

# Modeling Forecasting the Financial Condition of Organizations

E P Peshkova<sup>1</sup>, S P Kyurdzhiev<sup>2</sup>, A A Mambetova<sup>3</sup>

<sup>1</sup>Russian Presidential Academy of National Economy and Public Administration (RANEPA), Rostov-on-Don 344002, Russia

<sup>2</sup>Russian Presidential Academy of National Economy and Public Administration (RANEPA), Rostov-on-Don 344002, Russia

<sup>3</sup>Rostov State University of Economics (RINH), Rostov-on-Don 344002, Russia

E-mail: fareastcon2019@mail.ru

**Abstract.** Subject of article is forecasting the financial condition of organizations. The work purpose is to improve existing and develop new methodological approaches to the analysis and forecasting of the financial condition of the enterprise. Study hypothesis is based on the assumption that the results of the analysis of the financial condition make it possible to formulate an appropriate financial policy and develop measures aimed at increasing the efficiency of use of financial resources of business entities, which involves use of economic and mathematical modeling, which is an experimental and applied methodology and allows the formation of an adequate forecast financial condition, as well as substantiate specific recommendations, ensuring the possibility of continuous operation of the enterprise in the future.

Methodological foundations of a systematic approach and economic and mathematical modeling are applied: groupings, abstractions and comparisons - to determine the financial indicators needed to build predictive models of financial condition; regression analysis - to improve the integrated indicator and build economic and mathematical forecasting models.

Proposed approaches and models for forecasting the financial condition can be used by financial analysts to develop strategic plans for the development of the enterprise and optimize the structure of financial resources.

## 1. Introduction

Successful functioning of the enterprise, as the main element of the financial system of Russia, is due to the effective management of its finances. One of the elements of financial management of the enterprise is the analysis and forecasting of the financial condition, which determine the ability of the organization to stable functioning and development in the face of changing external and internal business environment.

Currently, a number of studies in this area are controversial and controversial. In particular, the study of forecast estimates of the financial condition of Russian enterprises focuses only on forecasting the probability of bankruptcy and the balance sheet. Object and directions of forecasting the financial condition are not defined, there are no methodological approaches that determine the sequence of forecasting.

Thus, it is necessary to develop and implement economic and mathematical models for predicting the financial condition of metallurgical enterprises, in particular: logical-descriptive, factorial, trend,

regression and dynamic. Economic content of these models consists in determining the financial condition depending on the dynamics of the development of its subsystems (capital efficiency, liquidity and solvency, financial stability), which allows determining directions for improving the financial condition of the enterprise.

### *1.1. Scientific significance of the issue and problem statement*

Need to assess and predict the financial condition in modern conditions of the sanctions restrictions of Russian economy is caused by loss-making and insolvency of a significant number of enterprises, and unsatisfactory structure of their capital. Real financial condition of organizations is complicated by imperfect methodological approaches to its assessment. These problems are relevant for Russian enterprises, regardless of their organizational and legal forms and forms of ownership.

Forecasting the financial condition of the enterprise is a tool to eliminate the uncertainty that arises as a result of managerial decisions regarding the mobilization and allocation of financial resources; allows you to justify the feasibility of financing and increase the level of efficiency of enterprise asset management; enables the company to develop steadily in the future.

Thus, the solution of issues related to the improvement of existing and the development of new methodological approaches to the analysis and forecasting of the financial condition of the enterprise, is of particular importance.

Main goal of constructing a model for predicting the financial condition of enterprises is to determine their future position, depending on the influence of external and internal factors.

Definition of the forecast financial condition of an organization should be based on its integral assessment, since the latter is an effective mechanism for consolidating individual financial indicators characterizing various components of financial activity.

Basis for predicting the financial condition of the enterprise is proposed to put the method of integrated assessment developed by the authors [16; 17].

Development of adequate models for predicting the financial condition of an enterprise is possible if the following sequence of their construction is observed: Stage 1 - production, involves determining the purpose of modeling the financial condition of the organization and selecting, depending on this, variables (financial indicators); Stage 2 - specification of the model, provides for the determination of the type and type of forecasting model; Stage 3 - information, at which the necessary data is collected to calculate the financial indicators included in the model; 4 - the stage of model identification, provides for the determination and assessment of the quality of the model parameters and is based on formalized methods; Stage 5 - verification (verification) of the model. At this stage, the adequacy of the forecasting model of financial condition is checked [15].

## **2. Prediction of the financial condition of the organization based on the definition of the purpose of modeling with the selection of variables and based on the specification of the model**

Given the above sequence of constructing mathematical models, let us consider in more detail at least the first two directions of forecasting. The first direction involves the construction of a model where the main goal is to determine the predicted value of the integral indicator depending on the forecast values of financial ratios. Variables are financial indicators included in the integral assessment (Table. 1).

