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DIAGNOSIS OF FINANCIAL STATE AND BANKRUPTCY THREATS OF AGRICULTURAL ENTERPRISES OF LVIV REGION IN ANTI-CRISIS MANAGEMENT SYSTEM

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Abstract

The difficult economic situation in Ukraine today is the main motivating factor for studying problems and developing possible solutions. Since Ukraine is an agrarian country, in our research we justified the need to take into account risk factors in the agricultural sector by diagnosing the financial situation using models to assess the likely crisis and bankruptcy. The article highlights the advantages and disadvantages of using discriminant models developed by both foreign and domestic scientists. The main drawback is the maladaptation to the industry factor. The shortcomings of the diagnosis of financial state for agricultural enterprises are also identified. In order to develop measures to prevent bankruptcy, recommendations for improving the financial state of agricultural enterprises on the example of Lviv region cluster analysis was used. The article states that the need to diagnose the financial condition of the enterprise is systematic and requires a comprehensive assessment using various methods, techniques and methods of analysis, as it is one of the most important characteristics of the results of agricultural enterprises, which is determined by the interaction of all components of the financial relations of the enterprise, the totality of all production and economic factors. The combination of financial indicators and risk assessment, which have the greatest impact on the life of agricultural enterprises, thanks to a comprehensive approach will increase the accuracy of assessing the prospects of the financial state of agricultural enterprises.

Key words**:** *diagnostics, crisis, bankruptcy, anti-crisis management, discriminant model, cluster analysis, financial management, financial stability*

INTRODUCTION

The main feature of the economy is stability and balance in all its processes and phenomena. From the standpoint of agricultural enterprises, stability means as the ability to achieve goals and expected results under the influence of factors that cause temporary deviations in their activities within acceptable limits.

In an unstable economy, the number of enterprises that lose financial capacity is increasing significantly, which leads to the rapid emergence of a crisis in agricultural enterprises.

All companies, regardless of their field of activity, must identify the first signs of possible crises in a timely manner, assess the likelihood of a financial crisis and respond quickly to possible threats of change in management. However, there is currently no generally accepted methodology for assessing or "diagnostic protocol" the probability of a financial crisis. In our opinion, the problem is not only that such a methodology should be based on risk assessment, which is difficult to measure, but also that it cannot be multipurposal.

Many agricultural companies have financial problems and are in danger of bankruptcy [6, 7] and for avoiding failure, management anti-crisis measures are required [9, 10, 12].

In this context, the paper aimed to make an analysis of financial state and bankrupcy threats of agricultural companies from Lviv Region, Ukraine based on the use of various models to assess probable crisis and bankruptcy.

MATERIALS AND METHODS

In recent years, the following economists have covered the issue of assessing the financial stability of the enterprise in their works: O. Arefieva, V. Andriychuk, I. Bilomistna, I. Blank, A. Voronkova, M. Golder, O. Gudz, M. Demyanenko, J. Conant, Ya. Kolesnik, L. Ligonenko, O. Ostrovska, A. Podderyogin, I. Sokyrynska, G. Springate, G. Tisshaw and others. In our opinion, A. Matviychuk's model is the most adapted model of bankruptcy diagnostics and forecasting of crisis situations in the agrarian sphere. This model is a "model for assessing the axiological (subjective) probability of bankruptcy" of Ukrainian enterprises in the form of a discriminant function [5]. But conducted research has shown that the scientific literature reveals only some aspects of the diagnosis of financial condition without determining its impact on the economic security of the enterprise.

The main purpose of this study is to substantiate the need to take into account risk factors in the agricultural sector by diagnosing the financial situation on the example of a few agricultural enterprises: SE «RF «Obroshyne», LLC «Agro Frutika Byshkiv», PAF «Bilyi Stik», SE «RF «Radekhivske», LLC «Danuta», Farming household «Agrotem» and Farming household «Povernennia», using models to assess probable crisis and bankruptcy: Beaver coefficient, Altman's five-factor model, Lis's model, Taffler's model, Springate's model, Tereshchenko's model, and Matviychuk's model.

RESULTS AND DISCUSSIONS

The term "diagnosis" translated from Greek means recognition, identification of signs, knowledge of marks: recognition of phenomena by their symptoms [2, p. 93].

