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Methodical Approach to Bankruptcy Prediction Model Development

Enfoque metódico para el desarrollo del modelo de predicción de quiebras

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### Abstract

The issue of declaring an organization bankrupt also applies to other interesting subjects; for example, the liquidation of an enterprise created by the founders means the loss of property contributed as a contribution to the authorized capital. There is a likelihood of a crisis in any organization, which is determined by objective factors such as the fluctuations in market conditions, periodic modernization of technology, the changes in the organization of production, the change of personnel or external conditions, and often political circumstances. Bankruptcy is a critical variant of crisis phenomena at an enterprise. Of course, bankruptcy is an important element of the market system structure, and its purpose is to protect social-economic processes from the results of ineffective activities of their members and the failure to fulfill their obligations. The primary purpose of the study is to analyze the methodical approach to bankruptcy prediction model development. To fulfill the purpose of the research, analysis, synthesis, comparison, assessment, generalization method, and system analysis are utilized. Based on the results of the current study, it can be concluded that foreign authors include the indicators calculated using the data on financial results (the report on financial results) as the most significant indicators, while Russian authors are more focused on the use of the enterprise property status (balance sheet).

**Keywords:** bankruptcy; bankruptcy analysis; bankruptcy analysis methods; bankruptcy prediction.

### Resumen

El tema de declarar en quiebra a una organización también se aplica a otros temas interesantes; por ejemplo, la liquidación de una empresa creada por los fundadores significa la pérdida de la propiedad aportada como contribución al capital autorizado. Existe la posibilidad de una crisis en cualquier organización, que está determinada por factores objetivos como las fluctuaciones en las condiciones del mercado, la modernización periódica de la tecnología, los cambios en la organización de la producción, el cambio de personal o condiciones externas y, a menudo, circunstancias políticas. La quiebra es una variante crítica de los fenómenos de crisis en una empresa. Por supuesto, la quiebra es un elemento importante de la estructura del sistema de mercado, y su propósito es proteger los procesos socioeconómicos de los resultados de las actividades ineficaces de sus miembros y el incumplimiento de sus obligaciones. El objetivo principal del estudio es analizar el enfoque metódico para el desarrollo del modelo de predicción de quiebras. Para cumplir con el propósito de la investigación, se utilizan análisis, síntesis, comparación, evaluación, método de generalización y análisis del sistema. Con base en los resultados del estudio actual, se puede concluir que los autores extranjeros incluyen los indicadores calculados utilizando los datos de resultados financieros (el informe de resultados financieros) como los indicadores más significativos, mientras que los autores rusos están más enfocados en el uso del estado de propiedad empresarial (balance).

**Palabras claves:** quiebra; análisis de quiebras; métodos de análisis de quiebras; predicción de quiebra.

## Introduction

The shareholders who bought the shares of the enterprise in order to make a profit will not receive income and lose invested funds (Ustinovich, 2019). The suppliers lose one of the consumers of their products, and the customers lose the supplier of goods and services, which leads to the disruption of the normal functioning of these counterparties (Gerasimenko, 2020).

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The enterprise itself is interested, but also its counterparties, as well as the state to obtain an objective picture of an enterprise's financial and economic condition and the degree of its stability (Kamenkov, 2018). This is especially important for maintaining a favorable state of individual industries and the country's economy. For an objective assessment of an enterprise, the analysis and forecasting of its bankruptcy probability are used. After analyzing the financial and economic activities of an enterprise, it becomes possible to predict the likelihood of bankruptcy, to clarify the economic "illness" of the debtor, which, in turn, provides the management with the opportunity to develop and implement timely a number of anti-crisis measures to prevent the liquidation of the enterprise (Konvisarova et al., 2020).