Logic of forecasting the financial condition of an enterprise according to this approach consists in a certain sequence of actions. First step involves predicting the level of indicators included in the integrated assessment. It is proposed to use the moving average method as a forecasting method for each indicator.

After determining the forecast values of financial indicators, this model provides for the calculation on their basis of an integrated indicator of financial condition. Based on the obtained value, a conclusion is drawn about the prospects for changing the financial condition of the enterprise under study.

**Table 1.** Financial indicators and their significance in the integrated assessment of the financial condition of the enterprise.

Weight	Indicator $\omega_i$	Standard value $a_i$
Capital Efficiency, Z		
	Return on current assets	8
	Return on sales	7
	Turnover ratio of tangible assets	5
	Accounts receivable turnover ratio	12
Solvency and liquidity, Y		
	Absolute liquidity ratio	14
	Current ratio	7
Financial Sustainability, X		
	Financial independence ratio	4

Since the approaches proposed by the authors to forecasting the financial condition were introduced into the practical activities of Turbostalkomplekt LLC, all examples of the application of the models will be given on the data of this enterprise. Practical use of the logical-descriptive model provides for the calculation of forecast values of financial indicators determined on the basis of data from previous periods, i.e. based on the financial statements of the company for 2014-2018 in Table 2.

**Table 2.** Initial and forecast indicators of financial condition of LLC Turbostalkomplekt.

Period	Return on current assets, V1	Return on sales, V2	Ratio of turnover of tangible assets, V3	Ratio of turnover of receivables, V4	Ratio of absolute liquidity, V5	Ratio of current liquidity, V6	Ratio of financial independence, V7
2014	0,23	0,14	8,67	3,81	0,00	0,65	0,48
2015	0,02	0,07	9,40	4,64	0,00	0,80	0,46
2016	0,04	0,07	11,22	5,56	0,00	0,89	0,42
2017	0,19	0,13	8,53	5,05	0,00	1,11	0,57
2018	0,21	0,16	7,36	7,21	0,00	1,29	0,56
forecast 1 year	0,14	0,12	9,04	5,25	0,00	0,95	0,50
forecast 2 year	0,12	0,11	9,11	5,54	0,00	1,01	0,50
forecast 3 year	0,14	0,12	9,05	5,72	0,00	1,05	0,51
forecast 4 year	0,16	0,13	8,62	5,75	0,00	1,08	0,53
forecast 5 year	0,15	0,13	8,63	5,90	0,00	1,07	0,52

Based on the calculated forecast values of financial indicators (Table 2), the forecast integral indicator of the financial condition of LLC Turbostalkomplekt is determined. For convenience, we integrate all the calculations in Table 3.

**Table 3.** Initial and forecast indicators of financial condition of LLC Turbostalkomplekt.

Indicator	$\omega_i$	$a_i$	1 forecast period		2 forecast period		3 forecast period		4 forecast period		5 forecast period	
			$z y x$	$s_i$	$z y x$	$s_i$	$z y x$	$s_i$	$z y x$	$s_i$	$z y x$	$s_i$
<b>Capital Efficiency, Z</b>												
Return on current assets	8	0,175	0,139	6,34	0,120	5,50	0,140	6,40	0,160	7,29	0,153	7,01
Return on sales	7	0,128	0,115	6,30	0,110	6,00	0,117	6,38	0,126	6,91	0,125	6,86
Turnover ratio of tangible assets	5	12,836	9,035	3,52	9,108	3,55	9,051	3,53	8,617	3,36	8,634	3,36
Accounts receivable turnover ratio	12	7,617	5,252	8,27	5,541	8,73	5,721	9,01	5,755	9,07	5,896	9,29
<b>Z</b>			<b>24,43</b>		<b>23,78</b>		<b>25,33</b>		<b>26,62</b>		<b>26,52</b>	
<b>Solvency and liquidity, Y</b>												
Absolute liquidity ratio	14	0,189	0,001	0,098	0,001	0,098	0,001	0,104	0,001	0,108	0,001	0,100
Current ratio	7	1,648	0,947	4,024	1,007	4,279	1,049	4,457	1,081	4,591	1,074	4,562
<b>Y</b>			<b>4,12</b>		<b>4,38</b>		<b>4,56</b>		<b>4,70</b>		<b>4,66</b>	
<b>Financial Sustainability, X</b>												
Financial independence ratio	4	0,639	0,497	3,108	0,500	3,133	0,509	3,185	0,527	3,296	0,518	3,240
<b>X</b>			<b>3,11</b>		<b>3,13</b>		<b>3,19</b>		<b>3,30</b>		<b>3,24</b>	
Integral indicator			31,66		31,29		33,07		34,62		34,42	
General characteristics of financial condition			satisfactory		satisfactory		satisfactory		satisfactory		satisfactory	

Based on the calculated integral indicator, the forecast characteristic of the financial condition of Turbostalkomplekt LLC (matrix of forecast types of financial condition) was determined.

