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Analytical tools for forecasting financial insolvency and potential bankruptcy of a company

SVETLANA ALEXANDROVNA CHERNYAVSKAYA[1]*, ULIANA YURYEVNA ROSHCHEKTAEVA[2], VALENTINA VYACHESLAVOVNA AKASHEVA[3], MALIKA IBRAGIMOVNA KITIEVA[4], FATIMA NIKOLAEVNA DZODZIEVA[5]

[1]Doctor of Economic Sciences, Department of Accounting Theory, Federal State Budgetary Educational Institution of Higher Education "Kuban State Agrarian University named after I.T. Trubilin", 350044, Russia, Krasnodar, st. Kalinina, 13, docsveta17@gmail.com
ORCID iD: 0000-0002-9677-4072
[2]Candidate of Economic Sciences, Department of Economic Security, Federal State Budgetary Educational Institution of Higher Education "Kuban State Technological University", 350072, Krasnodar region, Krasnodar, st. Moskovskaya, 2, ul_rosh@mail.ru
ORCID iD: 0000-0001-5674-498X
[3]Candidate of Economic Sciences, Department of "Accounting, Analysis and Audit", Federal State Budgetary Educational Institution of Higher Education «National Research Ogarev Mordovia State University», h. N68, Bolshevik st., Saransk city, Republic of Mordovia, 430005, valakasheva@mail.ru
ORCID iD: 0000-0003-3635-7629
[4]Candidate of Economic Sciences, Department of Economics, Ingush State University, h. N 7, I. Zyazikov Avenue, Magas city, The Republic of Ingushetia, 386001, malika2015@mail.ru
ORCID iD: 0000-0002-5518-5431
[5]Candidate of Economic Sciences, Department of Economic Theory and Applied Economics, Gorsky state agrarian university, h. N 37, Kirov Street, Vladikavkaz city, The Republic of North Ossetia-Alania, 362040, makxim_2009@mail.ru
ORCID iD: 0000-0002-0367-0064

Abstract: The activity of any company is a complex and multifaceted process. The company interacts with actors at different levels, from suppliers to the state, while throughout the entire operation of the organization, both external and internal ever-changing conditions affect its activity. Such an ever-changing environment puts companies at risk of an economically unstable state. Bankruptcy of a company is a crisis state that requires special methods of financial management to overcome it. It is very important to assess the state of the organization, take measures to restore solvency, and determine the probability of bankruptcy. Assessment and analysis of the probability of bankruptcy provides a general assessment of the financial stability of the company, its solvency, and a forecast for the future. The relevance of the research is due to a number of reasons: - in the modern Russian economy, the key problem is the crisis of non-payments; - in the context of the growing insolvency of Russian business entities, measures to prevent crisis situations, as well as measures aimed at restoring the solvency of the organization and stabilizing the financial condition, are of particular importance.
All this, in our opinion, indicates the relevance of this study, the practical significance of the results obtained.

Keywords: bankruptcy probability assessment, accounting (financial) statements, Beaver's model, Altman's model, Springate's model.

INTRODUCTION

In tough economic environment, the financial analysis of the company's activities is an integral stage of management. The functioning of a company in modern conditions implies the improvement of management processes. One of the most important tasks of a modern comapny is the search and development of financial strategies, coordination of management processes [1].

The stable position of Russian companies is the subject of thorough scientific study and continuous research. The stable existence of the company is achieved by analyzing the current financial condition and checking for possible bankruptcy in the future [2].

The main reasons for the deterioration in the financial state of the company are:

– economic (changes in market prices, market collapse);
– informational (loss of confidential information and data of the client base, manipulation of computer information);
– physical (loss, destruction or damage to fixed assets);
– human resources (outflow of key specialists, lack of qualified labor force in the labor market);
– reputation (theft of intellectual property, spreading false rumors about the company);
– natural disasters (floods, earthquakes, fires, man-made disasters).
Let us consider the application of Russian and foreign models for assessing the probability of bankruptcy on the example of accounting (financial) statements of a notional production company.

