

БЛИНДА

Юрії Орестович
blyndayura@gmail.com

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ECONOMIC-MATHEMATICAL MODELING AS A PRECONDITION FOR
FORMATION MEANS OF CRISIS MANAGEMENT OF ENTERPRISESЕКОНОМІКО-МАТЕМАТИЧНЕ МОДЕЛЮВАННЯ ЯК ПЕРЕДУМОВА
ФОРМУВАННЯ ЗАСОБІВ АНТИКРИЗОВОГО УПРАВЛІННЯ
ПІДПРИЄМСТВОМасистент кафедри,
Національний університет
"Львівська політехніка"

The article is devoted to the economic-mathematical modeling as a prerequisite for the creation of anti-crisis management tools for enterprises. The article uses a discriminant model to determine a bankruptcy risk of the enterprise and uses a correlation-regression analysis to determine the most important factor of influence on the financial and economic state of the enterprise.

The deterioration of financial and economic indicators is mainly accompanied by an increase in the debt burden, which may lead to a loss of solvency, and in the future to the curtailment of activities, that is a risk of bankruptcy. And current situation in the economic environment of Ukraine shows that there are significant disadvantages in this area. However the fact of bankruptcy of business entities is inherent in a market economy, but the amount of bankrupt enterprises and the pace of this process should be the subject of continuous analysis by management structures and the introduction of a system of necessary measures to reduce and stabilize such situations.

To form a toolkit for determining the probability of bankruptcy, a number of modern economic and mathematical models that were developed by scientists from different countries of the world were analyzed, and a model of the Ukrainian scientist was chosen. The machine-building enterprises of Ukraine have adopted objects for assessing the risk of the financial crisis, since for most Ukrainian enterprises in this sector currently characterized by unsatisfactory financial condition, and as a result of the signing of the Association Agreement between Ukraine and the European Union (EU), according to experts, this type of activity can be significantly damaged due to low competitiveness compared to similar EU enterprises.

A regression analysis, which is designed to show the dependence of one variable, as explained, on one or more explanatory variables, in order to calculate and / or predict the average of the first value with the known (fixed) values of the latter was applied to chosen enterprises for the determination of the need for investment strategy.

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Стаття присвячена економіко-математичному моделюванню як передумові формування засобів антикризового управління діяльністю підприємств. В статті використано дискримінантну модель оцінки банкрутства підприємства та застосовано кореляційно-регресійний аналіз для визначення вагового фактору впливу на фінансово-економічне стан підприємства.

Погіршення фінансово-економічних показників переважно супроводжується збільшенням боргового навантаження, що може призвести до втрати платоспроможності, а в майбутньому до згорання діяльності як такої, тобто виникає ризик банкрутства. Сучасна ситуація в економічному середовищі України свідчить про наявність суттєвих негараздів в цій сфері. Хоча сам факт банкрутства суб'єктів господарювання притаманний ринковій економіці, але кількість збанкрутілих підприємств і темпи цього процесу повинні бути предметом постійного аналізу з боку управлінських структур і впровадження системи необхідних заходів з метою зменшення та стабілізації таких ситуацій.

Щоб сформувані інструментарій для визначення ймовірності банкрутства було проаналізовано низку сучасних економіко-математичних моделей, які розробили науковці різних країн світу, та обрано модель українського вченого. Об'єктами для оцінювання ризику фінансової кризи прийнято машинобудівні підприємства України, оскільки для більшості українських підприємств цієї галузі в даний час характерний незадовільний фінансовий стан, а внаслідок підписання Угоди про асоціацію між Україною та Європейським Союзом (ЄС), на думку експертів, цей вид діяльності може істотно постраждати через низьку конкурентоспроможність порівняно з аналогічними підприємствами ЄС.

