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Three-Factor Model of Predicting Bankruptcy of a Trading Company and the Advantages of Its Application in a Digital Economy

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ABSTRACT

The rapid development of information and communication technologies, their escalation in all spheres of our life led to the formation of a new economic era - the digital economy, which is the key driver of acceleration of economic growth. This fact is generally acknowledged both in the scientific community and at all levels of government in the Russian Federation. Proof of this is the state program "Digital economy of the Russian Federation", which was approved by Government Order of July 28, 2017 No. 1632-r. The purpose of the program is to create favorable conditions in Russia for the development of digital economy institutions within the framework of the participation of the state, business community and citizens, and to ensure, on the basis of this, sustainable growth rates of the national economy. One of the main tasks, contributing to the achievement of this purpose, is the creation of new approaches to the organization of the service sector, production and trading sectors, that take into account the achievements of the digital economy and are effective in the development of a global digital ecosystem. In the context of specified objective, the study of these approaches in the field of financial management of Russian trading companies seems relevant. It should be noted, that the trading sector has a special place in the digital economy, as it is developing at the fastest rate due to the growth of electronic trade, the emergence and development of marketplaces and various digital marketing tools. Moreover, most Russian trading companies are characterized by a very conservative approach to financial management. The transition to the digital economy involves a change in the methods and tools of financial management, focused on making timely decisions in order to ensure financial stability and prevent bankruptcy. The subject of this study is the methodological tools for predicting bankruptcy of a company. The purpose of the study: to improve the methodological tools for assessing the probability of bankruptcy of a trading company through the development of the author's three-factor model.

The methodological basis of the study was the logical structural analysis and synthesis, methods of correlation and regression analysis, matrix method. Main results: 1. The analysis of the effectiveness of applying 15 models for assessing the probability of bankruptcy is carried out on the example of 200 Russian trading companies. A number of shortcomings was identified, that limit the effectiveness of their practical application. 2. A three-factor model of predicting the probability of bankruptcy of a trading company is developed by authors, taking into account the most important financial and economic aspects of its activity: economic stability, financial independence and profitability.

Keywords: *predicting bankruptcy, models, trading companies, Russia, financial risks, digital economy*

1. INTRODUCTION

Issues of assessing the likelihood of bankruptcy of organizations take an important place in economic science and are especially relevant in modern conditions of an unstable external business environment [1]. To date, a significant number of foreign and Russian models have been formed to assess the likelihood of bankruptcy of organizations. The most famous foreign models include the models of E. Altman, R. Tuffler, W. Beaver, R. Lis, D. Fulmer, G. Springate, J. Depalian [2,3]. Of the number of domestic models of predicting bankruptcy, the models of O.P. Zaitseva, G.V. Savitskaya, A.Yu. Belikova, G.V. Davydova (model of the Irkutsk State Economic Academy) are characterized by the most application popularity [4, 5].

However, as the practice of their application shows, often the results of assessing the financial condition of Russian companies, obtained by using different models in relation to the same economic entity, are controversial or inadequately reflect the real situation. This determines the objective necessity and relevance of the development of methodological tools for predicting bankruptcy of a company.

2. METHODS OF RESEARCH

The authors conducted a study, dedicated to assessing the effectiveness of applying 15 foreign and Russian models of predicting bankruptcy, using the example of Russian trading companies [6].

The studied models of predicting bankruptcy included:

1. Two-factor model of E. Altman;
2. Five-factor model of E. Altman for companies, that do not place shares in the stock market;
3. Four-factor model of E. Altman for non-production companies;
4. Four-factor model of E. Altman for non-production companies as applied to developing countries;
5. Five-factor model of E. Altman, G. Sabato (logit-model);
6. Four-factor model of R. Tuffler;
7. The system of indicators of W. Beaver;
8. The four-factor model of R. Lis;
9. Credit-men method of J. Depalyan;
10. Nine-factor model of D. Fulmer;
11. Four-factor model of G. Springate;
12. Four-factor model A.Y. Belikova, G.V. Davydova (model of the Irkutsk State Economic Academy);
13. Six-factor model of O.P. Zaitseva;
14. Five-factor model of G.V. Savitskaya;
15. Five-factor model of V.A. Parenoy, I.V. Dovgaleva.