METHODS AND RESULTS

The theoretical and methodological basis of the study was the domestic and foreign scientific works in economics on economic analysis, financial analysis, and management.
To achieve the goal and solve the problems posed in the process of writing the work, the following methods were used: monographic, economic-statistical, abstract-logical, etc.
Table 1 shows data of the acconting statements for assessing the probability of bankruptcy.

Table 1: Data of the accounting statements, thousand rubles

Item	31.12.2020	31.12.2019	31.12.2018
Intangible assets	32,673	32,706	32,706
Intangible development assets	1,253	47	-
Fixed assets	1,400,100	1,264,947	1,116,121
Income-bearing investments in tangible assets	20,516	15,636	11,562
Deferred tax assets	16,302	6,200	6,036
Other non-current assets	1,494	1,849	2,330
Stocks	470,862	415,246	408,179
VAT on acquired assets	2 590	864	2,403
Receivables	97 502	148,166	585,228
Cash and cash equivalents	15,933	4,842	15,665
Other current assets	10,801	8,170	7,769
Authorized capital (reserve capital, legal capital, contributions of partners)	43,200	43,200	43,200
Retained earnings (accumulated losses)	1,421,648	1,342,988	1,857,681
Borrowed funds	250,000	250,000	-
Deferred tax liabilities	82,861	45,482	45,798
Borrowed funds	63	-	-
Payables	247,378	190,274	216,075
Deferred income	-	-	1
Provisions	24,876	26,729	25,244
BALANCE	2,070,026	1,898,673	2,187,999

Table 2 shows the main indicators of the results of financial statements.

Table 2: Results of financial statements, thousand rubles

Item	2020	2019	2018
Revenue	2,079,896	2,018,452	1,905,123
Cost of sales	(1,562,976)	(1,310,142)	(1,205,729)

Profit (loss) on sales	155,203	388,271	397,635
Profit (loss) before taxation	101,976	310,190	361,985
Net profit (loss)	78,660	235,259	286,093

To predict and assess the risk of bankruptcy, we will use Russian financial models related to different classification groups of bankruptcy forecasting methods (Table 3).

Table 3: Russian models for forecasting the financial insolvency of a company

Model	Forecasting technique
Model by R.S. Saifulin and G.G. Kadykov [3]	Rating model
Model No.3 by A.V. Kolyshkin [4]	Rating model
Model by M.V. Evstropov [5]	Logit model
Model by A.E. Deshko	Integrated method
ISEA model [6]	Multiplicative discriminant analysis

To assess the probability of bankruptcy of a company, we use the five-factor discriminant model by R.S. Saifulin and G.G. Kadykov (Table 4). If the final indicator (R) is less than 1, then the probability of bankruptcy of the company is high, and otherwise [7].

Table 4: Assessment of the probability of bankruptcy according to the model by R.S. Saifulin and G.G. Kadykov

Coefficient	Numerator	Denominator	2018	2019	2020
K_1	Working capital	Current assets	0.72	0.11	-0.01
K_2	Current assets	Short-term liabilities	4.2	2.7	2.2
K_3	Sales revenue	Balance currency	0.89	0.99	1.05
K_4	Sales profit	Sales revenue	0.15	0.12	0.04
K_5	Net profit	Equity	0.15	0.17	0.05
R	$2\ X_1 + 0{,}1\ X_2 + 0.08X_3 + 0.45\ X_4 + X_5$		2.15	0.79	0.35

2020 shows are a high probability of bankruptcy.
Let us make an assessment based on the forecasting model by A.V. Kolyshkin (Table 5).