Of course, bankruptcy is an important element of the market system structure, and its purpose is to protect social-economic processes from the results of ineffective activities of their members and the failure to fulfill their obligations. As a result of bankruptcy, insolvent enterprises are removed from the market economy; that is, resources are redistributed from inefficient owners to those who work most efficiently, which means that bankruptcy is one of the ways to improve the country's economy (Gerasimenko, 2020). Also, bankruptcy ensures the safety and growth of the asset use efficiency by an enterprise experiencing financial difficulties, protecting the interests of creditors, and meeting their claims against the debtor. By implementing the latter function, bankruptcy contributes to lower prices and thus increases the availability of credit, which provides a favorable climate for the development of entrepreneurship (Ushanova, 2017).

## Methodology

During the writing of the work, several scientific methods were used, including non-formalized ones. The main ones include analysis, synthesis, comparison, assessment, generalization method, and system analysis.

## Result and Discussion

The terms “insolvency” and “bankruptcy” are synonymous in the legislative framework. However, it should be noted that the main sign of an enterprise bankruptcy is its insolvency, which is expressed in the inability of an enterprise to pay off its obligations timely and fully (Silchenko, 2017; Ustinovich, 2019).

We believe that the concepts of “insolvency” and “bankruptcy” must be distinguished. Insolvency should be determined through certain results of an enterprise financial activity, that is, according to its financial indicators, while bankruptcy - through the presence of certain legal facts, namely through the decision of the arbitration court, thereby:

- Insolvency should be understood as a certain stage of an enterprise crisis, associated with a complete loss of solvency, liquidity, and financial stability;
- Bankruptcy should be understood as the inability of a debtor to satisfy the creditors' claims fully recognized by the arbitration court (Kamenkov, 2018).

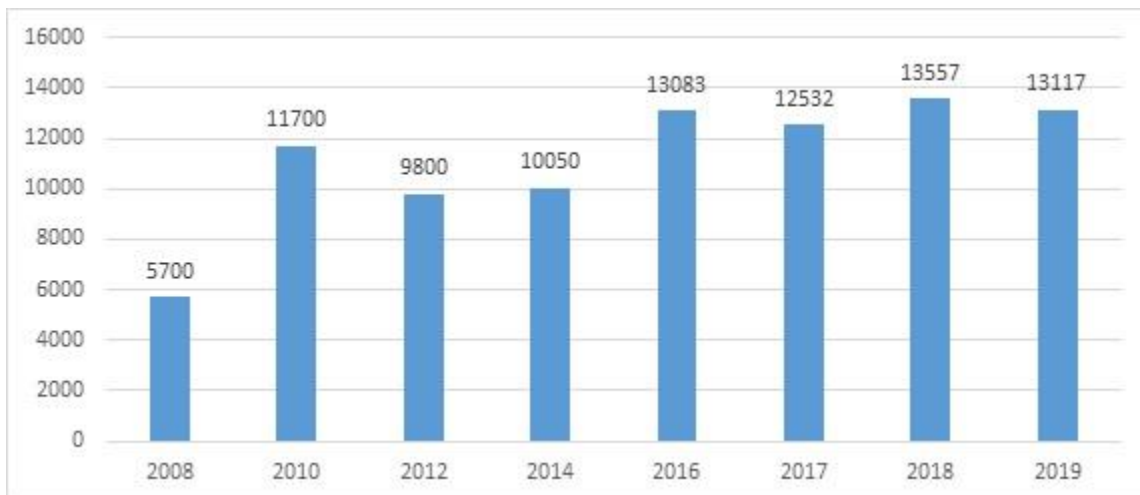
In modern economic conditions, the threat of bankruptcy for organizations is quite common. Historically formed features - the lack of an effective strategy for the development of the economy within the framework of a market economy, inflated prices for energy resources, transport, and rent, low rates of innovation, loss of economic ties with the former Soviet republics, strong competition from foreign counterparts - directly or indirectly affect the institution bankruptcy in Russia.