The data obtained showed that while maintaining the development trend, Turbostalkomplekt LLC will have a satisfactory financial condition over the next forecast year, with a slight improvement in solvency. This is because over the study period, the dynamics of liquidity and solvency indicators had a very slight increase.

This fact allows us to establish a restriction regarding the use of the above approach to determine the prospective financial condition, since its use in medium-term forecasting can lead to erroneous conclusions.

That is why the logical-descriptive model can only be used in operational forecasting.

Thus, the main bottleneck of the model is the low level of adequacy, but the simplicity of its application allows us to make the so-called express forecast to obtain data on the future financial condition of the enterprise in the short term.

As already noted, the financial condition of the enterprise is a complex multifactorial phenomenon. Therefore, forecasting an integral indicator without taking into account factors that directly affect the financial indicators characterizing the marginal composition of the integrated assessment is ineffective, since it does not make it possible to show directions and the level of influence on system-forming factors to achieve certain results in the forecast period [20].

This necessitates the development of a forecasting model for an integrated indicator of financial condition based on factors that directly affect the value of financial indicators.

The main goal of this direction of forecasting is to build a factor model that allows, by changing the level of absolute financial indicators, to determine the forecast financial condition of the enterprise. This model makes it possible to determine the main directions of improving the financial condition of the enterprise, since it will allow to identify those components of the financial condition that adversely affect its overall assessment.

This model is based on the calculation of financial indicators, which are part of the integral indicator of financial condition (see Table. 1).

As the main factors, it is advisable to use absolute indicators of financial statements that have a direct impact on the level of relative financial indicators. The system of relative indicators, which are proposed to be included in the model, their symbol and method of calculation are given in Table 4.

To obtain a factor model for predicting the financial condition of the enterprise, a number of mathematical transformations were performed:

1) in the formula (4), taking into account the method of calculating the main components of the financial condition of the enterprise (1-3), the standard values and significance of financial indicators are substituted (see Table. 1);

$$Z = \sum_1^m \frac{z_i}{a_i} \omega_i, \tag{1}$$

$$Y = \sum_1^m \frac{y_i}{a_i} \omega_i, \tag{2}$$

$$X = \sum_1^m \frac{x_i}{a_i} \omega_i, \tag{3}$$

where  $Z, Y, X$  - coordinates of the financial condition, characterizing the dynamics of change of its individual component;  $z_i, y_i, x_i$  - actual values of the corresponding financial indicators;  $\omega_i$  - weight (significance) of the financial ratio;  $a_i$  - average value of a financial indicator;  $m$  - number of financial indicators of the integrated assessment.

**Table 4.** Factors of influence on the level of financial indicators.

Indicator	Factors, affecting the level of a financial indicator	Legend	Formalization
Profitability of current assets	net profit	V1	$\frac{V1}{V2}$
	current assets	V2	
Return on sales	profit from sales	V3	$\frac{V3}{V4}$
	net income	V4	
Tangible asset turnover ratio	net income	V4	$\frac{V4}{V5}$
	current tangible assets	V5	
Accounts receivable turnover ratio	net income	V4	$\frac{V4}{V6}$
	accounts receivable	V6	
Absolute liquidity ratio	current assets	V2	$\frac{V2 - V5 - V6}{V7}$

	current tangible assets	V5	
	accounts receivable	V6	
	current liabilities	V7	
Current liquidity ratio	current assets	V2	$\frac{V2}{V7}$
	current liabilities	V7	$\frac{V7}{V7}$
Financial independence ratio	equity	V8	$\frac{V8}{V9}$
	balance sheet total	V9	$\frac{V8}{V9}$

2) method of calculating individual financial indicators is included in the obtained mathematical expression (see table 4).

$$I = Z + Y + X \tag{4}$$

After these transformations and certain simplifications, the mathematical expression of the factor model for forecasting the financial condition will have the following form:

$$I = \frac{45,7V1}{V2} + \frac{54,7V3}{V4} + 0,4V4\left(\frac{1}{V5} + \frac{4}{V6}\right) + \frac{74,1}{V7}(1,05V2 + V5 + V6) + \frac{6,3V8}{V9} \tag{5}$$

where V1 - net profit; V2 - current assets of the enterprise; V3 - profit from sales; V4 - net income; V5 - current tangible assets; V6 - accounts receivable; V7 - current liabilities; V8 - equity; V9 - total assets of the enterprise.

Proposed model allows you to determine the forecast integral indicator of financial condition, depending on the trend of a particular absolute indicator.

Main disadvantages of the considered approach include: the need to forecast each indicator separately, using extrapolation methods; a number of certain assumptions regarding the values of individual financial indicators.

This fact does not reduce the importance of this approach, since this model allows financial analysts of the enterprise to quickly identify the indicator that needs to be influenced in order to keep the financial condition at the appropriate level. The model can be used in simulation, to determine optimistic, neutral and pessimistic forecasts of the financial condition of the enterprise. In addition, this approach allows you to determine the amount of financial indicators to achieve the maximum level of financial condition.