Table 5: Assessment of the probability of bankruptcy according to the model by A.V. Kolyshkin

Coefficient	Numerator	Denominator	2018	2019	2020
K_1	Working capital	Balance currency	0.3555	0.1898	0.1572
K_2	Net profit (loss)	Equity	0.1505	0.1239	0.0380
K_3	Net cash flow	Short-term liabilities	0.0568	-0.0500	0.0408
K_4	Current assets	Short-term liabilities	4.2236	2.6603	2.1948
K_5	Net profit (loss)	Balance currency	0.1308	0.1239	0.0380
K_6	Net profit (loss)	Net revenue	0.7195	0.6059	0.5068
Model 1	$Z = 0.47*K_1 + 0.14*K_2 + 0.39*K_3$		0.21	0.09	0.10
Model 2	$Z = 0.61*K_4 + 0.39*K_5$		2.63	1.67	1.35
Model 3	$Z = 0.12*K_2 + 0.19*K_3 + 0.49*K_4 + 0.19*K_6$		2.24	1.41	1.18

According to this model, the probability of bankruptcy is low.
Let us use the model by M.V. Evstropov to assess the probability of bankruptcy (Table 6). If Y>0.5, then the probability of bankruptcy is very high.

Table 6: Assessment of the probability of bankruptcy according to the model by M.V. Evstropov

Coefficient	Numerator	Denominator	2018	2019	2020
R_1	Profits before taxes	Total assets	0.07	0.03	0.06
R_2	Revenue in the reporting period	Revenue in the past period	-0.04	0.06	3.04
R_3	cash + short-term financial investments	Short-term liabilities	0.06	0.02	0.06
Y	$Y = 0.25 – 14.64 * R_1 – 1.08 * R_2 – 130.08 * R_3$		-8.54	-2.86	-11.72

The results show a low probability of bankruptcy.
Let us use the ISEA model to assess the probability of bankruptcy (Table 7).

Table 7: Assessment of the probability of bankruptcy according to the ISEA model

Coefficient	Numerator	Denominator	2018	2019	2020
K_1	Working capital	Balance currency	0.36	0.19	0.16
K_2	Net profit	Equity	0.15	0.17	0.05
K_3	Sales revenue	Balance currency	0.87	1.06	1.00
K_4	Net profit	Cost of sales	0.24	0.18	0.05
R	$8.38X_1 + X_2 + 0.054X_3 + 0.63 X_4$		3.36	1.93	1.45

The probability of bankruptcy in the analyzed period is less than 10%.
The models presented above have been adapted to the Russian economy. However, the considered models neglect the specifics of the company, and therefore provide ambiguous forecast result. For a more accurate forecast, we will analyze the selected company based on foreign models.
We will use foreign financial models related to different classification groups of bankruptcy forecasting methods (Table 8).

Table 8: Western models for forecasting the financial insolvency of a company

Model	Forecasting technique
Beaver's model [8]	Financial ratio analysis
Argenti's model [9]	Integrated method
E. Altman's model [10]	Multiplicative discriminant analysis
G. Springate's model [11]	Multiplicative discriminant analysis

Let us make an assessment based on the W. Beaver's model:
– 2018 – 9.8;
– 2019 – 1.4;
– 2020 – 0.8;
The probability of bankruptcy is low because $K_Б > 0,4$.
The next model for determining the risk of bankruptcy will be E. Altman's five-factor model for companies not listed on the stock exchange (Table 9).

Table 9: Assessment of the probability of bankruptcy according to the E. Altman's five-factor model

Coefficient	Numerator	Denominator	2018	2019	2020
X_1	Working capital	Balance currency	0.36	0.19	0.16
X_2	Retained profit	Balance currency	0.85	0.71	0.69
X_3	Sales profit	Balance currency	0.17	0.16	0.05
X_4	Equity	Borrowed capital	6.62	2.70	2.42
X_5	Revenue	Balance currency	0.87	1.06	1.0

Z	$0.717X_1 + 0.847\ X_2 + 3.1X_3 + 0.42\ X_4 + 0.995\ X_5$	5.14	3.42	2.85

In 2018 and 2019, the company is financially stable, while 2020 shows a situation of uncertainty.
The next model for assessing the probability of bankruptcy will be the Gordon Springate's model (Table 10).