Scientists around the world identify the most likely causes of bankruptcy from their point of view. For example, G. Burleigh names low sales and competition (Berle, 1989). E. Torkanovsky (2000) identified four main areas that can serve as the sources of the

economic situation deterioration in an organization: the organization strategy, resources, principles of activity, quality, and level of marketing. Also, the most common is the classification by M.D. Ames, which is presented below (Ames & Wellsfry, 1983):

- Insufficient capital;
- Disadvantageous location of business;
- Lack of experience;
- Ineffective working capital management;
- Non-optimal credit policy;
- Overinvestment of fixed assets;
- Unjustified use of company funds for personal needs;

The dynamics of the number of bankruptcies among legal entities in Russia for the period from 2008 to 2019 is shown by Figure 1.



**Figure 1.** The actual number of bankruptcies in the Russian economy

Such industries as construction, trade, and real estate are the most affected by bankruptcy. The number of bankruptcies decreased in all three industries during 2019: by 3.4% in trade, up to 3,701 companies, by 3.5% in construction, up to 2,670, by 4.1% in real estate transactions, up to 1 405. The recognition of enterprises as bankrupt occurred as the result of these enterprises' unprofitability and inefficiency. This situation has developed due to the belated response (decision-making) of enterprise managers

to changes in the external business environment. Therefore, keeping production “afloat”, maintaining fixed assets and key technologies, and labor resources, stabilizing the situation in business at least at the pre-crisis level (Konvisarova et al., 2020) has become a global task.

Bankruptcy forecasting is a complex tool for predetermining the bankruptcy of an enterprise; in Russian and world economics, bankruptcy assessment models are often used, which combine the assessment of various factors and methods. The feasibility and effectiveness of bankruptcy forecasting models depend not only on the actual performance of an enterprise, but also on the specifics of the country economic development, on the pace and volume of legislation development, on the political situation in the country and the world. The classical models developed in the 90ies of the 20th century and much earlier have become widespread, which casts doubt on their effectiveness in the modern conditions of the economy (Vasilenko & Titova, 2019).

The financial condition is characterized by a whole system of indicators reflecting the ability of a business entity to finance its activities and timely pay off obligations at a certain point in time. Assessing and analyzing an enterprise’s financial condition, the enterprise’s financial and economic services can predict the development of the enterprise in the future and improve its position (Savinkova, 2017).

In general, the methods for analyzing the financial activities of the enterprise are presented in Table 1.

**Table 1.** Methods for analyzing the financial activities of an organization

Indicator	Analysis trend
1. Preliminary overview of the economic and financial situation of an organization	1.1. Description of the general focus of financial activities; 1.2. Identification of “sick” reporting items.
2. Assessment and analysis of the organization economic potential	2.1. Property assessment. 2.1.1. Analytical net balance development 2.1.2. Horizontal balance analysis

	2.1.3. Vertical balance analysis 2.1.4. The analysis of qualitative shifts in property status 2.2. Financial assessment 2.2.1. Estimation of liquidity 2.2.2. Financial stability assessment 2.2.3. Business activity assessment
3. Assessment and analysis of the organization financial performance	3.1. Assessment of production activities 3.2. Profitability analysis
4. Assessment of bankruptcy likelihood	4.1 Diagnosis and prediction of bankruptcy
5. Development of trends for the financial recovery of the organization	Development of an anti-crisis strategy

Anti-crisis management is not sufficiently developed in Russia: there are few of those who own fine financial and economic technologies for business recovery. Market mechanisms for obtaining additional financing are not always available for medium and small businesses, and the high rate of debt depreciation does not allow long waiting for their return; the procedure becomes unprofitable for creditors (Miroshnikova & Taskaeva, 2018; Terentyeva et al., 2019).

Despite the emergence of new methods and models for bankruptcy prediction, at present, multiple discriminant analysis is most popular in the domestic theory and practice of anti-crisis management, which necessitated a more detailed study of its well-known representatives in order to identify the weights (factors) to which the authors of a particular methodology give the greatest value (weight).

