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**SECTION 31. Economic research, finance,
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DYNAMIC STANDARD AS A METHOD OF SYSTEM ANALYSIS FOR FINANCIAL SUSTAINABILITY ASSESSMENT OF RUSSIAN ENTERPRISES

Abstract: *The aim of this paper is to present dynamic standard as a method of system analysis for financial sustainability assessment of Russian enterprises. The paper describes the following concepts: financial sustainability, prerequisites for development of the dynamic standard, features of the dynamic standard and comparison of the method with other approaches regarding their accuracy, alpha error and beta error. Furthermore, financial ratios, which enable to assess financial sustainability and their predictive power, were scrutinized for the purpose of classification accuracy improvement for increasing number of years before the failure.*

Key words: *Financial sustainability, financial distress, financial ratios, dynamic standard, system analysis, standard relationships*

Language: *English*

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1. Introduction

In the terms of the modern market economics development in Russia, the problem of companies' financial performance assessment regarding their financial sustainability represents the most serious issue. According to the statistical data the insolvency proceeding is initiated concerning more than 40 thousand Russian companies every year, while only 4 percent of the above mentioned enterprises manage to avoid initiating them as insolvent [1, p.29].

The reason for the described trend is the lack of timely and qualitative analysis of companies' data regarding their sustainability and financial condition. Well-timed classification of enterprises' financial condition makes it possible to adjust companies' activity, find out different bottlenecks and make correct managerial decisions.

Nowadays there is a great variety of methods, which are supposed to assess financial stability as a basic indicator of a company's financial performance and financial distress possibility. The list of the methods consists of approaches, which were developed by Russian scientists and foreign scholars.

In spite of the variety of the analytical means they cannot be determined as trustworthy because of several reasons. Firstly, some of them were not adapted to specific conditions of Russian economics which determines low accuracy of financial sustainability assessment process. Secondly, they perform one-sided analysis of financial performance of a company neglecting the system feature of enterprises which has an impact on assessment of overall accuracy. Thirdly, the accuracy of the methods becomes less and less informative within the increasing number of years before the failure.

Hence, the goal of this paper is to represent the system approach of financial sustainability assessment based on standard relationships called the method of dynamic standard. The stated goal will be achieved by considering the term "financial sustainability", scrutinizing the nature of dynamic standard, analysis of financial ratios which enable to assess financial stability and comparing the methods in terms of their accuracy.

The paper is organized as follows: brief description of financial sustainability term, prerequisites for the dynamic standard creation,



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description of the approach, analysis of financial ratios and comparative analysis of the methods in terms of their accuracy.

2. Financial sustainability

The financial sustainability of an organization can be defined as one of the most important characteristics that makes it possible to describe the financial condition of an enterprise. In foreign and domestic literature, financial sustainability is generally defined as an organization's ability to maintain a stable financial position under the negative influence of internal and external factors [2, p.87]. This ability is achieved by creating an optimal structure of a company's resources and the sources of their financing and efficient use of resources [3, p.8].

Financial stability is inseparably linked with solvency of an organization, however, an assessment of a company's solvency cannot be seen as the only criterion for determination of its financial performance. Financial sustainability provides a many-sided slice of an organization's activities based on assessing its solvency, creditworthiness, financial resources, balance of assets and liabilities, balance of revenues and expenditures, and balance of cash flows across various activities, including operating and financial [4, p.75].

In the domestic literature, it is customary to single out several degrees of financial stability, namely absolute and normal sustainability, unstable and crisis financial position of a company, or instability and critical instability. Absolute sustainability is expressed in the fact that a company's reserves are covered by its own circulating assets. This characteristic of sustainability reflects that a business entity does not depend on external creditors, has no outstanding non-payments and violations of internal and external financial discipline. It should be noted that absolute sustainability is an ideal condition, which is extremely rare. However, some scientists tend to think that absolute sustainability means unwillingness or inability of managers to use external sources of funds for enterprises' activity. In correspondence with the last opinion, absolute sustainability cannot be considered as an ideal situation [5, p.119].