The object of the study was a sample of large Russian organizations in the form of limited liability companies, engaged in wholesale and retail trade. The sample consisted of 200 organizations, including 100 operating and 100 bankrupts. Average proceeds from sales of the studied organizations for the period 2017–2018 ranged from 2 to 16 billion rubles.

It should be noted, that the industry choice of the studied organizations is not random. Based on the analysis of statistical data, provided by the Unified federal register of bankruptcy information [7] and the Center for macroeconomic analysis and short-term forecasting [8], the authors conducted an analysis of the sectoral nature of the distribution of bankrupt organizations in Russia in 2018, the results of which are shown in Figure 1.

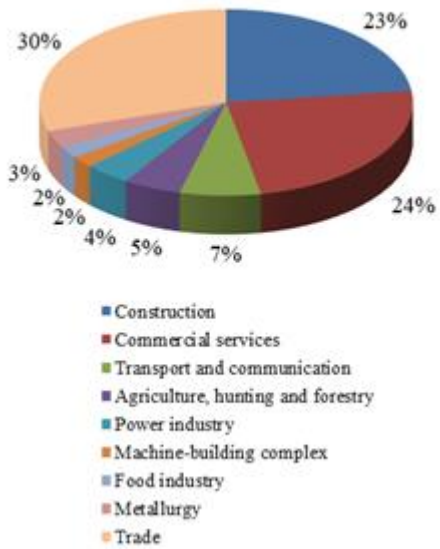

Figure 1 Distribution of bankrupt legal entities in Russia by industry in 2018

Figure 1 shows, that the largest number of Russian bankrupt organizations are in the sphere of trade. This situation is characteristic not only for 2018, a similar nature of the sectoral structure of bankruptcies in Russia has been persisting over the past five years.

An analysis of the effectiveness of the use of the studied models of predicting bankruptcy was in comparing the obtained results of the assessment with the actual financial condition of each sample unit and calculating the indicator of the accuracy of the assessment for both each sample group (100 operating organizations and 100 bankrupt organizations) and according to the total sample (200 organizations). The indicator of the accuracy of assesment characterizes the percentage ratio between the number of organizations, whose assessment results coincided with the actual financial condition, and the sample volume. Thus, the maximum accuracy of the assessment is 100%. It is important to note, that if, as a result of applying one or another models of predicting bankruptcy, the financial condition of the sample unit was in the zone of uncertainty, then 0.5% was added to the indicator of the accuracy of the assessment.

The obtained results of the authors' analysis are shown in table 1.

As can be seen from table 1, the “victory podium” in ranking the models according to the degree of accuracy of predicting bankruptcy of the studied 200 trading companies was occupied by three foreign models: the logit-model of E. Altman, G. Sabato (1st place); E. Altman’s five-factor model for companies, that do not place shares on the stock market (2nd place); four-factor model of G. Springate (3rd place).

In general, it should be noted, that the studied 15 models of predicting bankruptcy demonstrate insufficiently high accuracy of assessment as applied to Russian trading companies. Even the logit-model of E. Altman, G. Sabato,

which occupies the first place in the ranking, is characterized by an assesment accuracy of 65%. According to the authors' opinion, such assessment results are due to the following factors:

1. The formation of weight (empirical) ratios in the models took place at different times. Since the time factor in the economy plays a very important role, each model of predicting bankruptcy should be periodically adjusted taking into account current trends.
2. The studied models are universal in the context of industry, do not take into account the type of economic activity of an economic entity and factors of industry specificity.
3. In most models, the Z-score formula contains indicators, that correlate with each other, which leads to a decrease in the accuracy of the assesment [9].