Comparative characteristics of the most priority weight coefficients in bankruptcy forecasting models by foreign and Russian authors are presented in Table 2.

**Table 2.** Comparative characteristics of the most priority weight coefficients in bankruptcy forecasting models by foreign and Russian authors

Factor	Beaver	Taffler	Lis	ISEA	Zaitseva
Profitability of core business			0.092		
The ratio of the sales profit to short-term liabilities	0.40	0.53			
Coefficient of security by own funds					
Net loss to equity ratio					0.25
Share of current assets in property				8.38	
Net loss to sales ratio					0.25

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Source: author's development

Table 2 shows that according to the Lis model, preference is given to such an indicator as the profitability of the main activity. According to the models by Beaver and Taffler, the most significant indicator is the ratio of the sales profit to short-term liabilities (profitability of short-term liabilities). According to the ISEA model, the greatest weight is assigned to the share of circulating assets in property. Zaitseva's model considers the ratio of net loss to equity and net loss ratio to sales to be equally significant.

The least significant indicators in the models of the abovementioned scholars are summarized in Table 3.

**Table 3.** Comparative characteristics of the least priority weighting factors for bankruptcy forecasting models by foreign and Russian scholars

Factor	Beaver	Taffler	Lis	ISEA	Zaitseva
Liabilities to Assets Ratio	0.37				
Equity to Liabilities Ratio			0.0014		
Revenue to balance sheet ratio				0.054	
The ratio of current assets to the amount of liabilities		0.13			
The ratio of accounts payable and receivable					0.1
Debt to equity ratio					0.1
Balance sheet currency to revenue ratio					0.1

Source: author's development



Table 3 shows that the least weight in the Beaver model belongs to the share of liabilities to assets and in the Fox model - to the share of equity in liabilities. Taffler assigned the lowest rating to the ratio of current assets to the number of liabilities. In the ISEA model, the ratio of revenue to balance sheet total is estimated as the lowest one. In Zaitseva's model, three indicators have the least weight: the ratio of accounts payable and receivable, the ratio of borrowed capital to equity, and the balance sheet currency ratio to revenue.

Having analyzed the possibilities of foreign discriminant function application to assess the financial insolvency of Russian enterprises, we note that, despite a number of advantages of these models, confirmed experimentally, when using them in national analytical practice, it is necessary to take into account the differences in the factors of the external economic environment that generate the threat of bankruptcy of business entities in Russia (Terentyeva et al., 2018; Vasilenko & Titova, 2019): instability and ignorance of the sectoral features of domestic enterprises and organization activities, bias in accounting information on the value of assets and liabilities and the differences in accounting and calculation of individual indicators. Thus, it is safe to say that Western models for diagnosing bankruptcy at Russian enterprises do not provide sufficiently objective forecasts.

To eliminate the listed disadvantages, adjusting the weighting parameters of the indicators used in the above discriminant functions is necessary. Speaking about the need to adapt foreign models to the specifics of the domestic practice of forecasting insolvency, it is also worth mentioning the main problems that arise in this case:

- Lack of comprehensive information about the empirical database used to calculate the weighting parameters of the model coefficients;
- Lack of information about the database used to calculate the criteria evaluating the obtained values of the integral indicator;
- The lack of extensive statistics on the bankruptcies of national enterprises, which denied or confirmed the reliability of a particular discriminant function;

- Low reliability of information is reflected in the reporting of enterprises, also due to various methodological approaches to accounting and reporting.

An assumption was made about the creation of an author's model based on these indicators. To do this, a corresponding weight is assigned to each of the indicators, based on the considerations about the importance of its values to analyze the bankruptcy threat. The overall score of the proposed four-factor model was defined as - 1. The results of the gradation of indicators are presented in Table 4.

