.148	1.218	1.115	1.027	1.007	1.060	1.822	1.207

Year	$e^{-k'_1\cdot\frac{p_h}{P_h}}$	$e^{-k'_2\cdot\frac{CR}{CA}}$	$e^{-k'_3\cdot\frac{d_h}{P_h}}$	$e^{-k'_4\cdot\frac{PN}{PC}}$	$e^{-k'_5\cdot\frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$	$e^{-k''_1\cdot\frac{\Delta p_h}{\Delta P_h}}$	$e^{-k''_2\cdot\frac{\Delta CR}{\Delta CA}}$	$e^{-k''_3\cdot\frac{\Delta d_h}{\Delta P_h}}$	$e^{-k''_4\cdot\frac{\Delta PN}{\Delta PC}}$	$e^{-k''_5\cdot\frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$
1	0.963	0.970	0.892	0.834	0.812	0.956	0.949	0.883	1.221	0.897
2	0.960	0.986	0.815	0.781	0.900	0.945	0.980	0.964	1.000	0.806
3	0.981	0.987	0.764	0.825	0.809	1.000	0.983	0.939	0.549	0.725
4	0.963	0.963	0.925	0.826	0.896	0.984	0.986	0.946	0.861	0.829
5	0.948	0.977	0.871	0.821	0.897	0.973	0.993	0.944	0.549	0.828

Year	$\mu_{earning}$	μ_{risk}
1	2.018	0.496
2	2.565	0.390
3	5.519	0.181
4	2.405	0.416
5	4.061	0.246
Total:	16.567	1.729

Enterprise 5 **Table 5**

Year	Increasing prevision (mill. lei)								
	Δp_h	ΔP_h	ΔCA	ΔCR	Δd_h	ΔPN	ΔPC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	340	720	2.600	500	550	-4	2	0.10	0.10
2	380	1,320	4,700	550	600	-2	3	0.12	0.13
3	380	1,950	6,800	570	700	1	2	0.12	0.14
4	440	2,600	9,000	550	800	3	2	0.13	0.15
5	480	3,200	11,200	600	900	4	1	0.14	0.16

Year	Index value prevision (mill. lei)								
	p_h	P_h	CA	CR	d_h	PN	PC	$\overline{I_{ms}}$	$\overline{I_{pf}}$
1	2,340	7,720	34,600	5,500	8,050	38	60	1.21	1.19
2	2,720	9,040	39,300	6,050	8,650	36	63	1.32	1.30
3	3,100	10,990	46,100	6,620	9,350	37	65	1.43	1.41
4	3,540	13,590	55,100	7,170	10,150	40	67	1.41	1.35
5	2,020	9,790	34,300	2,770	3,550	2	10	1.54	1.49

Year	Calculation of index ratio					Calculation of index variation ratio				
	$\frac{p_h}{P_h}$	$\frac{CR}{CA}$	$\frac{d_h}{P_h}$	$\frac{PN}{PC}$	$\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$	$\frac{\Delta p_h}{\Delta P_h}$	$\frac{\Delta CR}{\Delta CA}$	$\frac{\Delta d_h}{\Delta P_h}$	$\frac{\Delta PN}{\Delta PC}$	$\frac{\overline{I_{ms}}}{\overline{I_{pf}}}$
1	0.303	0.159	1.043	0.633	1.021	0.472	0.192	0.764	-2.000	1.000
2	0.301	0.154	0.957	0.571	1.017	0.288	0.117	0.455	-0.667	0.923
3	0.282	0.144	0.851	0.569	1.008	0.195	0.084	0.359	0.500	0.857
4	0.260	0.130	0.747	0.597	1.045	0.169	0.061	0.308	1.500	0.867
5	0.206	0.081	0.363	0.200	1.034	0.150	0.054	0.281	4.000	0.875

Year	$e^{k'_1 \cdot \frac{p_h}{P_h}}$	$e^{k'_2 \cdot \frac{CR}{CA}}$	$e^{k'_3 \cdot \frac{d_h}{P_h}}$	$e^{k'_4 \cdot \frac{PN}{PC}}$	$e^{k'_5 \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$	$e^{k''_1 \cdot \frac{\Delta p_h}{\Delta P_h}}$	$e^{k''_2 \cdot \frac{\Delta CR}{\Delta CA}}$	$e^{k''_3 \cdot \frac{\Delta d_h}{\Delta P_h}}$	$e^{k''_4 \cdot \frac{\Delta PN}{\Delta PC}}$	$e^{k''_5 \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$
1	1.062	1.032	1.110	1.209	1.227	1.048	1.059	1.165	0.549	1.105
2	1.062	1.016	1.211	1.257	1.107	1.059	1.024	1.047	0.819	1.203
3	1.029	1.014	1.291	1.186	1.223	1.000	1.017	1.074	1.162	1.293
4	1.053	1.040	1.078	1.196	1.110	1.017	1.012	1.063	1.568	1.189
5	1.064	1.016	1.075	1.062	1.109	1.030	1.005	1.058	3.320	1.191

Year	$e^{-k'_1 \cdot \frac{p_h}{P_h}}$	$e^{-k'_2 \cdot \frac{CR}{CA}}$	$e^{-k'_3 \cdot \frac{d_h}{P_h}}$	$e^{-k'_4 \cdot \frac{PN}{PC}}$	$e^{-k'_5 \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$	$e^{-k''_1 \cdot \frac{\Delta p_h}{\Delta P_h}}$	$e^{-k''_2 \cdot \frac{\Delta CR}{\Delta CA}}$	$e^{-k''_3 \cdot \frac{\Delta d_h}{\Delta P_h}}$	$e^{-k''_4 \cdot \frac{\Delta PN}{\Delta PC}}$	$e^{-k''_5 \cdot \frac{\overline{I_{ms}}}{\overline{I_{pf}}}}$
1	0.941	0.969	0.901	0.827	0.815	0.954	0.944	0.858	1.822	0.905
2	0.942	0.985	0.826	0.796	0.903	0.944	0.977	0.956	1.221	0.831
3	0.972	0.986	0.775	0.843	0.817	1.000	0.983	0.931	0.861	0.773
4	0.949	0.962	0.928	0.836	0.901	0.983	0.988	0.940	0.638	0.841
5	0.940	0.984	0.930	0.942	0.902	0.970	0.995	0.945	0.301	0.839

Year	$\mu_{earning}$	μ_{risk}
1	1.417	0.706
2	2.031	0.492
3	3.209	0.312
4	3.201	0.312
5	5.933	0.169
Total:	15.791	1.991

Centralizator results:

Enterprise	$\mu_{earning}$	μ_{risk}
1	9.037	2.829
2	14.604	1.770
3	17.012	1.580
4	16.567	1.729
5	15.791	1.991

Year	Gain $10 \cdot \ln_{\mu_c}$	Risk $10 \cdot \ln_{\mu_r}$
1	-2.333	0
2	-3.146	-0.318
3	-3.838	-0.261
4	-2.399	-0.417
5	-2.889	-0.346

We obtain, $\mu_{earning} > \mu_{risk}$ consequently, the organization is bankrupt.

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