Table 1 Analysis of the effectiveness of the studied models for assessing the probability of bankruptcy of 200 trading companies

Model name	Assessment accuracy for a group of 100 operating organizations, %	Assessment accuracy for a group of 100 bankrupt organi zations, %	Model effectiveness rating by the criterion of accuracy of the assessment for the whole sample
Two-factor model of E. Altman	84	35	5th place (accuracy 59.5%)
Five-factor model of E. Altman for companies, that do not place shares in the stock market	88.5	40.5	2nd place (accuracy 64.5%)
Four-factor model of E. Altman for non-production companies	100	9	8th place (accuracy 54.5%)
Four-factor model of E. Altman for non-production companies as applied to developing countries	100	2.5	10th place (accuracy 51.5%)
Five-factor model of E. Altman, G. Sabato (logit-model)	93	37	1st place (accuracy 65%)
Four-factor model of R. Tuffler	93	3	13th place (accuracy 48%)
System of indicators of U. Biver	99.5	0.5	11th place (accuracy 50%)
The four-factor model of R. Lis	97	22	5th place (accuracy 59.5%)
Credit-men method of J. Depalyan	98	14	6th place (accuracy 56%)
Nine-factor model of D. Fulmer	98	13	7th place (accuracy 55.5%)
Four-factor model of G. Springate	100	23	3rd place (accuracy 61.5%)
Four-factor model of A.Y. Belikov G.V. Davydova	100	0	11th place (accuracy 50%)
Six-factor model O.P. Zaitseva	58	46	9th place (accuracy 52%)
Five-factor model of G.V. Savitskaya	98	22	4th place (accuracy 60%)
Five-factor model of V. A. Parenaya, I. V. Dovgaleva	50	48	12th place (49% accuracy)

The next objective of the study was to develop an author's model of predicting bankruptcy of a trading company. In the framework of this objective, a correlation analysis of 60 indicators (ratios) was conducted, which are used in the studied 15 model of predicting bankruptcy, and the most effective ones were selected from them. Conditionally, these indicators can be divided into 5 groups:

- liquidity indicators;
- indicators of financial independence;
- indicators of business activity (turnover);
- profitability indicators;
- author's indicators (logarithmic ratios; ratio of equity to non-current assets; ratio of profit before tax and interest to payment, etc.).

The greatest correlation was demonstrated by the ratios of financial independence, profitability and liquidity. However, liquidity ratios showed a relations with financial independence ratios, so their simultaneous presence in the model of predicting bankruptcy of a trading company is more likely to spoil it, creating autocorrelation. This is due to the fact, that in 90% of the studied trading companies the share of current assets exceeds 3⁄4 of assets, and, as a rule, long-term liabilities are generally absent.

3. RESEARCH RESULTS

The model of predicting bankruptcy of a trading company, proposed by the authors, takes into account the most important financial and economic aspects of its activity: economic stability, financial independence and profitability. Profitability characterizes the ratio of net profit to assets (it can be both positive and negative); financial autonomy - an indicator of the ratio of borrowed capital to liabilities; stability is characterized by a factor of variation of asset turnover.

The distribution of the studied group of trading companies by these three indicators is presented in figures 2, 3, 4.

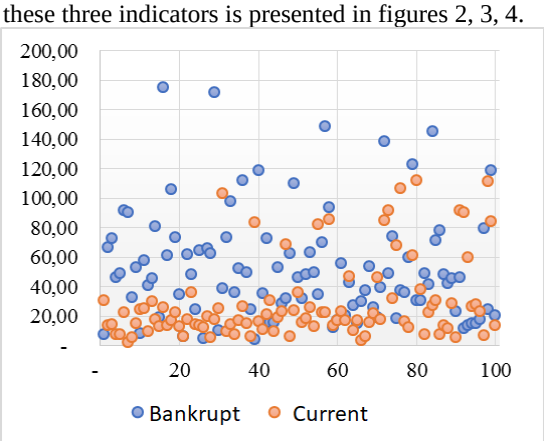

Figure 2 Distribution of the studied sample (200 trading companies) by the factor of variation of asset turnover