Ya. Kolesnik in his research notes that diagnosing of financial condition is a mandatory component of financial management for any agricultural enterprise [4, p. 71].

The application of integrated analysis according to the models of probability of bankruptcy is the first stage of diagnosis of the crisis from the standpoint of the internal environment. At the same time, it should be noted that discriminatory models and calculations performed in accordance with them of the propensity of agricultural enterprises to the crisis carried out in accordance with them cover only certain indicators, so they do not provide comprehensive information on the full range of possible causes of bankruptcy. In addition, constants are subjective, as their reliability depends on the specifics of the industry, country, region, research period and other internal and external factors. That is, all models are devoid of signs of universality, because according to none of them we can not unequivocally state that the agricultural enterprise is a potential bankrupt. At the same time, the use of bankruptcy probability models jointly allows at the initial stage of diagnosis to average the obtained results and determine the agricultural enterprise that is likely to be threatened with bankruptcy.

Summarizing the information presented in Table 1, PAF «Bilyi Stik» according to any of these models is not threatened with bankruptcy. Thus, this result can be considered as plausible. The second position on financial stability is occupied by Limited liability company «Danuta», and the third – farming household «Povernennia». Other agricultural enterprises during the period under study, in various manifestations show the threat of crisis appearance. At the same time, the aggravation of the crisis should be noted for farming household «Povernennia» and SE «RF «Radekhivske». Despite the smaller number of bankruptcy threats for LLC «Agro Frutika Byshkiv», this agricultural enterprise should be considered as potentially bankrupt due to its unprofitability, which has led to the predominance of negative values of integrated indicators of discriminant models of bankruptcy probability. At the same time, the described patterns persist throughout all four years of the study. We can assume that in the external and internal environment of the surveyed agricultural enterprises there were no unforeseen events that could dramatically affect the financial condition. That is, the

course of economic activity was equable given the situation that has formed in previous periods.

Based on the absence of threats of bankruptcy in all surveyed agricultural enterprises according to the model of Matviychuk, which is adapted to the conditions of the domestic economy, we can say that the agricultural sector is not critical. At the same time, due to the diametrically opposed values of integrated indicators according to separate discriminant models for LLC «Danuta» (2019, Tereshchenko's model), FH «Povernennia» (2017 and 2018, Taffler's model), FH «Agrotem» (2019, Lis's model), the presented calculations and generalized results cannot be considered absolutely accurate. For the most part, we have an initial vision of the situation, which can be considered as crisis for LLC «Agro Frutika Byshkiv» and FH «Agrotem».

Table 1. Matrix of values of integrated indicators according to discriminant models of bankruptcy probability

Model	**Agricultural enterprise**						
	SE «RF «Obroshyne»	LLC «Agro Frutika Byshkiv»	PAF «Bilyi Stik»	SE «RF «Radekhivske»	LLC «Danuta»	Farming household «Agrotem»	Farming household «Povernennia»
2017 year							
Beaver coefficient		-		T		T	+-
Altman's five-factor model	T	-	+-	+-	+-	T	
Lis's model	T	-		T		T	
Taffler's model		T		+-	+-	T	T
Springate's model	T	-		T		T	
Tereshchenko's model		-		+-	+-	T	
Matviychuk's model		-					
Number of threats	3	1		3		6	
2018 year							
Beaver coefficient		T		+-		T	+-
Altman's five-factor model	T	+-	+-	T	+-	T	
Lis's model	T	-		T		T	
Taffler's model		+-		T		T	T
Springate's model	T	T		T		T	
Tereshchenko's model		T				T	
Matviychuk's model		-					
Number of threats	3	2		4		6	1
2019 year							
Beaver coefficient	+-	T		T	+-	T	
Altman's five-factor model	T	+-	+-	+-	+-	T	
Lis's model	T	-					
Taffler's model	+-	T		+-		T	+-
Springate's model	T	T				T	
Tereshchenko's model	+-	-		+-	T	+-	
Matviychuk's model		-					
Number of threats	3	3		1	1	4	
2020 year							
Beaver coefficient	+-	-		T		T	+-
Altman's five-factor model	T	-	+-	+-	+-	T	+-
Lis's model	T	-		T		T	
Taffler's model	+-	T		+-	+-	T	
Springate's model	T	-		T		T	
Tereshchenko's model	T	-		T		+-	
Matviychuk's model		-				T	
Number of threats	4	1		4		6	

□ – there is no threat of bankruptcy; - – the calculated integrated indicator of the model does not make sense, because of its negative value; +- – financial stability is violated; T – threat of bankruptcy.