Table 10: Assessment of the probability of bankruptcy according to the g. Springate's model

Coefficient	Numerator	Denominator	2018	2019	2020
K_1	Working capital	Total assets	0.36	0.19	0.16
K_2	Profit before interest and tax	Total assets	0.17	0.16	0.05
K_3	Profit before tax	Short-term liabilities	1.50	1.43	0.37
K_4	Revenue	Total assets	0.87	1.06	1.0
Z	1.03X1 + 3.07X2 + 0.66X3 + 0.4X4		2.23	2.05	0.96

The analyzed period shows a low probability of bankruptcy.
Thus, we have considered foreign and domestic methods, which showed that the simplest to use is coefficient analysis - W. Beaver's model. The main disadvantage of this method is:
- the use of coefficient analysis exclusively;
- lack of objectivity for the Russian economy (as the critical values were derived for American companies in the last century) [12].

The next one, the easiest to use, is E. Altman's two-factor model, which is related to the discriminant model. Its disadvantage is the consideration of only two indicators, which in the context of the multifaceted nature of modern business in a market economy is not entirely correct. This model gives a very imprecise result.
More accurate are multivariate models using multiplicative discriminant analysis, which has a comprehensive effect on the financial state of the company.
The considered models by E. Altman, G. Springate, A.V. Kolyshkin and the ISEA model showed a low probability of bankruptcy. The exception is the model by R.S. Saifulin and G.G. Kadykov (in 2020 - high probability).
The use of models based on the multiplicative discriminant method showed that the organization falls into the so-called "zone of uncertainty", while it is impossible to say whether the organization will be bankrupt or not.
The use of integrated and Logit models in Russian practice has not been widely used, which is due to high labor costs and subjective assessment by the analyst [13].
In general, any of the considered models can be used to diagnose the probability of bankruptcy. Due to the volatility of the economic situation, external and internal risks, it is a prerequisite that all models should be periodically reviewed and tested for accuracy.

SUMMARY AND SUGGESTIONS

To assess the risk of bankruptcy, we need to conduct monthly analysis using the domestic logit model by G.A. Khaidarshin [14] and the predictive integrated model by A.E Deshko. These two models most accurately show the problem areas in the company.
For example, A.E Deshko's model helps analyze the internal qualitative indicators of the organization that affect its solvency (Table 11) [15].

Table 11: Monitoring of company's activities

Coefficient	Score
Order planning – time factor	2
Information support	1
Technical support	3
Personnel	1
Holding of capital	0
State of fixed assets	1
Products/services	2
Marketing	2
Innovation management	0
Economic cyclicity	0
Expert support	0
Corporate form	5

Correspondence of the corporate form to the conditions of the region	5
Production chain	4
Foreign economic factor	5
Foreign policy factor	0
Diplomatic factor	0
Ecology	3
Reputation	0
Investments	1
Financial monitoring	1
Total score	36

The evaluation criterion for this model is the total number score. If it ranges from 5 to 18 out of 100 possible, the company is considered successful. If the total score is more than 25, then the company is likely to go bankrupt within the next 5 years. The total score in companies on the brink of bancruptcy ranges from 34 to 70 points. The analysis of the studied organization showed that the total score is 36, thus the company is on the verge of a crisis. The use of A.E. Deshko's model will reveal the internal imbalance and allow the management personnel to timely adjust the strategy for the near future. The disadvantage of the model may be the bias of the internal auditor based on personal experience and qualifications.

Based on the analysis, in order to increase the efficiency of the company's capital, the following measures can be recommended:

– to normalize working capital by planning the minimum need for working capital for all the constituent elements necessary for the company's normal, uninterrupted operation. To compare the planned indicators with the actual ones on a monthly basis, carry out a factor analysis of deviations (if any);

– improve settlement and payment discipline to reduce the risk of non-payment.

Conflicts of interest

The authors have no conflicts of interest to declare.

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