**Table 4.** Gradation of indicators according to the degree of importance of their values for predicting the bankruptcy of an enterprise

Symbol	Indicator	Specific weight
K1	General ratio of financial independence	0.40
K2	General solvency (liquidity) ratio	0.30
K3	Financial stability ratio	0.20
K4	Return on assets	0.10

The model proposed in accordance with this gradation is the following:

$$Z = 0,4K1 + 0,3K2 + 0,2K3 + 0,1K4 \quad (1)$$

Thus, a conclusion is drawn based on the Z indicator:

- If the value  $Z \leq 0.8$ , then the probability of bankruptcy is maximum;
- If the value  $Z \geq 0.8$ , then the probability of bankruptcy is minimal.

It should be noted that it is impossible to be guided by these four indicators for a more objective assessment of an enterprise's financial condition. However, a comprehensive analysis of the financial condition of an enterprise is often not required in order to identify the signs of a threat of bankruptcy.

In most cases, a preliminary diagnosis of the financial condition of an enterprise can be given based on the results of the calculations of the financial independence general

coefficient, the coefficient of total solvency (liquidity), the coefficient of financial stability, and return on assets.

Let us analyze what value Z we will obtain when calculating the indicators for an energy enterprise while this enterprise is not officially declared bankrupt. At the same time, the analysis of the threat of bankruptcy according to Russian and foreign methods indicates the approaching insolvency of an enterprise (Table 5).

**Table 5.** Testing the mathematical forecasting model of an enterprise bankruptcy based on significant factors of the energy company financial condition

Indicator	2018	2019
General ratio of financial independence	0.67	0.67
General solvency (liquidity) ratio	0.45	0.71
Financial stability ratio	0.70	0.84
Return on assets	-7.44	2.26
Z1	0.54	0.87
Z2	-0.20	0.87

Table 5 shows that the overall financial independence ratio is 0.67 in 2017-2018, which is higher than the standard value of 0.5. Consequently, the energy company is financially independent of external sources of financing; that is, during the analyzed period, 67% of assets are covered by its own funds. The remaining 33% of assets are secured from external sources of financing. The total solvency (liquidity) ratio amounted to 0.45 in 2018 and increased to 0.71 by the end of 2019. However, it is below standard one and means that the company is insolvent since it is able to cover only 45% of its existing liabilities in 2018 with its own assets and 71% in 2019. The financial stability ratio in 2018 was 0.70 and increased to 0.84 at the end of 2019, which is higher than the standard value of 0.6 and indicates that 84% of the company financing sources can be used for a long time, and 16% of the company assets are financed from sustainable sources.

The question arises with the return on assets. In table 5, it is presented as the indicator with a negative sign. This is due to the fact that profit before tax is presented as a loss in the statement of financial results of the energy company for 2018. There is no

consensus in the economic literature on this situation - whether to take into account the zero value for this indicator or to calculate the profitability with a minus sign, but most often, it offers the possibility of analyzing the negative profitability. However, there is another point of view: the indicator of negative profitability is almost meaningless. The authors believe that profitability, which is close to zero, is already a bad indicator, indicating the weak efficiency of the enterprise, and if this indicator is less than zero, then it does not matter which figure it is - 2, 4, or 5. Therefore, the calculation was performed taking into account these two points of view. If we use “negative profitability” in the calculation, then Z takes a negative value; if we do not take into account the “negative profitability”, Z takes the values less than 1.

According to the proposed model, the probability of bankruptcy of the energy company in 2018 is high, and it is low in 2019.

Comparing the developed model with other techniques, a number of advantages can be noted:

- Based on up-to-date data;
- Ease of the value interpretation;
- Simplicity of calculations.
- The industry specificity of enterprise activities is taken into account;

At the same time, the model has a number of disadvantages:

- Small amount of statistical data;
- The possibility of the final coefficient to be beyond the standard;
- The organizational form of the company is not taken into account.

Thus, it can be concluded that further research is needed to improve the resulting model.