Регресійний аналіз, який покликаний показати залежності однієї змінної, такої, що пояснюється, від однієї або декількох пояснювальних змінних, з метою обчислення і/чи прогнозування середньої величини першої при відомих (фіксованих) значеннях останніх був застосований до обраних підприємств для визначення необхідної інвестиційної стратегії.

Keywords: economic-mathematical modeling, discriminant model, bankruptcy risk, correlation-regression analysis

Ключові слова: економіко-математичне моделювання, дискримінантна модель, ризик банкрутства, кореляційно-регресійний аналіз

INTRODUCTION

Economic, and, therefore, the social development of any state depends on the level of efficiency of the business entities of different forms of ownership, since the filling of budgets of different levels most depends on the taxes paid by the enterprises themselves. In connection with this, there is a need for regular evaluation and analysis of their financial and economic condition, which allows, in case of problems in the enterprise, which lead

to financial problems and increase the risk of bankruptcy, take timely measures in the framework of crisis management. Such information is extremely important for counteragents, investors, bank lenders, insurance companies and other stakeholders – the subjects of both domestic and foreign market environment.

A large number of discriminatory multifactorial models, such as Altman for the United States [1], Tuffler and Tishou for Great Britain [2], Beerman for Germany [3],

Davidov and Belikov [4] for Russia, Tereshchenko [5], Chernyak [6], Matviychuk [7] for Ukraine, and many others, have been developed in the direction of modeling the assessment of the financial status and the diagnosis of bankruptcy of enterprises for different countries. The basis of these models is the task of classifying enterprises by the levels of the potential possibility of their bankruptcy.

The deterioration of financial and economic indicators is mainly accompanied by an increase in the debt burden, which may lead to a loss of solvency, and in the future to the curtailment of activities, that is a risk of bankruptcy. That is why in-depth research is required not only to diagnose the financial condition of an enterprise, but to assess the risk of bankruptcy by providing objective assessments of the financial and economic security of an enterprise, but also the adequate use of this diagnosis as a basis for attracting crisis management in order to develop effective practical recommendations for overcoming negative consequences of management.

The **PURPOSE** is on the basis of real information on the financial and economic problems of industrial enterprises to demonstrate how a road map is being prepared for the withdrawal of these enterprises from the risk zone of bankruptcy, which involves economic and mathematical modeling, in particular, a correlation and regression analysis of risk assessment, and models of anticrisis management.

RESULTS

The current situation in the economic environment of Ukraine shows that there are significant disadvantages in this area. Although the fact of bankruptcy of business entities is inherent in a market economy, but the amount of bankrupt enterprises and the pace of this process should be the subject of continuous analysis by management structures and the introduction of a system of necessary measures to reduce and stabilize such situations. For example, the amount of bankrupt enterprises in Ukraine is much higher than in the Polish economy. Table 1 shows the dynamics of the amount of enterprises declared bankrupt in Ukraine and Poland.

Table 1

Analysis the amount of bankrupt enterprises in Ukraine and Poland

[based on data of <http://www.coig.com.pl/lista-upadlosci-firm.php> and <http://www.ukrstat.gov.ua>]

Years	Amount of enterprises declared bankrupt in Ukraine	Amount of enterprises declared bankrupt in Poland	Change to the previous year in Ukraine		Change to the previous year in Poland	
			Absolute value	Relative value	Absolute value	Relative value
2010	3614	681	-	-	-	-
2011	4086	710	472	13,06	29	4,26
2012	6743	880	2657	65,03	170	23,94
2013	4628	888	-2115	-31,37	8	0,91
2014	3359	807	-1269	-27,42	-81	-9,12
2015	2096	750	-1263	-37,6	-57	-7,06
2016	1524	606	-572	-27,29	-144	-19,20

The data presented in Table 1 shows that the number of bankruptcies in Ukraine is significantly higher than in neighboring Poland. From 2013 in Ukraine and from 2014 in Poland there is a positive dynamics, a decrease in such enterprises. It should be noted that the dynamics of the reduction of bankrupt enterprises in Ukraine is much higher than in Poland, for example, in the year 2015 the indicator of domestic enterprises decreased by 37.6 %, in Poland only by 7.06 %. The positive trend is also observed in relation to the number of bankrupt enterprises in Ukraine to the number in Poland, in 2010 these were more than 5 times higher than in Poland, and in 2016 it was only 2.5 times, but still this amount remains too high. Figure 1 shows a chart of the number of bankrupt enterprises in Ukraine and Poland, their trend lines and projected values for 2017-2018.