Normal financial stability shows that an organization's need to use long-term borrowed funds in conjunction with its own funds to cover its reserves. Normal financial stability is the most profitable option for financial management, which does not threaten the stable development of an enterprise.

The instability of an organization indicates a reduced degree of solvency of an enterprise and a decrease in profitability that can be corrected by replenishing sources of own funds, reducing accounts receivable and terms of its repayment and increasing

the intensity of the use of funds, namely, increasing inventory turnover.

Critical instability is expressed in the fact that cash and equivalents, the most liquid assets and receivables do not cover its accounts payable and overdue loans. Beginning of bankruptcy proceedings and bankruptcy are the results of critical instability, or rather the lack of corrective measures and policies [6, p.7].

3. The prerequisites for the creation of dynamic standard

Two basic principles, which make it possible to assess the activity of an enterprise comprehensively, are the core of economic analysis. It is supposed to mark out system and composite principles. The system principle consists in consideration of an object as a separate system representing set of the interconnected elements. The system principle enables to estimate economic processes of a subject from the point of view of interrelation between them and their interdependence. Respectively, for ensuring fulfilment of the system approach it is necessary to estimate changes of financial indicators on the basis of their growth rates in combination with assessment of their interrelations [7, p.1].

Composite assessment represents comprehensive qualitative and quantitative characteristics of the results of activity of an enterprise. The composite approach which consists in versatile views of enterprises' results, is the most important source of information for substantiation and adoption of administrative decisions.

Economic analysis is based on the calculation of financial ratios which, in turn, is not additive measures that defines the appearance of the problem of aggregation and generalization of information. In connection with this feature of financial ratios, it is necessary to consider them as not metric measures expressed in relationships of "quicker" and "more slowly" [8, p.15].

Due to the requirements of system and composite approaches defined earlier and nonadditivity of financial measures the method of the dynamic standard, which combines the above mentioned concepts, has been created. The set of the indicators ordered within the growth rates so that maintenance of this order in real activity of the enterprise provides the best economic results is called the dynamic standard of an economic state [9, p.91]. The name of this method is caused by scrutinizing the changes happening in a system and their correspondence to standard growth rates as standard measures ratios' trends.

4. The method of dynamic standard

The method consists in the following steps: formation of the set of financial ratios, creation of a standard matrix, transitive closure of ratios and rebuilding of the matrix, calculation of growth rates of the ratios within selected accounting quarters as

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periods, creation of a fact matrix, creation of a match matrix, creation of a mutability matrix and calculation of specific measures.

The first step requires the determination of financial ratios which are applicable for financial sustainability assessment and play a role of input variables on the basis of which all matrixes will be built. The list of the chosen ratios and the process of their selection will be described in the following section.

The second step consists in building of standard matrix which represents the standard growth rates of ratios based on financial axioms. Transitive closure of the ratios' relationships is stipulated by system principle. With a glance of transitive relationships of ratios it is necessary to rebuild the matrix. Building the matrix is implemented in correspondence with the Formula 1:

$$e_{ij} = \begin{cases} 1, & \text{if } T(R_i) > T(R_j) \\ -1, & \text{if } T(R_i) < T(R_j) \\ 0, & \text{if relationship does not exist,} \end{cases} \quad (1)$$

where n - number of indicators;

e_{ij} - an item of a standard matrix;

i, j - ID of ratios;

R_i, R_j - ratios;

$T(R_i) > T(R_j), T(R_i) < T(R_j)$ - standard growth rates.