Source: formed by the authors according to statistical reports and [8].

Along with the manifestations of the crisis, the detection of signs of violation of financial stability also requires an immediate response from the management of the agricultural enterprise. To stabilize the financial situation, prevention the crisis through the preservation of financial balance, agricultural enterprises are forced to adopt and implement a system of anti-crisis management. At the same time, great importance is attached to preventive measures, which focus on identifying early symptoms of the crisis and developing measures to prevent bankruptcy. We agree that the main task of anti-crisis management, from a functional standpoint, should be considered timely and effective use of financial mechanism, special management functions and tools to prevent crisis and bankruptcy, as well as ensuring the financial recovery of the enterprise [1, p. 172].

Therefore, we consider it appropriate to abandon the already proven practice of using elements of financial state. Instead, we will cluster the surveyed agricultural enterprises based on the calculated integrated indicators according to discriminant models of bankruptcy probability.

The purpose of using cluster analysis in our study is to divide the surveyed agricultural enterprises into clusters, i.e. groups with homogeneous characteristics of financial state according to the values of integrated indicators according to discriminant models of probability of bankruptcy.

Therefore, based on ease of use, it was decided to use for clustering the method of distances. It should be noted that LLC «Agro Frutika Byshkiv» is not included in the rating process due to the prevalence of negative values of integrated indicators of bankruptcy probability. Taking into account this fact, LLC «Agro Frutika Byshkiv» can be considered as potential bankrupt.

According to the proposed method in the context of models for detecting the probability of bankruptcy, the distance from the reference point to the specific values of the indicators of the surveyed agricultural enterprises being assessed. The closer the agricultural enterprise is to the benchmark, the smaller its distance to the benchmark and the higher the rating. The highest rating is given to an agricultural enterprise with the minimum value of a comprehensive assessment [3, p. 109-111]. Thus, the following formula was used to calculate the values of the complex rating assessment of the surveyed agricultural enterprises:

$$Kj = \sqrt{(1-x_{ij})^2 + (1-x_{2j})^2 + \ldots + (1-x_{nj})^2}\,, \qquad (1)$$

where: x_{ij} – standardized indicators of the j-th agricultural enterprise, which are determined by the ratio of the actual value of the integrated indicator for a particular discriminant model of the probability of bankruptcy with the reference by the formula:

$$x_{ij} = ai_j / \max a_{ij}\,, \qquad (2)$$

where: max a_{ij} – is the reference value of the integrated indicator.

Thus, the results of the rating of agricultural enterprises on the integrated indicators of discriminatory models of bankruptcy probability give grounds to claim that PAF «Bilyi Stik» operates stably, in FH «Povernennia» – a mild stage of the crisis, in SE «RF «Obroshyne», SE «RF «Radekhivske» and LLC «Danuta» – the middle stage of the crisis, in FH «Agrotem» – a protracted stage of the crisis, and LLC «Agro Frutika Byshkiv» – a potential bankrupt. It is obvious that PAF «Bilyi Stik» effectively uses its production potential, it is characterized by signs of diversification of production.

The application of the hierarchical approach in cluster analysis occurs in several stages. Instantly we prepare the data for clustering. In our case, as already mentioned, this is the average value of the integral indicator of discriminant models of bankruptcy probability (Kjc) (Table 2). The next step is to calculate the Euclidean distance between each mean value of the integrated indicator for the studied farms. At the final stage, we combine the studied agricultural enterprises into clusters by visualizing the obtained Euclidean distance values.

The Euclidean distance *d(AB)* between the points A and B located on the line is defined as the square root of the square of the difference of their X coordinates:

$$d(AB) = \sqrt{(xB - xA)^2}, \qquad (3)$$

where: *xA* та *xB* – average values of comprehensive assessment of agricultural enterprises on integrated indicators of discriminant models of bankruptcy probability.