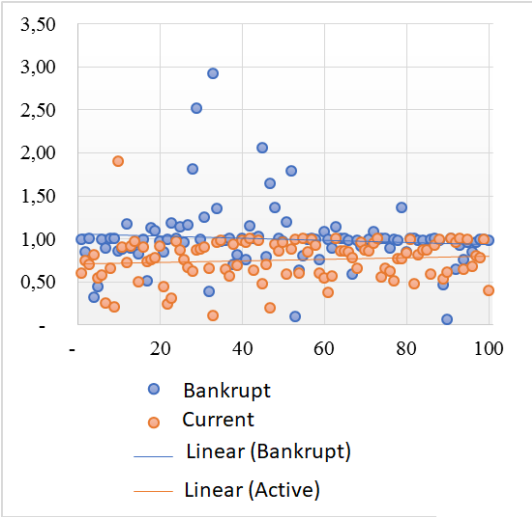

Figure 3 Distribution of the studied sample (200 trading companies) by the indicator of ratio of borrowed capital to liabilities

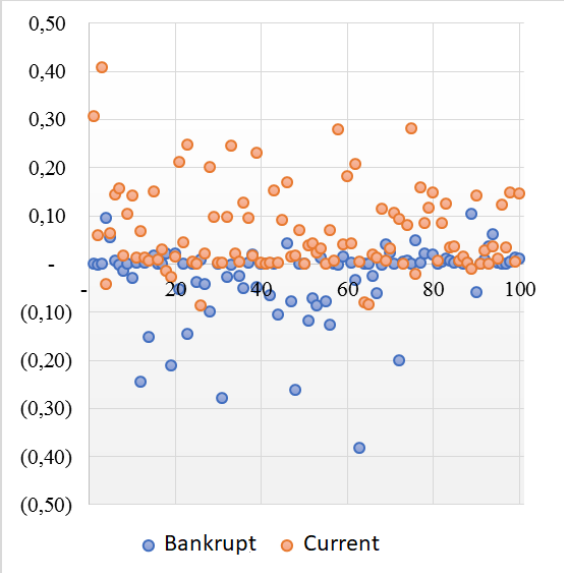

Figure 4 Distribution of the studied sample (200 trading companies) by the indicator of return on assets

In the model, proposed by the authors, the weight (empirical) ratios were determined by the matrix method through a search for combinations of parameters with maximum total accuracy. As a result, the regression equation took the following form:

$$V = K_1 + 0{,}8 * K_2 - 8{,}2 * K_3 \qquad (1)$$

Where:
V – net score;
K_1 - factor of variation of the asset turnover of the company;
K_2 - the share of borrowed capital in the liabilities of the company;
K_3 – return on assets of the company.

Below are the formulas for calculating the specified indicators.
The factor of variation of the asset turnover of the company is calculated by the formula:

$$K_1 = \frac{\sigma}{\overline{OA}} = \frac{\sqrt{D}}{\overline{OA}} = \frac{\sqrt{\frac{\sum_{i=1}^{n}(OA_i - \overline{OA})^2}{n}}}{\overline{OA}} \quad (2)$$

Where:
σ – quadratic mean deviation of asset turnover;
D – dispersion of asset turnover;
n – the number of observation periods (the authors recommend to use at least three periods);
$\overline{OA}$ - the average value of the factor of asset turnover for n observation periods, calculated by the formula:

$$\overline{OA} = \frac{\sum_{i=1}^{n} OA_i}{n} \quad (3)$$

OA_i – factor of asset turnover in the *i*-th period, calculated by the formula:

$$OA_i = \frac{B_i}{\overline{A_i}} \quad (4)$$

Where B_i is the company's proceeds in the *i*-th period;
$\overline{A_i}$ - the average annual value of the company's assets in the *i*-th period.
The share of borrowed capital in the liabilities of the company is calculated by the formula:

$$K_2 = \frac{ЗК}{П} \quad (5)$$

Where ЗК - the borrowed capital of the company;
П - liabilities of the company.
In the case of a negative value of the company's own capital, this indicator may take values greater than 1.
The return on assets of the company is calculated by the formula:

$$K_3 = \frac{ЧП}{\overline{A}} \quad (6)$$

Where ЧП - net profit of the company;
$\overline{A}$ - the average annual value of the company's assets.
In the case of losses, the return on assets indicator takes negative values.
As the variation of asset turnover and the share of borrowed capital in liabilities increases, as well as the profitability of assets decreases (the model assumes the presence of negative profitability for bankrupts), the value of the net *V*-score tends to the maximum. The higher the value of the net *V*-score, the higher the risk of bankruptcy of the studied company.
The empirical method (optimal cut-off) set the threshold value for the net *V*-score of 0.94, below which there is a relatively risk-free zone, above there is a risk zone. With this value, the accuracy of the bankruptcy risk assessment of the studied sample of Russian trading companies was 79.5%. The distribution of the sample for the net *V*-score is shown in figure 5.

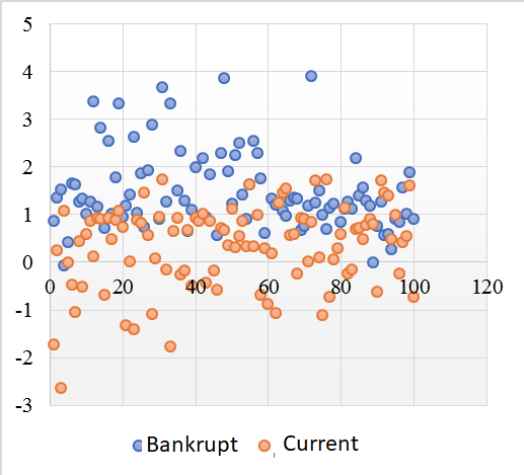

Figure 5 Distribution of the studied sample (200 trading companies) by the net V-score

4. DISCUSSING THE RESULTS.

The model of predicting bankruptcy in the field of its application is focused, first of all, on trading companies. This is due to the sample on the basis of which the model is built. However, the authors do not exclude the potential of its universal application in enterprises of other industries, which causes the objective need for further testing. The results of this testing will be reflected in subsequent authors' works.
A feature of the proposed model is also, that the objects of its application are only organizations of medium and large businesses.
In addition to the limited field of application, the disadvantages of the author's model include the difficulty of using it for express analysis of the financial condition of the studied companies due to the presence of a factor of variation of asset turnover. On the one hand, this indicator is quite informative and objectively reflects the level of stability of the company, however, for its calculation it will be necessary to use the data of financial statements for at least three annual periods. This fact also makes it impossible to use the author's model of predicting bankruptcy for newly created companies.

5. CONCLUSION

The methodological support, created as a result of the author's study, can be applied not only by financial services and management of trading companies for the purpose of timely financial diagnostics and bankruptcy risk assessment, but also by potential investors, credit organizations, auditors, crisis managers for a complex assessment of the financial condition of the studied companies.
According to the authors, the proposed model of predicting bankruptcy is characterized by a number of advantages of

its application in modern conditions of the digital economy:

- the object orientation of the model to trading companies as the fastest growing and riskiest segment of digital business;
- the presence in the model of a factor of variation of asset turnover, which allows to assess the economic stability of the company. In the conditions of the high rate of change of factors of the external business environment, that is characteristic of the digital economy, economic stability plays no less decisive role in the financial condition of companies, than financial independence and profitability.

In addition, the problem of the limited use of the author's model for express analysis of the financial condition of the studied companies can be easily solved by using modern digital technologies of automation of financial business processes (RPA, digital labor, intelligent automation) [10]. Listed advantages allow to conclude, that the proposed model of predicting bankruptcy is appropriate for modern economic realities.

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