The following steps consist in the creation of matrixes of the actual growth rates of ratios and a matrix of correspondence of the actual growth rates and determined standard rates. Creation of the first matrix, or a fact matrix is implemented on the basis of the Formula 2, and the second matrix, or a match matrix - Formula 3:

$$f_{ij} = \begin{cases} 1, & \text{if } T(R_i) > T(R_j) \\ -1, & \text{if } T(R_i) < T(R_j) \\ 0, & \text{if } T(R_i) = T(R_j), \end{cases} \quad (2)$$

where n - number of indicators in standard;

f_{ij} - an item of a fact matrix;

i, j - ID of indicators;

$T(R_i), T(R_j)$ - actual growth rates.

$$b_{ij} = \begin{cases} 1, & \text{if } e_{ij} = 1 \text{ and } f_{ij} \geq 0 \\ 1, & \text{if } e_{ij} = -1 \text{ and } f_{ij} \leq 0 \\ 0, & \text{in other cases,} \end{cases} \quad (3)$$

where n - number of indicators in standard;

i, j - ID of indicators;

b_{ij} - an item of a match matrix;

e_{ij} - an item of a standard matrix;

f_{ij} - an item of a fact matrix [10, p. 65].

The Formula 4 implements building of a mutability matrix. This matrix represents the changes of particular ratios which appear in matters of the sequence of consecutive accounting periods.

$$d_{ij} = \begin{cases} 1, & \text{if } b_{ij}^o > b_{ij}^p \\ -1, & \text{if } b_{ij}^o < b_{ij}^p \\ 0, & \text{in other cases,} \end{cases} \quad (4)$$

where b_{ij}^o - an item of a match matrix in a current accounting period;

b_{ij}^p - an item of a match matrix in a previous accounting period;

d_{ij} - an item of a mutability matrix.

Assessment of activity of an enterprise is conducted on the basis of assessment of its sustainability, variability and integrated assessment of stability. The assessment of sustainability represents the degree of similarity between actual growth rates included in the dynamic standard and their standards. Range of assessment of sustainability changes from 0 to 1 where 0 demonstrates growth rates which are opposite to standard rates, 1 - correspondence of standard and the actual dynamics of indicators.

Assessment of variability represents change of structure of the right and wrong relationships from the point of view of direction of changes described in the dynamic standard during a particular accounting period. Assessment of variability is an obligatory addition to sustainability assessment for identification of all violations which have happened in terms of the reporting period.

The described assessment is supposed to be in the range from -1 to 1. The negative value testifies about negative influence of changes in structure on stability. The zero value displays the invariance of activity of the subject or compensation of violations by existing relationships. The value equal to 1 indicates that the activity of the enterprise leads to improvement or constancy of stability from a period to a period.

In spite of the fact that estimates of sustainability and variability are complementary, they represent independent measures. Respectively, there is a need of creation of the indicator reflecting the stability of the enterprise corrected on its variability. Integrated stability assessment acts like this indicator. In the context of this paper integrated stability assessment boils down to assessment of financial sustainability.

Assessment of sustainability is implemented by the Formula 5, variability - Formula 6 and integrated stability - Formula 7:

$$S = \frac{\sum_{i=1}^n \sum_{j=1}^n b_{ij}}{\sum_{i=1}^n \sum_{j=1}^n |e_{ij}|}, \quad (5)$$

where S - sustainability of an enterprise,

b_{ij} - an item of a match matrix;

e_{ij} - an item of a standard matrix.

$$C = \frac{\sum_{i=1}^n \sum_{j=1}^n d_{ij}}{\sum_{i=1}^n \sum_{j=1}^n |d_{ij}|}, \quad (6)$$

where C - mutability of an enterprise,

d_{ij} - an item of a mutability matrix.

$$IS = S^{\frac{2}{C+1}}, \quad (7)$$

where IS - economic stability of an enterprise;

S - sustainability;

C - mutability of an enterprise [10, p.68].

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5. Financial ratios as indicators of financial sustainability

Financial ratios represent the input variables for the described method. It is crucial to determine correctly the list of the ratios which are connected with financial sustainability and distress. Furthermore, it is necessary to assess predictive power of ratios to find negative changes of financial sustainability timely.

This section provides information about selected financial ratios and their predictive power.