One of the areas of forecasting the financial condition of an enterprise is forecasting the main components of an integrated assessment. This approach is based on the additivity of the integral assessment and the presentation of the financial condition depending on the integral values of the group of relative indicators characterizing financial stability, capital efficiency, liquidity and solvency. A generalizing characteristic that combines all the groups of these indicators is an integral estimate, the geometric content of which is to determine the coordinates of the point  $A_0$ .

Namely, over a certain period of time, the financial condition will change under the influence of various factors, and the location of a point in three-dimensional space will change accordingly (point  $A_1$ ). So, first the point  $A_0$  has coordinates (X; Y; Z), and then it shifts to the coordinates ( $X_1$ ;  $Y_1$ ;  $Z_1$ ), i.e. it can be argued that the financial condition goes from state  $A_0$  to state  $A_1$  (Fig. 1) [13].

$x$  - financial stability;  $y$  - liquidity and solvency;  $z$  - capital efficiency.

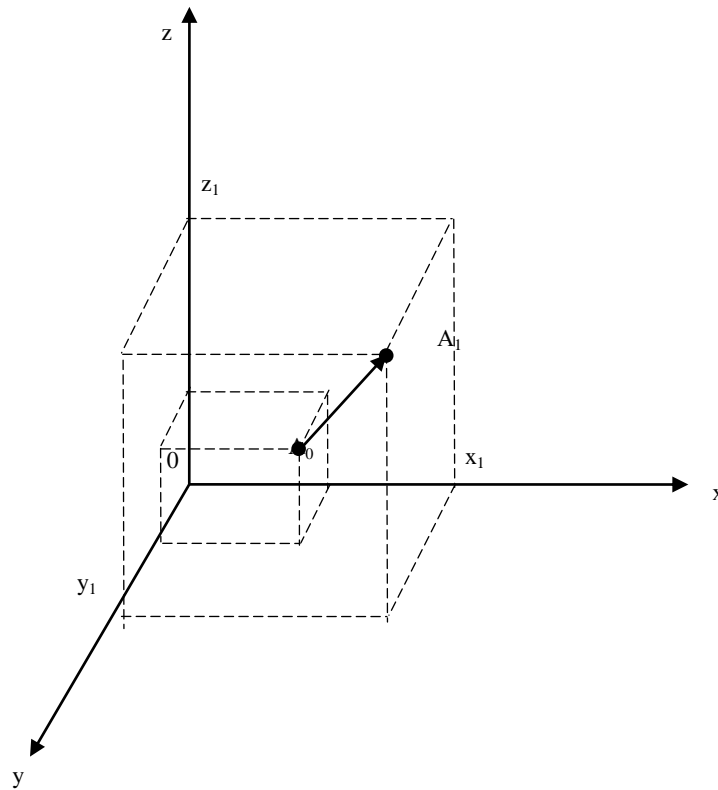
Based on this approach, the forecast model of financial condition takes the form:

$$I = f(z) + f(y) + f(x) \tag{6}$$

where  $f(z)$ ,  $f(y)$ ,  $f(x)$  - functional dependences of changes in the integral components of the financial condition, determined by the dynamics of their changes in previous periods.

Developed approach will allow you to clearly demonstrate trends in the financial condition of the enterprise and its main advantage is the simplicity of practical application.

Purpose of constructing this model is to determine the forecast values of individual integral indicators characterizing the individual components of the financial condition of the enterprise. The basis of the model is proposed to use the trend of changes in the components of the financial condition in previous periods and the time factor.



**Figure 1.** Coordinate method in predicting the financial condition of the enterprise.

This task will help to solve the problem of building a system of trend equations that characterize trends in the components of the financial condition:

$$\begin{aligned} f(z) &= \hat{z} = f(t) + \xi_t \\ f(y) &= \hat{y} = f(t) + \xi_t \\ f(x) &= \hat{x} = f(t) + \xi_t \end{aligned} \quad (7)$$

where  $f(t)$  - trend coordinates of the financial condition;  $\xi_t$  - stochastic component of the process of forming a component of the financial condition of the enterprise.

Input data will be the values of the components of the integral assessment in previous periods, on the basis of which the dependence is determined for individual coordinates. It should be noted that this approach reduces the possibility of building a universal model that could be used by all metallurgical enterprises, since the trend of the model should be based on the data of an individual enterprise. In this case, the accuracy of the forecast significantly increases, due to the individual approach to the enterprise, and taking into account those trends that are unique to it.

Consider the basic logic of building a model. The stage of its identification involves two steps. The first step is to determine the model parameters for a certain series of dependencies. The second involves the selection of a model that is most adequate to empirical data and has sufficient predictive capabilities.