The given statistics (Table 1, Figure 1) indicate that there are significant problems in the field of entrepreneurship in Ukraine. However, this information also indicates the need for constant professional monitoring of the financial and economic condition of the company in order to predict the signs of the crisis and prevent its development. In economics and mathematical theory and practice, many effective methods and appropriate tools have been developed that allow "to be armed" in time. In particular, the

experience of using modern discriminatory multifactorial models suggests the feasibility of their application not only for assessing the real financial condition of the enterprise, but also for modeling the future risk of bankruptcy in the development process.

To form a toolkit for determining the probability of bankruptcy, a number of modern economic and mathematical models that were developed by scientists from different countries of the world were analyzed, and a model of the Ukrainian scientist A. Matviychuk was chosen. The machine-building enterprises of Ukraine have adopted objects for assessing the risk of the financial crisis, since for most Ukrainian enterprises in this sector currently characterized by unsatisfactory financial condition, and as a result of the signing of the Association Agreement between Ukraine and the European Union (EU), according to experts, this type of activity can be significantly damaged due to low competitiveness compared to similar EU enterprises. An important factor in favor of manufacturing enterprises is that the Ukrainian economy needs restructuring of its business in order to change the economic priorities from the raw material specificity of the product, in which the machine-building industry occupies an important place.

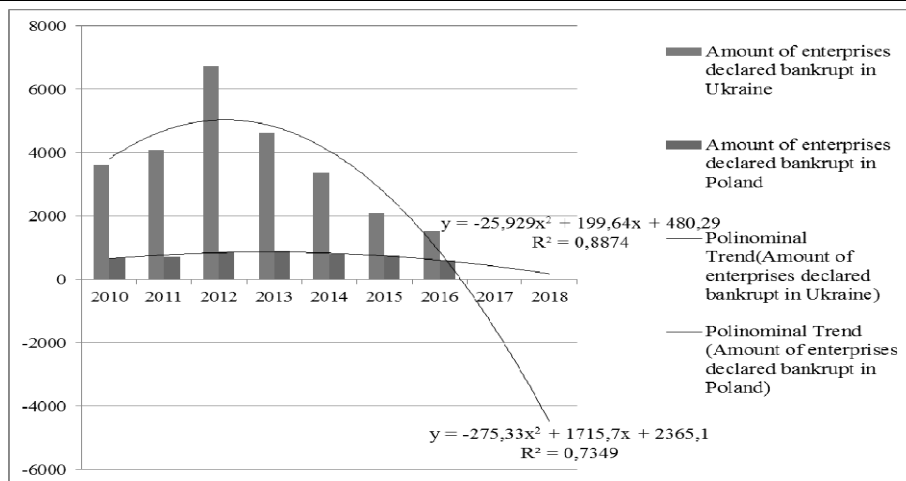


Fig. 1. The number of bankrupt enterprises in Ukraine and Poland, their trends and projections for 2017-2018

As a result of the research carried out for modeling, a set of input factors was selected that cover all major groups of financial and economic indicators of enterprises, have high bankruptcy ability and lack of multicollinearity, which enables to ensure stable and reliable work of the developed discriminant model. As a result, a model for evaluating the axiological (subjective) probability of bankruptcy of Ukrainian enterprises in the form of a discriminant function is derived on the basis of the following set of explanatory variables:

$$Z = 0,033X_1 + 0,268X_2 + 0,045X_3 - 0,018X_4 - 0,004X_5 - 0,015X_6 + 0,702X_7, \quad (1)$$

where the explanatory variables X_i , $i = 1, 7$ and the rules for their calculation are given in Table 2.