The process of research of their power is based on Mann-Whitney's U-test which was conducted for two independent samples of values of each financial ratio calculated for sustained companies and companies in financial distress. Selected companies refers to the similar accounting periods to provide the similarity of economic conditions in Russia.

On the basis of Russian and foreign literature the list of significant financial ratios was marked out. These ratios are shown in the Table 1.

Table 1

Crucial financial ratios for financial sustainability assessment

ID	Numerator	Denominator	ID	Numerator	Denominator
K1	Current assets	Current liabilities	K14	Sales	Total assets
K2	Cash	Current liabilities	K15	Gross profit	Total assets
K3	Equity	Total assets	K16	Cash	Total assets
K4	Own circulating assets	Equity	K17	Inventory	Sales
K5	Long term debt	Fixed assets	K18	Current assets	Total assets
K6	Borrowed capital	Equity	K19	Long term debt	Total assets
K7	Net income	Total assets	K20	Operating income	Sales
K8	Net income	Sales	K21	Cash	Sales
K9	Total liabilities	Total assets	K22	Current assets	Sales
K10	Working capital	Total assets	K23	Current assets - inventory	Current liabilities
K11	EBIT	Total assets	K24	Own circulating assets	Inventory
K12	Operating income	Total assets	K25	Own circulating assets	Current assets
K13	Retained earnings	Total assets			

Before investigating predictive power of ratios it is important to mark out the distribution laws of ratios' values of sustained and distressed companies. Figures 1 and 2 show the distribution of Current ratio as an example calculated for two types of companies.

As it can be seen form the figures this ratio is distributed in correspondence with lognormal law. All the above mentioned ratios correspond to the revealed feature.

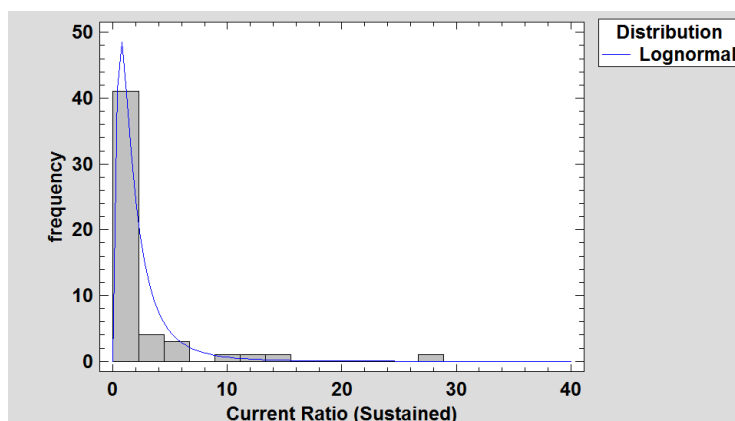


Figure 1 – Distribution of Current ratio for sustained companies

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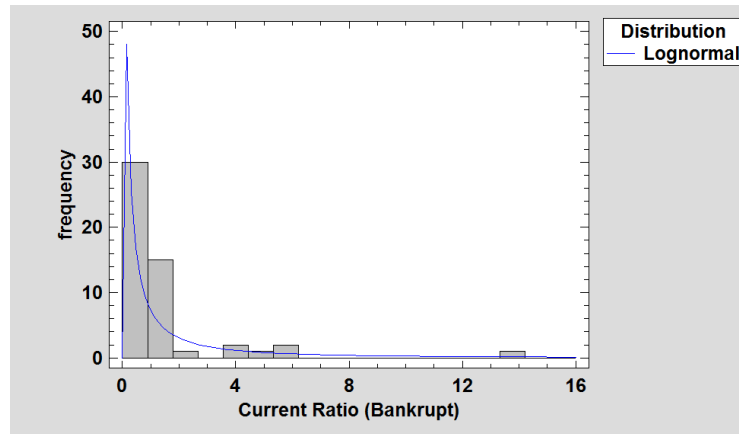


Figure 2 – Distribution of Current ratio for distressed companies

In connection with the need to evaluate the differences between two independent samples distributed according to the lognormal law, the Mann-Whitney's U-test, which is a non-parametric rank test should be used. As a null hypothesis sampling similarity was considered. This criterion was applied in pairs to the values of the ratios of sustained companies and companies, which later

became a bankrupt. Based on the results of this test accepting the null hypothesis, the indicators with identifiers K12, K17, K19, K20, K21 and K24 were excluded from the sample of indicators that classify the financial performance from the sustainability standpoint at the time the bankruptcy procedure started. The Figure 3 represents the results of U-test to investigate the predictive power of ratios.