Trend equation can be described by a wide range of diverse dependencies. To determine the parameters of the trend equation, you can use the least squares method, used for linear dependence, in connection with this there is a need for linearization of some non-linear equations.

After determining the parameters of the model, it is necessary to check its adequacy and forecast capabilities. This stage involves the calculation of the coefficient of determination and the Tail coefficient [24]. The last step in building a model is to choose a trend equation that approximates as much as possible the tendency for certain components of the financial condition of the enterprise to change.

Main limitations of the considered approach include the presence of a sufficient amount of analysis data, on the basis of which the trend line is built. The advantage of this approach is the possibility of operational monitoring of the dynamics of changes in the main components of the financial condition of the enterprise, allowing timely detection of negative trends in changes in financial indicators, displayed by the level of these components, and timely development of preventive measures to eliminate such negative dynamics.

Thus, we have developed three models for predicting the financial condition of the enterprise, each of which has its own specific features.

To improve the accuracy of the forecast data of the enterprise, it is advisable to develop individual models for forecasting the financial condition. These models include the trend model, which provides for the determination of the forecast financial condition depending on the dynamics of changes in its main components based on the trends in their changes in previous periods.

These models should be used in the short term to determine trends in the formation of financial condition.

### **3. Modeling the financial condition of the organization**

The models built above are not universal for predicting the financial condition of all enterprises, since they take into account certain individual characteristics of individual business entities. Therefore, there is a need to develop a universal model, the main purpose of which is the forecasting of the integral indicator.

Since the level of the integral indicator depends on many factors, it is advisable to use regression analysis methods to build a model for predicting the financial condition, which allow us to determine the relationship between different indicators and determine their impact on the overall assessment of the financial condition of the enterprise.

This approach will allow you to explore the forecast financial condition of the enterprise, taking into account many factors.

Based on the results of previous studies, an iteration was used to determine the system of indicators of the model, which significantly affects the integral indicator of financial condition, namely:

- profitability of sales ( $V1$ ), %;
- return on sales by cash flows ( $V2$ ), %;
- share of the most liquid assets ( $V3$ ), %;
- part of assets that are difficult to sell ( $V4$ ), %;
- share of term liabilities ( $V5$ ), %;
- share of short-term liabilities ( $V6$ ), %;
- share of long-term liabilities ( $V7$ ), %.

In addition to these indicators, a dummy variable ( $V8$ ) must be added to the regression model, which would take into account the influence of the external environment on the financial condition. Therefore, the model should include the influence of the forecast background, i.e. the space in which the enterprise operates.

Index of GDP growth is taken as the main indicator characterizing the external environment (forecast background).

Analysis showed that there is a relationship between the financial condition and the forecast background, which must be taken into account when building the regression model. Therefore, depending on the influence (positive, negative or in the absence thereof) of the fictitious variable, the forecast background will be assigned the corresponding value: 1 or 0.

Our study allows us to conclude that there is a linear dependence of the integral assessment of the financial condition of the enterprise on financial indicators, therefore, to construct a model for predicting the financial condition, it is advisable to use the linear regression equation, represented by the following dependence:

$$\hat{I} = \beta_0 + \beta_1 V_{i1} + \beta_2 V_{i2} + \dots + \beta_p V_{ip} + \varepsilon_i, \quad (8)$$



where  $\hat{I}$  - predicted value of the integral indicator;  $\beta_p$  - parameters of the regression model;  $\varepsilon_i$  - model error;  $v_{ip}$  - the value of the relative financial indicator, or forecast background.

Input data for constructing a regression model are indicators characterizing the structure of assets and capital of an enterprise in terms of liquidity, maturity of liabilities and capital efficiency.

At the same time, observations were excluded from the study in which net worth is negative, since such a value causes its imbalance.

Identification of the regression model involves the determination of its parameters depending on the value of the correlation indicator, which allows to establish the influence of a single financial indicator on the overall assessment of the financial condition of the enterprise.

Adequacy of the forecast model depends on the system of indicators included in it. Financial indicators are in a certain interdependence and interdependence, which is the basis for the hypothesis of multicollinearity between them.

Since the proposed input data system has more than two variables, the multicollinearity test must be carried out using the Farrara-Glober algorithm [15], which involves the calculation of a number of criteria and their comparison with standard values.

This step made it possible to identify pairs of financial indicators between which there is multicollinearity, in particular, these are indicators  $V1$  and  $V2$ ;  $V5$  and  $V3$ . The most optimal for the model is the elimination of  $V2$  and  $V5$ .

A repeated check of factors for multicollinearity showed the absence of a relationship between the indicators that remained after the exclusion of factors  $V2$  and  $V5$ , i.e. these indicators can be used as input for a regression model for predicting the financial condition of the enterprise.

Choosing a certain system of financial indicators, we can say that the financial condition depends on less variable indicators characterizing it. These indicators include long-term liabilities and assets. This is completely justified, since these indicators are more static and form the basis for the development of any enterprise. This set of indicators confirms the fact that the financial condition of the enterprise depends on the structure of sources of financing of its economic activity.