According to the above model, if $Z > 1,114$ then the analyzed company is in a satisfactory financial and economic state, and when $Z < 1,114$, then there is a threat of bankruptcy.

Table 2

Calculation of stability coefficients and discriminant function for certain industrial enterprises in the selected bankruptcy model [data for the calculation of these enterprises was obtained from the electronic resource <https://smida.gov.ua>]

Symbol	Indicator	Calculation	Indicator value					
			PJSC "Drohobyt'skyi mashynobudivnyi zavod"	PJSC "Pivden-zakhidelektromerezhbud"	PJSC "Publichne aktsionerne tovarystvo «Naukovovyrobnyche obiednannia "Termoprylad" im. V. Lakha»"	PJSC "Avtonavantazhuvach"	PJSC "L'viv'skyi lokomotyvo-remontnyi zavod"	PJSC "L'viv'skyi instrumental'nyi zavod"
X1	Mobility of assets	Current assets / Non-current assets	3,473	0,496	2,208	1,149	1,066	2,489
X2	Turnover of accounts payable	Net realizable value / Current liabilities	0,431	2,082	19,074	1,862	0,135	7,217
X3	Turnover of equity capital	Net realizable value / Equity	0,575	0,972	1,158	2,631	0,133	1,229
X4	Payback assets	Balance / Net realizable value	4,052	1,500	0,915	1,117	14,926	0,952
X5	Secured by own working capital	(Current assets – Current liabilities) / Current assets	0,264	0,040	0,916	0,101	-0,022	0,796
X6	Concentrations of attracted capital	(Long-term liabilities + Current liabilities) / Balance	0,571	0,320	0,057	0,659	0,496	0,145
X7	Coverage of debt with equity	Equity / (Provide the following costs and payments + Long-term liabilities + Current liabilities)	0,750	2,141	16,464	0,515	1,014	5,871
Z	The value of the discriminant function		0,932	2,084	16,773	0,986	0,513	6,17

In our case, the enterprise PJSC "Pivden'zakhidiektromerezhbud", PJSC "Publichne aktsionerne tovarystvo «Naukovo-vyrobnyche obiednannia «Termoprylad» im. V. Lakha»" and PJSC "L'vivs'kyi instrumental'nyi zavod" indicators of which 2,0847; 16.7736 and 6.17, respectively, have low probability of bankruptcy, and in enterprises PJSC "Drohobys'kyi mashynobudivnyi zavod", PJSC "Avtonavantazhuvach" and PJSC "L'vivs'kyi lokomotyvoremontnyi zavod" these indicators are 0,9329; 0,9864 and 0,513, which means they have a threat of bankruptcy. After analyzing the information presented in the above table, we can draw some conclusions:

- At PJSC "Publichne aktsionerne tovarystvo «Naukovo-vyrobnyche obiednannia «Termoprylad» im. V. Lakha»" value of the discriminant function is quite large and makes 16,7736, this is explained by the low value of current liabilities of 1390 thousand UAH, but the lack of long-term commitments and the provision of subsequent costs and payments, which led to too much importance the indicator of the turnover of accounts payable 19,074 and debt coverage by equity 16,464.

- At PJSC "Drohobys'kyi mashynobudivnyi zavod" in comparison with other analyzed enterprises, the high values of asset mobility ratios 3.473 and assets recoupment 4,052, in the first case, such values were achieved due to a significant excess of current assets of UAH 38273 thousand – over irrevocable UAH 11020 thousand, and in the other case due to the high balance value UAH 49293 thousand and a low income from sales UAH 12165 thousand; also a small income from sales and large current liabilities UAH 28160 thousand led to a low level of turnover of accounts payable 0.431; the lack of long-term commitments and the subsequent costs and payments did not provide a high indicator of debt-equity coverage due to large current liabilities and a low level of equity.