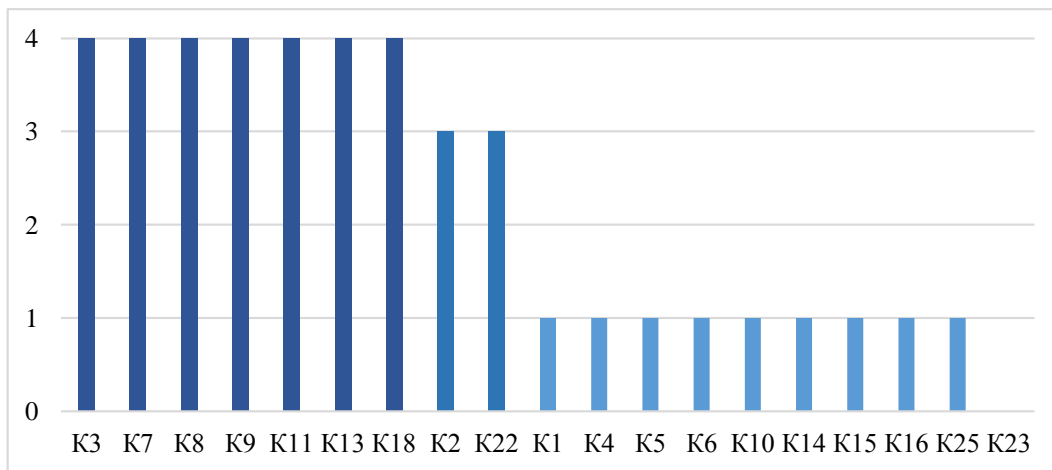


Figure 3 – Predictive power of financial ratios

As it can be seen from the Figure 3 all financial ratios except ratio K23 have an ability to show financial distress for one year before the failure. Ratios with the following identifiers: K1, K2, K3, K4, K5, K6, K7, K8, K9, K11, K13, K18 and K22 will be considered as input variables for dynamic standard.

6. Comparison of the dynamic standard with other methods

On the list of selected methods the following methods are: methods of Altman based on 2 factors (A2) and 5 factors (A5), Springate (S), Lis (L), Taffler (T), Ohlson (O) and domestic methods of Kovalev (K), Selezneva-Ionova (S-I), Kadykov-

Saifullin (K-S), R model (R) and the method of dynamic standard (DS).

In terms of this research it is interesting to examine alpha error, beta error and overall accuracy of the methods. Alpha error represents wrong classification of distressed companies as sustained companies. Beta errors shows wrong classification of sustained companies as bankrupts. Overall accuracy is determined in correspondence with the rule: the number of right classification is divided by the number of measurements.

The results of the research are represented in Tables 2, 3 and 4. Table 2 shows data about alpha error, Table 3 - beta error and Table 4 - overall accuracy of the methods. Furthermore, the Figure 4

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represents the accuracy of classification of financial sustainability regarding the increasing number of years before the failure. The rules of companies'

selection for this part of research correspond to the rules described previously.