Formula 3 ensures that the distance between the two values of the complex estimate is a positive value, ie the distance between A and B is equal to the distance between B and A. Thus, Table 3 presents the values of Euclidean distances between the indicators of the average comprehensive assessment of enterprises on the integrated indicators of discriminant models of probability of bankruptcy.

Table 2. Comprehensive rating assessment of agricultural enterprises according to integrated indicators of discriminant models of bankruptcy probability

Enterprise	**Year**								**average *Kjc***	**ranking**
	2017		2018		2019		2020			
	Kj	ranking	*Kj*	ranking	*Kj*	ranking	*Kj*	ranking		
SE «RF «Obroshyne»	2.11	4	2.13	5	2.22	5	2.30	5	2.19	5
LLC «Agro Frutika Byshkiv»	-	7	-	7	-	7	-	7	-	7
PAF «Bilyi Stik»	0.35	1	0.4	1	0.67	1	0.28	1	0.43	1
SE «RF «Radekhivske»	2.22	5	1.95	3	2.14	4	2.15	4	2.12	4
LLC «Danuta»	2.08	3	2.05	4	2.02	3	1.93	2	2.02	3
Farming household «Agrotem»	2.33	6	2.35	6	2.38	6	2.36	6	2.36	6
Farming household «Povernennia»	1.77	2	1.77	2	1.75	2	1.95	3	1.81	2

Source: calculated by the authors.

Table 3. Matrix of distances of the average complex estimation of agricultural enterprises on integrated indicators of discriminant models of probability of bankruptcy

Enterprise	**Euclidean distances**					
	SE «RF «Obroshyne»	PAF «Bilyi Stik»	SE «RF «Radekhivske»	LLC «Danuta»	Farming household «Agrotem»	Farming household «Povernennia»
SE «RF «Obroshyne»	0	1.76	0.07	0.17	0.17	0.38
PAF «Bilyi Stik»	1.76	0	1.69	1.59	1.93	1.38
SE «RF «Radekhivske»	0.07	1.69	0	0.1	0.1	0.31
LLC «Danuta»	0.17	1.59	0.1	0	0.34	0.21
Farming household «Agrotem»	0.17	1.93	0.1	0.34	0	0.55
Farming household «Povernennia»	0.38	1.38	0.31	0.21	0.55	0

Source: calculated by the authors.

The dendrogram is an effective visualization of the hierarchical clustering of the studied agricultural enterprises according to the average value of the complex assessment. The constructed dendrogram is made in the form of nested groups and shows a hierarchical relationship between the formed clusters - the higher the column, the greater the distance between the clusters.

Thus, on the basis of hierarchical

agglomerative methods (Agglomerative Nesting, AGNES), the studied agricultural enterprises were consistently merged by reducing the number of clusters. The basic principle of the algorithm is that initially all objects are separate clusters. Then, one cluster was formed with the smallest Euclidean distances between agricultural enterprises according to the studied indicator. It includes SE «RF «Radekhivske», LLC «Danuta» and FH «Agrotem». In the next stages, the consolidation of facilities continues until all agricultural enterprises form one cluster. In doing so, we were guided by specific rules of grouping: the nearest neighbor or single connection, the most distant neighbors or full connection.

Thus, our cluster analysis based on the "nearest neighbor" principle formed two clusters, the distance between which is equal to P=1.38, and during the analysis based on the "most distant neighbors" principle, two clusters were obtained, the distance between which is equal to P=1.93.

The results of the hierarchical classification of objects are presented in the Figures 1 and 2.