- At the PJSC "Pivden'zakhidiektromerezhbud", the indicators for covering debt-equity (2,141) and the turnover of accounts payable (2,082) are high, since the value of equity capital is UAH 57834 thousand, and net realizable value UAH 56240 thousand, and current liabilities UAH 27004 thousand, as well as there are no long-term liabilities and provision of the following expenses and payments; the indicator of the availability of own working capital is quite low (0,040) due to the small amount of current assets UAH 28136 thousand.

- PJSC "Avtonavantazhuvach" is characterized by a high level of return on equity (2,631) and a concentration of attracted capital (0.659), which was achieved by a high net realizable value UAH 32026 thousand and a small amount of equity capital UAH 12168 thousand; the low values of the availability of own working capital (0.101) and the debt-equity ratio (0.515) can be explained by the large number of long-term and current liabilities.

- At the PJSC "L'vivs'kyi lokomotyvoremontnyi zavod" it was revealed that the indicators of turnover of equity (0.133) and turnover of payables (0.135) are the lowest among the analyzed enterprises, which is explained by the insignificant net proceeds from the sale UAH 17324 thousand and high indicators of current liabilities UAH 28003 thousand and equity UAH 130230 thousand; It should also be noted that the availability of own working

capital is negative (-0,022), unlike other enterprises, since current assets are less than current liabilities; another feature is the highest value, among analyzed enterprises, the payback of assets (14,926), this was due to the high balance value UAH 258586 thousand and vice versa, a small net income from the sale UAH 17324 thousand, however, the size of the payback of assets did not affect the final discriminatory indicator (Z).

- PJSC "L'vivs'kyi instrumental'nyi zavod" has high asset mobility ratios (2,489) and turnover accounts payable (7,217), since the company has large working assets UAH 4721 thousand and net realizable value UAH 6950 thousand and the low value of non-current assets is UAH 1896 thousand and current liabilities UAH 963 thousand; the lack of provision of the following costs and payments, long-term liabilities and, again, low level of current liabilities, led to a high level of coverage of debt-equity (5,871), which also affected the final discriminative indicator of the enterprise (6,17).

The calculations made show that the enterprises PJSC "Pivden'zakhidiektromerezhbud", PJSC "Publichne aktsionerne tovarystvo «Naukovo-vyrobnycheobiednannia «Termoprylad» im. V.Lakha»", PJSC «L'vivs'kyi instrumental'nyi zavod», which according to the model of Matviychuk received the following values of the discriminant function, respectively, $Z=2,084$, $Z=16,773$, $Z=6,170$, exceeding 1,114, are in a satisfactory financial and economic state. And since the work is devoted precisely to crisis management, we are interested in such enterprises as PJSC "Drohobys'kyi mashynobudivnyi zavod", PJSC «Avtonavantazhuvach», PJSC "L'vivs'kyi lokomotyvoremontnyi zavod", with values $Z=0,932$, $Z=0,986$, $Z=0,513$, respectively, which are below the regulatory level of 1,114, so, there is a threat of a financial crisis and the subsequent probability of bankruptcy. However, the Economic Court of Lviv region by its ruling of October 9, 2012 recognized bankrupt PJSC "Avtonavantazhuvach" (Lviv region), specializing in the production of forklift trucks. This, according to the procedure, was reported in an advertisement published in the newspaper "Holos Ukrainy" dated October 23, 2012. Thus, the court began the liquidation procedure in relation to the bankrupt business and the sale of PJSC "Avtonavantazhuvach" property was started. Therefore, further analysis is subject to only on PJSC "Drohobys'kyi mashynobudivnyi zavod" та PJSC "L'vivs'kyi lokomotyvoremontnyi zavod".