The parameters of the regression model were calculated by an algorithm that allows you to determine the value of the members of the regression equation.

For calculations, the built-in MS Excel function REGRESSION was used. The model parameters were determined on the basis of the calculated data of the financial statements of enterprises.

The results obtained led to the conclusion that the regression model for forecasting the financial condition will have the following form:

$$I_i = -3,284 + 1,742V1 + 5,437V3 + 0,383V4 - 0,408V6 - 0,556V7 + 7,655V8, \quad (9)$$

where  $V1$  - profitability of sales;  $V3$  - share of the most liquid assets;  $V4$  - share of hard-to-sell assets;  $V6$  - share of short-term liabilities;  $V7$  - share of long-term liabilities;  $V8$  - influence of the external environment.

The analysis of the obtained model allows us to note that the internal factors affecting the financial condition include the profitability of the products sold, the share of long-term liabilities and non-current assets. The level of financial condition is also affected by the external environment of its functioning.

Proof of this thesis requires determining the adequacy of the mathematical expression of the resulting model, which includes the following steps:

- 1) checking the model parameters for significance;
- 2) determination of regression statistics indicators proving the adequacy of the model;
- 3) conducting tests for heteroskedasticity;
- 4) determining the presence of autocorrelation of the model.

1. Checking the significance of the model parameters involves calculating the t criterion and comparing it with the critical value (Table 5).

**Table 5.** Calculated values of the t-criterion of the parameters of the regression model for forecasting the financial condition.

Parameter	Parameter value	Standard error	Estimated t-test	Standard t-test with probability 0,9
$\beta_1$	1,74210	0,41094	4,23931	1,67
$\beta_3$	5,43662	0,75772	7,17496	1,67
$\beta_4$	0,38326	0,19435	1,97196	1,67
$\beta_6$	-0,40793	0,21414	-1,90496	1,67
$\beta_7$	-0,55649	0,19911	-2,79494	1,67
$\beta_8$	7,65472	2,73604	2,79774	1,67

According to the table, it is clear that the criteria obtained are significantly different from zero, therefore, they can be included in the model. Thus, the system of indicators included in the regression model objectively reflects the dependence of the overall assessment of the financial condition of the enterprise on a particular system of financial indicators.

2. Calculation of the indicators of the regression model (Table 6) also confirms the hypothesis about the reliability of the obtained dependence of the integral indicator of the financial condition on indicators characterizing the structure of assets and capital of the enterprise, taking into account the profitability of the products sold.

Based on the data of the regression model with a probability of 0.95, and degrees of freedom:  $m-1$ ,  $n-m$ , it can be argued that the regression model (9) obtained as a result of the study is adequate to empirical data. The integrated assessment characterizing the financial condition of an industrial enterprise, by 91.34% depends on the system of indicators that are defined in the model (9).

**Table 6.** Indicators of the regression model for predicting the financial condition of the enterprise.

Indicator	Estimated value	Recommended value
Multiple Correlation Coefficient	0,91341694	Approaching 1
Coefficient of determination	0,8343305	Approaching 1
Clarification coefficient of determination	0,81557546	Approaching 1
Standard error of model	15,9620872	Nearing minimum
F-test	44,4856748	Greater than 2,25
Significance of the F-test	5,6496 E-19	Nearing minimum

4. Presence of autocorrelation indicates the inefficiency of estimates of the parameters of the regression model, which leads to biased forecasts.

Testing for model autocorrelation involves calculating the Darbin-Watson criterion and comparing it with the recommended value (approaching 2) [15, 26]. Study of this aspect led to the conclusion that there is no autocorrelation of residuals, which indicates the effectiveness of forecasts based on this model.

Main disadvantages of the developed regression model include prediction of individual structural elements of the assets and capital of the enterprise, i.e. in order to determine what the financial condition of the enterprise will be after a certain period of time, it is necessary to separately predict the indicators included in the model, which reduces the universality of this development.

**4. Modeling the financial condition of the organization**

To eliminate the drawback of model (9), it is proposed to supplement it with the functions of extrapolating the development trends of the main indicators included in its composition.

To determine the development trends of individual financial indicators, it is advisable to use the moving average method. A feature of this method is that the level of indicators is more significant than the influence of indicators that are at the end of the time series of initial data. This mechanism is implemented using a coefficient  $\lambda_t$ .

According to this method, the forecast value of the indicator is calculated as follows:

$$x_{t+k} = x_t + \lambda_t \Delta x_t + \lambda_{t-1} \Delta x_{t-1} + \lambda_{t-2} \Delta x_{t-2} + \dots + \lambda_{t-k} \Delta x_{t-k}, \tag{10}$$

where  $\Delta x_t$  - absolute change in the indicator in previous periods;  $k$  - forecast horizon;  $t$  - number of previous periods.