Since the obtained value of Z is in the interval from 0.8 and indicates a low probability of bankruptcy of the company in 2019, it follows that it is necessary to adopt an anti-crisis strategy for sustainable development, the purpose of which is not to fall into the zone of

the high probability of bankruptcy on the one hand and to strengthen their financial condition on the other, continuing to develop their activities.

## **Conclusion**

Based on the analysis results of the most and least priority indicators of bankruptcy models by foreign and Russian authors, it was found that foreign authors include the indicators calculated using the data on financial results (the report on financial results) as the most significant indicators, while Russian authors are more focused on the use of the enterprise property status (balance sheet). Most publications on the analysis of the threat of bankruptcy using Russian and foreign methods contain opinions about the inadequacy of these models to modern Russian conditions. The development of weight coefficients took place in other economic conditions. It should be noted that currently, there is no universal model that allows any stakeholder to predict the likelihood of an unfavorable financial situation with a high degree of reliability. Nevertheless, the variety of models allows each subject to choose a method that suits his capabilities and interests.

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## **References**

Ames, M. D., & Wellsfry, N. L. (1983). *Small Business Management*. St. Paul: West Publishing.

Berle, G. (1989). *The Do-It-Yourself Business Book*. New York: John Wiley & Sons.

Gerasimenko, Yu. A. (2020). Bankruptcy of enterprises. *Scientific Electronic Journal Meridian*, 9(43), 394-396.

Kamenkov, V. S. (2018). Bankruptcy begins with terms. *Bulletin of regulatory information. Legal world*, 2, 59-66.

Konvisarova, E. V., & Levchenko, T. A., & Pustovarov, A. A. (2020). Problems of Statistical Accounting in Russian Price Index Determination. *Reice-Revista Electronica De Investigacion En Ciencias Economicas*, 8(15), 272-285. doi: 10.5377/reice.v8i15.9958.

Lazareva, O. S., & Nelyubov, N. G. (2018). Bankruptcy of legal entities. Fictitious and deliberate bankruptcy. *Alley of Science*, 1, 6(22), 376-382.

Luneev, E. D. (2013). Bankruptcy of companies: causes and consequences. *Marketing and Sales Director*, 5.

Miroshnikova, T., & Taskaeva, N. (2018). Model for assessing the financial potential of the region. *International Scientific Conference on Business Technologies for Sustainable Urban Development (SPbWOSCE)*, 170, 1042. doi: 10.1051/mateconf/201817001042.

Savinkova, T. S. (2017). On the issue of organization bankruptcy prevention: legal and economic aspects. *Financial Bulletin*, 4(39), 52-60.

Silchenko, E. S. (2017). Legal aspects of legal entity bankruptcy. *Science. Society. State*, 5, 4(20), 140-145.

Terentyeva, T. V., & Konvisarova, E. V., & Levchenko, T. A., & Borovitskaya, M. V. (2018). Theoretical and methodical approaches for control introduction in the management system of industrial organization. *Amazonia Investiga*, 7(14), 50-60.

Terentyeva, T. V., & Vasilenko, M. V., & Titova, N. Y. (2019). Organizational and economic mechanism for sustainable development of Fishing Industry of the Primorsky territory: Cluster Approach. *Dilemas Contemporaneos-Educacion Politica Y Valores*, 6, 132.

Torkanovsky, E. (2000). Anti-crisis management. *Economy and law*, 1, 14–30.

Ushanova, A. M. (2017). Bankruptcy concept. Diagnostics of bankruptcy. *Competitiveness in the global world. Economics, Science, Technology*, 12(59), 109-111.

Ustinovich, E. S. (2019). Legal aspects of a legal entity bankruptcy. *Marketing and*

Sales Director, 2, 69-75.

Vasilenko, M., & Titova, N. (2019). Accounting policy the system of enterprise economic security. Amazonia Investiga, 8(22), 254-260. Retrieved from <https://amazoniainvestiga.info/index.php/amazonia/article/view/424>.