The next step was to propose a regression analysis, which is designed to show the dependence of one variable, as explained, on one or more explanatory variables, in order to calculate and / or predict the average of the first value with the known (fixed) values of the latter. The following indicators were chosen for regression analysis: dependent variable (Y) – value of discriminant function; independent variables X1 – turnover rate of stocks; X2 – coefficient of financial stability; X3 – staff turnover; X4 – coefficient of information protection. It is proposed to conduct a diagnosis of the level of information security of the enterprise in three key areas: assessment of software and technical security of information; assessment of information reliability of personnel; evaluation of information provided to decision makers, information service of the enterprise. This indicator was obtained by the expert estimation method.

The obtained parameters of the regression equation will indicate the nature of the relationship between the discriminant function and the listed parameters. The nature of such a dependency will make it possible to identify the most important factors that significantly affect the performance of the enterprise, in particular, to reduce the likelihood of its bankruptcy.

The results of the regression analysis for PJSC "Drohobyt'skyi mashynobudivnyj zavod" indicate that the proposed model is adequate, since R (square), the determination coefficient is 0.994, which means that the influence of x_1 , x_2 , x_3 , x_4 is at 99, 4%, and other factors that were not taken into account affect the resulting indicator by 0.6%. Also, Fisher's criteria for this four-factor regression was used, which reflects on how correctly this model explains the general variance of the dependent variable. To check the significance of the regression equation, the calculated value of Fisher's criteria is compared with its table value. The estimated value of the F-criteria in this case is F-

rational = 220.83, which is bigger than its table value $F_{\text{table}} = 5,19$. So, it can be argued that the selected factorial features, independent variables, really significantly affect the resulting sign – the value of the discriminant function.

Parameters of the regression equation will be:

$$a_0=2,15092E-16, a_1=0,2008,$$

$$a_2=0,8034, a_3=0,0969, a_4=-0,0537,$$

so, the regression equation will take the following form:

$$y=0,2008x_1+0,8034x_2+0,0969x_3-0,0537x_4+2,15092E-16. \quad (2)$$

Conclusions on the influence of independent variables x_1 , x_2 , x_3 , x_4 (turnover rate of stocks, coefficient of financial stability, staff turnover and coefficient of information resources protection), respectively, on the resulting sign – the significance of the discriminant function are given in Table 3.

Table 3

Influence of independent variables (X_1 , X_2 , X_3 , X_4) on the dependent variable (Y) for PJSC "Drohobyt'skyi mashynobudivnyj zavod"

	Value X_1	Value X_2	Value X_3	Value X_4
increased by 0,2008	Increase by 1%	Const	const	const
increased by 0,8034	const	Increase by 1%	const	const
increased by 0,0969	const	Const	Increase by 1%	const
decreased by 0,0537	const	Const	const	Increase by 1%
increased by 2,15092E-16	const	Const	const	const

For the constructed model of four factor regressions we can conclude that:

- an increase in the rate of turnover of stocks (X_1) by 1%, with the invariance of all other factors (X_2 , X_3 , X_4), will increase the value of the discriminant function (y) by 0,2008 point;

- with an increase in the coefficient of financial stability (X_2) by 1% and with the invariability of all other factors (X_1 , X_3 , X_4) will increase the value of the discriminant function (y) by 0.8034 point;

- with an increase in the staff turnover (X_3) by 1% and with the invariance of all other factors (X_1 , X_2 , X_4) will increase the value of the discriminant function (y) by 0,0969 point;

- with an increase in the coefficient of information resources protection (X_4) by 1% and with the invariance of all other factors (X_1 , X_2 , X_3) will decrease the value of the discriminant function (y) by 0.0537 point;

- the immutability of all independent variables will increase the value of the discriminant function (in) to 2.15092E-16 point.

From the above analysis it can be argued that the most important factor affecting the resulting sign is the coefficient of financial stability, and the stock turnover rate is also significantly affected.