Coefficient is calculated by the formula:

$$\lambda_t = \frac{i \times \beta}{n}, \tag{11}$$

where  $i$  - number that means a consecutive natural series of prehistory, starting from the last;  $\beta$  - sequence coefficient determined on the basis of tabular data [4].

Based on the history period and the  $\lambda_t$  coefficient value (11), the forecast value of the indicators of the regression model will be calculated as follows:

$$x_{t+k} = x_t + 0,333 \Delta x_t + 0,267 \Delta x_{t-1} + 0,2 \Delta x_{t-2} + 0,133 \Delta x_{t-3} + 0,067 \Delta x_{t-4} \tag{12}$$

To build a dynamic model for predicting the financial condition of an enterprise, we carry out a series of transformations of a previously developed regression model (9):

1) in model (9) we substitute the function of changing individual financial indicators, which is determined on the basis of the current average method (12);

2) after substitution, we calculate in the model the values of the corresponding coefficients.

Thus, taking into account the forecast function of a separate financial indicator (12) and the initial dependence (9), the model of the financial condition of the enterprise takes the form:

$$\begin{aligned} I_i = & -3,284 + 1,742V1_t + 0,580\Delta V1_t + 0,465\Delta V1_{t-1} + 0,348\Delta V1_{t-2} + 0,231\Delta V1_{t-3} + \\ & + 0,117\Delta V1_{t-4} + 5,436V3_t + 1,810\Delta V3_t + 1,451\Delta V3_{t-1} + 1,087\Delta V3_{t-2} + 0,723\Delta V3_{t-3} + \\ & + 0,364\Delta V3_{t-4} + 0,383V4_t + 0,127\Delta V4_t + 0,102\Delta V4_{t-1} + 0,077\Delta V4_{t-2} + 0,051\Delta V4_{t-3} + \\ & + 0,026\Delta V4_{t-4} - 0,408V6_t - 0,136\Delta V6_t - 0,109\Delta V6_{t-1} - 0,081\Delta V6_{t-2} - 0,054\Delta V6_{t-3} - \\ & - 0,027\Delta V6_{t-4} - 0,556V7_t - 0,185\Delta V7_t - 0,148\Delta V7_{t-1} - 0,111\Delta V7_{t-2} - 0,074\Delta V7_{t-3} - \\ & - 0,037\Delta V7_{t-4} + 7,655V8_t \end{aligned} \tag{13}$$

where  $V1t, \Delta V1t$  - value / absolute deviation of the profitability of the products sold;  $V3t, \Delta V3t$  - value / absolute deviation of the share of the most liquid assets;  $V4t, \Delta V4t$  - share / absolute deviation of a part of hard-to-sell assets;  $V6t, \Delta V6t$  - share / absolute deviation of the share of short-term liabilities;  $V7t, \Delta V7t$  - share / absolute deviation of the share of long-term liabilities;  $V8$  - environmental impact, positive or negative;  $t$  - number of previous periods.

For ease of use, it is proposed to simplify model (13) by expressing predicted indicators through the moving average function (12):

$$\begin{aligned} I_i = & -3,248 + 1,742f(V1_{t+k}) + 5,436f(V3_{t+k}) + 0,383f(V4_{t+k}) - 0,408f(V6_{t+k}) - \\ & - 0,556f(V7_{t+k}) + 7,655V8 \end{aligned} \tag{14}$$

A feature of this approach is the prediction of the financial condition of the enterprise of a more dynamic nature, which is related to the dynamics of changes in indicators that significantly affect the overall assessment of the financial condition.

Consider the practical use of the developed regression models on the example of LLC Turbostalkomplekt (Table. 7).

Analyzing data Table. 7, we can conclude that for five years, subject to the absence of fundamental changes in the financial policy of the enterprise, LLC Turbostalkomplekt will have a clear tendency to improve its financial condition. At the same time, it should be noted that a change in the forecast value

of the integral indicator of the financial condition, based on the standard deviation, is possible within  $\pm 15.9$ .

**Table 7.** The calculation of the forecast financial condition of LLC Turbostalkomplekt based on the regression model.

Year	V1	V3	V4	V6	V7	V8	I	Financial condition
Input information								
2014	14,21	0,07	67,14	4,90	1,52	-1,0	33,52	satisfactory
2015	7,47	0,04	59,92	1,02	2,99	1,0	22,35	unstable
2016	6,87	0,06	52,16	2,59	1,48	1,0	25,34	unstable
2017	13,08	0,07	51,62	2,05	0,19	0,0	35,61	satisfactory
2018	15,94	0,04	55,24	7,05	7,14	1,0	41,47	satisfactory
Estimated figures								
forecast 1 year	17,53	0,04	53,79	8,36	9,01	1,00	47,32	satisfactory
forecast 2 year	19,53	0,03	52,65	9,98	11,13	1,00	48,50	satisfactory
forecast 3 year	21,98	0,02	52,02	11,90	13,45	1,00	50,41	satisfactory
forecast 4 year	24,45	0,01	51,66	13,86	16,00	1,00	52,30	satisfactory
forecast 5 year	26,73	0,00	51,20	15,86	18,61	1,00	53,77	satisfactory

In general, this forecast, based on data from previous periods, is objective. To further stabilize the financial condition in the future, an enterprise needs to pay more attention to cash management in order to ensure a sufficient level of solvency.