Table 2

Data regarding Alpha error

	A2	A5	T	R	L	S	K	O	S-I	K-S	DS
Min	0,35	0,05	0,41	0,26	0,09	0,03	0,15	0,08	0,14	0,18	0,05
Max	0,41	0,35	0,51	0,41	0,55	0,14	0,40	0,25	0,30	0,55	0,08
Mean	0,38	0,18	0,47	0,33	0,26	0,08	0,25	0,18	0,25	0,37	0,07
Median	0,38	0,18	0,49	0,34	0,19	0,07	0,26	0,18	0,29	0,38	0,07

Table 3

Data regarding Beta error

	A2	A5	T	R	L	S	K	O	S-I	K-S	DS
Min	0,03	0,29	0,20	0,21	0,43	0,24	0,05	0,05	0,08	0,43	0,13
Max	0,07	0,46	0,60	0,45	0,50	0,40	0,32	0,08	0,32	0,55	0,18
Mean	0,05	0,39	0,42	0,33	0,47	0,32	0,21	0,07	0,22	0,48	0,16
Median	0,06	0,41	0,50	0,35	0,47	0,30	0,21	0,07	0,23	0,47	0,16

Table 4

Data regarding Accuracy

	A2	A5	T	R	L	S	K	O	S-I	K-S	DS
Min	0,66	0,57	0,49	0,57	0,49	0,66	0,74	0,80	0,69	0,45	0,83
Max	0,71	0,78	0,63	0,76	0,63	0,84	0,82	0,89	0,80	0,59	0,88
Mean	0,68	0,66	0,54	0,67	0,57	0,75	0,77	0,83	0,75	0,54	0,86
Median	0,68	0,62	0,50	0,66	0,58	0,77	0,76	0,83	0,76	0,55	0,86

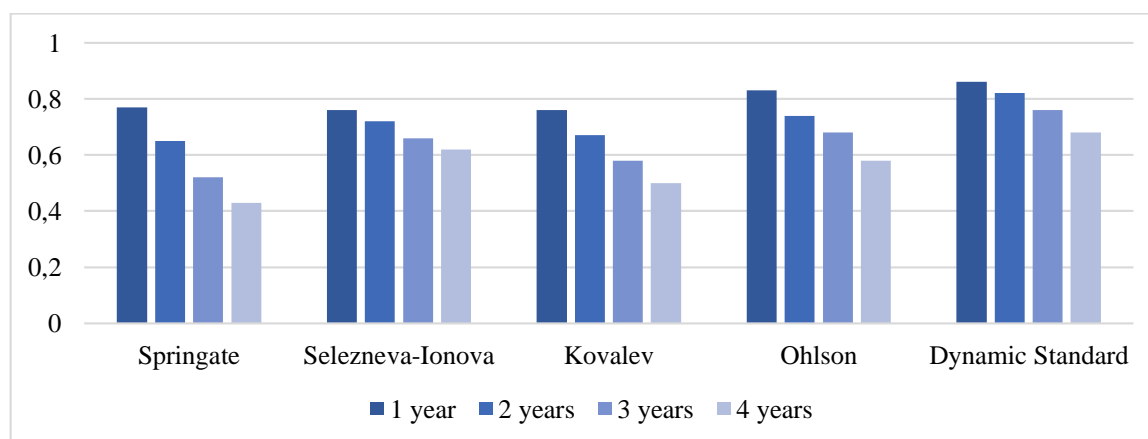


Figure 4 – Accuracy of the methods regarding the numbers before the failure

As it can be seen the approach based on the usage of dynamic standard has provided positive results regarding the financial sustainability

assessment. However, this method has shown relatively high values of beta error which determines the need of revision of growth rates for sustained

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companies regarding contemporary economic conditions. Furthermore, the usage of ratios with high predictive power makes it possible to increase the accuracy of classification regarding the increasing number of years before the failure.

7. Conclusion

To sum up, the method of dynamic standard can be successfully used for financial sustainability of enterprises of Russia because of financial axioms

about ratios' growth rates as a cornerstone of the method and its independence from statistical data.

Furthermore, as it was shown, different financial ratios are characterized by different predictive power. Thus, the usage of ratios which are capable of identifying the early stages of financial distress as negative degree of financial sustainability will have an impact on the increasing accuracy of classification of financial performance. In connection with this feature, applicability of the method in practice is supposed to be improved.

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