The results of PJSC "L'viv'skyi lokomotyvremontnyi zavod" indicate that the proposed model is adequate, since R (square), the determination coefficient is 0.988, which means that the influence of x_1 , x_2 , x_3 , x_4 is 98.8 %, while other factors that were not taken into account affect the resulting result by 1.2%. The estimated value of the Fractional = 109,04, which is larger than its tabular value $F_{\text{etal}} = 5,19$. So, it can be argued that the selected factorial features, independent variables, really significantly affect

the resulting sign – the value of the discriminant function.

Parameters of the regression equation PJSC "L'viv'skyi lokomotyvremontnyi zavod" will be:

$$a_0=3,9703E-16, a_1=0,1179,$$

$$a_2=1,0065, a_3=0,1310, a_4=0,0218,$$

so, the regression equation will take the following form:

$$y=0,1179x_1+1,0065x_2+0,1310x_3+0,0218x_4+3,9703E-16. \quad (3)$$

Conclusions on the influence of independent variables x_1 , x_2 , x_3 , x_4 (turnover rate of stocks, coefficient of financial stability, staff turnover and coefficient of information resources protection), respectively, on the resulting sign – the significance of the discriminant function for PJSC "L'viv'skyi lokomotyvremontnyi zavod" are given in Table 4.

For the constructed model of four factor regressions we can conclude that:

- with an increase in the rate of turnover of stocks (X_1) by 1% and with the invariability of all other factors (X_2 , X_3 , X_4) will increase the value of the discriminant function (y) by 0,1179 point;

- with an increase in the coefficient of financial stability (X_2) by 1% and with the unalteredness of all other factors (X_1 , X_3 , X_4) will increase the value of the discriminant function (y) by 1.0065 point;

- with an increase in the staff turnover (X_3) by 1 % and with the invariance of all other factors (X_1 , X_2 , X_4) will increase the value of the discriminant function (y) by 0,1310 point;

- with an increase in the coefficient of information resources protection (X_4) by 1% and with the invariance of all other factors (X_1 , X_2 , X_3) will increase the value of the discriminant function (y) by 0.0218 point;

Table 4

Influence of independent variables (X1, X2, X3, X4) on the dependent variable (Y) for PJSC "L'vivs'kyi lokomotyvoremontnyi zavod"

Значення Y	Value X1	Value X2	Value X3	Value X4
increased by 0,1179	Increase by 1%	const	const	const
increased by 1,0065	const	Increase by 1%	const	const
increased by 0,1310	const	const	Increase by 1%	const
decreased by 0,0218	const	const	const	Increase by 1%
increased by 3,9703E-16	const	const	const	const

- with the invariance of all independent variables, the magnitude of the discriminant function (y) will increase by 3.9703E-16 point.

The evaluation of the results of the conducted simulation, in particular, correlation-regression analysis showed that the main indicators of the impact on the bankruptcy prevention index for the analyzed enterprises are four indicators: 1) turnover rate of stocks; 2) the coefficient of financial stability; 3) coefficient of personnel turnover; 4) the coefficient of information protection.

Since the key direction of crisis management is targeted investment, the presence of several key indicators makes it necessary to choose an anti-crisis investment strategy that can affect the change of one and improve several or all of the indicators. Taking into account the dynamics of modern economic development, as well as the possibility (and mobility) of various financial and economic priorities for the analyzed enterprises, the following variants of anti-crisis investment strategies are considered: focusing strategy on the dominant factor; polyfactorial strategy; balancing strategy.

The relevance of the strategies presented is different for enterprises. Since the influence of each of the factors on the resulting sign was calculated using regression analysis, it can be argued that when the weight of one factor is significantly different from all others, then it is advisable to apply a focus strategy. If there are several factors of great importance, it is more efficient to apply a polyfactorial investment strategy. It is expedient to use the investment strategy of balancing when the influence of factors is very different from each other, and also when there is a number of stakeholders with a significant impact on the activity of the enterprise.