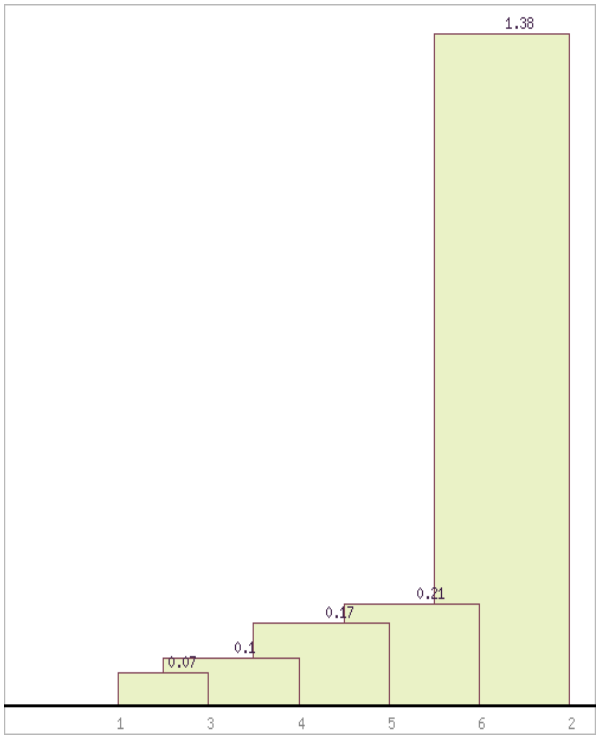

Fig. 1. Dendrogram of clustering of agricultural enterprises by the average value of the integrated indicator of discriminant models of probability of bankruptcy ("nearest neighbor" principle)
Source: Own design and result.

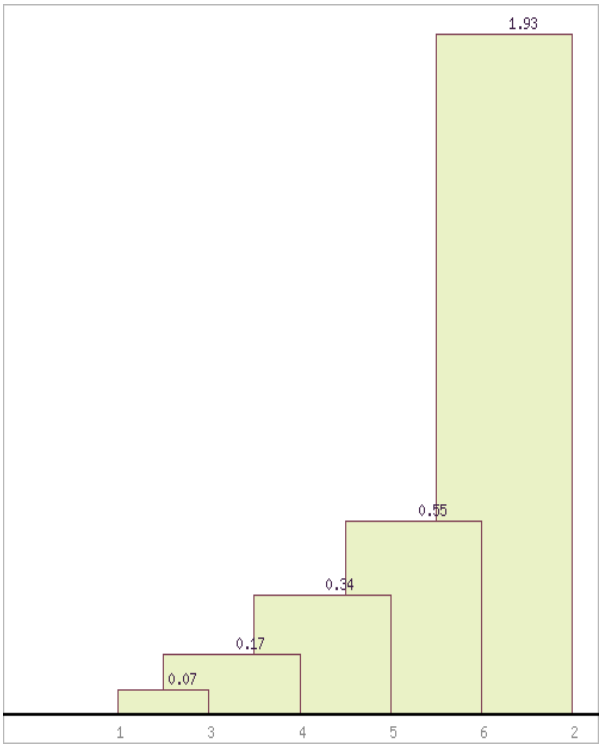

Fig. 2. Dendrogram of clustering of agricultural enterprises by the average value of the integrated indicator of discriminant models of probability of bankruptcy ("most distant neighbors " principle)
Source: Own design and result.

According to Table 3, it is obvious that the similarity between farms is marked by a smaller Euclidean distance. Conversely, the greater Euclidean distance indicates significant differences between farms by the studied indicator.

We see that the shortest distances were formed between SE «RF «Radekhivske», LLC «Danuta» and FH «Agrotem».

Obviously, they will form a separate cluster. Instead, the distance of PAF «Bilyi Stik» to all other agricultural enterprises is the largest.

At the same time, this approach provides less analytical skills in elucidating the preconditions for crises, i.e. the factors that provoked volatile liquidity, business activity, profitability, and so on. In this regard, it is advisable to use the data in Table 3 for grouping in terms of formed clusters (Table 4). This, in turn, will identify specific problem areas and identify specific objects of anti-crisis management influence.

This situation is observed in relation to the average value of the coefficients of turnover of inventories, the turnover of receivables and

the profitability of operating costs. At the same time, the results of the calculations cannot be questioned. Obviously, the importance of other factors in the models of discriminant analysis of the probability of bankruptcy is greater. This affected the redistribution of the impact of the values of these indicators on the place of the studied agricultural enterprises in specific clusters.

Thus, the results of cluster analysis are obvious and visual. The large number of clusters for a relatively small number of clustering facilities is largely due to differences in agricultural enterprises in size, form of ownership, scale of production capacity, specialization, and therefore the scale of the crisis.