## 5. Conclusion

As a result of the study, areas of forecasting the financial condition of the enterprise, we have built five models for forecasting the financial condition, namely:

- 1) a logical-descriptive model;
- 2) factor model (5);
- 3) a trend model of financial condition (6, 7);
- 4) a regression model of financial condition (9);
- 5) a dynamic model for forecasting financial condition (13, 14).

The developed models have both advantages and some limitations, which is due to the goal of predicting the financial condition of the enterprise. In general, the choice of a particular model depends on the purpose of forecasting, the availability of input data and the forecast horizon.

Summing up the study, it should be noted that the developed models meet the forecasting goals that most often arise in front of financial analysts of industrial enterprises and specialists of financial and credit institutions. In our opinion, these models are quite simple to use and allow us to make adequate conclusions regarding the financial condition of the enterprise in the medium term.

## References

- [1] Altman E 1984 Further Empirical Investigation of the Bankruptcy Cost Question *Journal of Finance* 1067 – 1089
- [2] Artemenko V, Bellender M 2000 Financial Analysis. Business and Service (Moscow)
- [3] Balabanov I 2010 Financial management Theory and practice Perspektiva (Moscow)
- [4] Basovskiy L 2018 Forecasting and planning in market conditions *INFRA-M* (Moscow)
- [5] Beaver W 1966 Financial ratio and Predictions of Failure Empirical Research in Accounting Selected Studies *Supplement to Journal of Accounting Research* 4 39-47
- [6] Berdnikova T 2012 Analysis and diagnosis of the financial-economic activity of enterprise *Infra-M* (Moscow)
- [7] Bilik M, Pavlovskaya O, Pritulyak N, Nevmerzhitskaya N 2005 Financial analysis *KNEU*

- (Kiev)
- [8] Blank I 2014 Management of financial security of an enterprise 2-nd ed *Elga* (Kiev)
  - [9] Blank I 2013 Strategy and tactics of financial management *Elga* (Kiev)
  - [10] Blazhevich O 2016 Financial security of enterprises: the definition of the minimum required level *Scientific Herald: Finance, Banks, Investments* **2(35)** 40-49
  - [11] Boyko I, Semkova D 2018 Analysis of the financial condition of an economic entity as a way to assess its economic security system *The young scientist* **24** 117-119
  - [12] Chesser D 1974 Predicting Loan Noncompliance *The Journal of Commercial Bank Lending* **56(12)** 28-38
  - [13] Ilyin V, Poznyak E 2002 Analytical geometry 6th ed FIZMATLIT (Moscow)
  - [14] Kovalev V 2013 The analysis of the balance, or how to understand balance: educational and practical 3rd ed *Prospekt* (Moscow)
  - [15] Kremer N, Putko B 2003 Econometrics *YUNITI-DANA* (Moscow)
  - [16] Kurdzhiev S, Mambetova A, Peshkova E 2016 An Integral Evaluation of the Financial State of the Regional Enterprises *The economy of the region* **2(12)** 586-601
  - [17] Kyurdzhiev S, Mambetova A, Peshkova E 2016 An Integral Evaluation of the Financial State of the Regional Enterprises *R-Economy* **2(2)** 245-258
  - [18] Nedosekin A personal Internet site <http://sedok.narod.ru/eng/index.hlm>
  - [19] Nikbakht E, Gropelli A 1992 *Finance Globus* (Kiev)
  - [20] Rogalsky F, Kurilovich J, Tsokurenko A 2002 Mathematical methods for analyzing economic systems *Scientific thought* (Kiev)
  - [21] Sahakian C 1997 The Delphi Method *The Corporate Partnering Institute* **5** 47-54
  - [22] Taffler R, Tisshaw H 1977 Going, going, gone – four factors which predict Accountancy
  - [23] Tereshchenko O 2004 Crisis financial management at the enterprise KNEU (Kiev)
  - [24] Theil H 1971 Principles of Econometrics (Wiley, New York)
  - [25] Zaporozhtseva L, Ryabykh M 2013 Development of a strategy to ensure the financial security of an enterprise *Basic research* **11(8)** 45-57
  - [26] Skorikov D S, Solovov D B 2018 Consideration of an Ecosystem From the Standpoint of Theory and Practice of Managing Production Systems *IOP Conference Series: Materials Science and Engineering* **463** paper № 022003. [Online]. Available: <https://doi.org/10.1088/1757-899X/463/2/022003>