CONCLUSION

An overview of the results of the study allows us to formulate certain conclusions about the preconditions and feasibility of using the proposed methods for assessing the degree of risk of the financial crisis, which may lead to bankruptcy of the enterprise, and to decide on the application of the proposed models of investment strategies within the framework of crisis management:

- search and systematization of available economic and mathematical methods for assessing the risk of crisis phenomena, in particular, the achievements of modern world and Ukrainian theory and practice of mathematical modeling in order to identify the most risky situations for a particular enterprise;

- choice of existing enterprises, the financial condition of which requires interference in order to avoid the risk of bankruptcy or to reduce this danger;

- mathematical estimation of financial and economic

parameters of the activity of these enterprises, which are the subject of their mandatory reporting, in order to identify the risks of bankruptcy and ways to overcome them;

- use of methods of economic and mathematical modeling to identify the level of danger of crisis phenomena in the analyzed enterprises and taking into account the results of these studies in the development of anticrisis management tools.

References

1. Altman E.I. *Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. The Journal of Finance.* 1968. №.4. pp. 589-609.
2. Toffler R., Tishaw H. *Going, going, gone – four factors which predict. Accountancy.* 1977. March. pp. 50-54.
3. Beermann K. *Prognosemöglichkeiten von Kapitalverlusten mit Hilfe von Jahresabschlüssen. Schriftenreihe des Instituts für Revisionswesen der Westfälischen Wilhelms-Universität Münster.* 1976. №11. pp. 118-121. (in German)
4. Davydova H.V., Belikov A.Yu. *Method of Quantitative Assessment of the Risk of Bankruptcy of Enterprises. Risk Management.* 1999. № 3. pp. 13-20. (in Russian)
5. Tereschenko O. *Anticrisis Financial Management at the Enterprise. KNEU.* 2004. 268 p. (in Ukrainian)
6. Cherniak O.I., Krekivs'kyi V.O., Monakov V.O., Yaschuk D.V. *Detection a sign of incompatibility of the company and the possibility of bankruptcy. Ukrainian Statistics.* 2003. № 4. pp. 87-94. (in Ukrainian)
7. Matviychuk A.V. *Fuzzy, neural network and discriminant models for diagnosing the possibility of bankruptcy of enterprises. Neuro-fuzzy simulation technologies in economics.* 2013. № 2. pp. 71-118. URL: <http://oaji.net/articles/2015/1846-1428045809.pdf> (in Ukrainian)

Список використаних джерел

1. Altman E.I. *Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. The Journal of Finance.* 1968. №.4. pp. 589-609.
2. Toffler R., Tishaw H. *Going, going, gone – four factors which predict. Accountancy.* 1977. March. pp. 50-54.
3. Beermann K. *Prognosemöglichkeiten von Kapitalverlusten mit Hilfe von Jahresabschlüssen. Schriftenreihe des Instituts für Revisionswesen der Westfälischen Wilhelms-Universität Münster.* 1976. № 11. pp. 118-121.
4. Давыдова Г.В., Беликов А.Ю. *Методика количественной оценки риска банкротства предприятий. Управление риском.* 1999. №3. с. 13-20.
5. Терещенко О.О. *Антикризове фінансове управління на підприємстві. КНЕУ,* 2004. 268 с.
6. Черняк О.І., Креківський В.О., Монаков В.О., Ящук Д.В. *Виявлення ознак неплатоспроможності підприємства та можливого його банкрутства. Статистика України.* 2003. № 4. С. 87-94.
7. Матвійчук А.В. *Нечіткі, нейромережеві та дискримінантні моделі діагностування банкрутства підприємств. Нейро-нечіткі технології моделювання в економіці.* 2013. № 2. с. 71-118. URL: <http://oaji.net/articles/2015/1846-1428045809.pdf>