Table 4. Grouping of average values of coefficients of financial state of agricultural enterprises in the context of formed clusters

Coefficient	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Normative value
Liquidity ratios						
Immediate (absolute) liquidity ratio	0.07	0.02	0.04	0.30	1.12	over 2
Total coverage ratio (current liquidity ratio)	0.41	2.22	2.94	11.11	16.07	0.2 – 0.25
Intermediate coverage ratio	0.47	2.46	3.05	14.60	19.13	in the range of 0.7 – 0.8
Level of operational solvency	17.23	34.28	3.31	109.23	25.44	above 0
Coefficients of financial stability						
Coefficient of financial stability	0	0	0	0.03	0	over 2
Coefficient of provision with own funds	0.12	0.01	0.02	0.03	0.08	0.2 – 0.25
Coefficient of financial independence (autonomy)	-1.82	0.62	0.91	0.31	0.97	in the range of 0.7 – 0.8
Debt ratio	2.15	0.49	0.09	0.70	0.03	0.5
Financial leverage ratio	0	0.68	0	2.19	0	less than 1
Accounts payable to receivables ratio	23.56	25.46	11.41	24.64	0.34	about 1
Coefficients of business activity						
Working capital turnover	1.48	2.46	1.91	1.37	1.24	
Inventory turnover	2.26	3.08	4.75	1.39	1.40	3.6
Accounts receivable turnover	8.72	41.51	48.16	6.69	6.36	4.8
Operating cycle duration, days	215	165	92	324	320	
Accounts payable turnover	0.42	3.95	4.77	0.94	14.83	4.8
Duration of the financial cycle, days	-759	-199	-6	-65	296	
Cost-effectiveness (profitability) ratios						
Net return (loss) of equity	0.13	0.05	0.01	0.74	0.15	
Return on assets	-0.20	0.02	0.01	0.21	0.14	> 0.14
Profitability of turnover (sales)	-0.40	0.04	0.02	0.25	0.21	> 0.3
Profitability of operating costs	-0.17	0.48	0.01	6.42	0.25	
Economic profitability	-0.31	0.04	0.02	0.33	0.29	

Source: calculated by the authors.

Despite the fact that LLC «Agro Frutika Byshkiv» was excluded from the clustering process due to the negative values of the integral coefficients of discriminant models, we decided to allocate this agricultural enterprise as a potential bankrupt to a separate unit cluster with the subsequent formation of anti-crisis management measures for the deep recovery of its financial condition.

LLC «Agro Frutika Byshkiv» is characterized by growing losses, shortage of current assets, which leads to a deep crisis and recognition of potential bankruptcy. A characteristic feature of LLC «Agro Frutika Byshkiv» to be classified as potential bankrupt is the negative value of equity, throughout the study period, as well as the violation of the balance of receivables and payables (Table 4).

Individual clusters are also formed from enterprises that are in both mild and medium stages of the crisis, as well as an agricultural enterprise that operates stably.

CONCLUSIONS

The anti-crisis management subsystem in the management system of an agricultural enterprise with the help of appropriate tools facilitates the timely detection of negative phenomena in the activities of these enterprises. The method of identifying the probability of a crisis is based on the diagnosis of financial condition based on the calculation of financial ratios and discriminant analysis to identify the propensity of agricultural enterprises to bankruptcy.

The application of the anti-crisis management subsystem of agricultural enterprises of common models of discriminant analysis of the probability of crisis and diagnosis of financial state involves ease of calculation and the ability to diagnose both internal and external users of information. At the same time, some models for diagnosing the probability of crisis are not adapted to modern conditions of transformation of the Ukrainian economy, do not take into account the specifics of agricultural activities, features of domestic accounting and tax system, variability of tax legislation, significant impact of inflation and price disparity on the level of profitability of agricultural enterprises, etc. In particular, a common feature of the models of Altman, Lis, Taffler and Springate is the focus on diagnosing the financial state of enterprises in the United States and Western Europe. Therefore, these models can be used as additional diagnostic tools in parallel with modern domestic models of Tereshchenko and Matviychuk.

According to the authors [11, p. 593], every agricultural producer should strive for vertical integration into business and create added value. Because, at the very least, it will help them diversify their risks and survive difficult times.

Most of the studied agricultural enterprises are characterized by different stages of the crisis. Even at the stage of a mild crisis, agricultural enterprises are sensitive to the effects of negative internal and external factors.

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