GENERALIZED METHODOLOGY OF MANAGING ENTERPRISE ECONOMIC INDICES WITH THE USE OF CONTROL ACTION OPTIMIZATION

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Keywords: profitability, good will, value added, integrated index of the company's economic position, operational management of the indices using the working capital, matrix of selections of the prospective models for management, solution of the problem of non-linear programming for the selection of the management methods.

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The authors have developed and generalized the methodology of enterprise economic indices day-to-day management with the use of control action choice optimization, with control actions being the relative turnover means volume and the sources for their short-term financing. The overall goal of the methodology is to ensure higher values of the leading economic indices of an enterprise, compared with their current values. The key stages of the methodology are presented in figure. The procedure of identifying control actions and forecasting the values of the index in question is considered below.

To find a solution to this task we have to know the optimum absolute values of the control actions (stage 7), have the models for improved index value forecasting with the use of the above-mentioned control actions, both allowing for the current market trends (stage 4) and not (stage 5).

The process of finding the optimized control actions can be based on statistical treatment and analysis of enterprise performance data (stage 3) or on the solution to the optimization task (stage 4), where the effectiveness criterion, and, consequently, the criterion function is the one of enterprise rating (stage 2) for the foundations like relative values of control actions (stage 1).

Let us consider each stage in detail.

The process of choosing relative control actions (Stage 1) is based on the fact that the considered process of managing metallurgical production often requires changing the volume of turnover means and the sources of their financing. That is why control actions in this particular case must be connected with changing the aforementioned volumes while keeping the relatively stable (normative) short-term structure.

Such control actions in the form of factors of p_1 and p_2 are suggested in this work. The first one represents the ratio of turnover means volume to the balance currency B:

$$\pi_1 = S_{oc} / B.$$

The second one π_2 is connected with the reserves of the enterprise's own funds and the long-term loan funds. It is calculated according to the formula:

where $И_c$ is the enterprise's own funds and reserves; K_T is the long-term loan funds; K_t is the short-term loan funds; R_p is the credit debt; K_1 is the times burden covered ratio.

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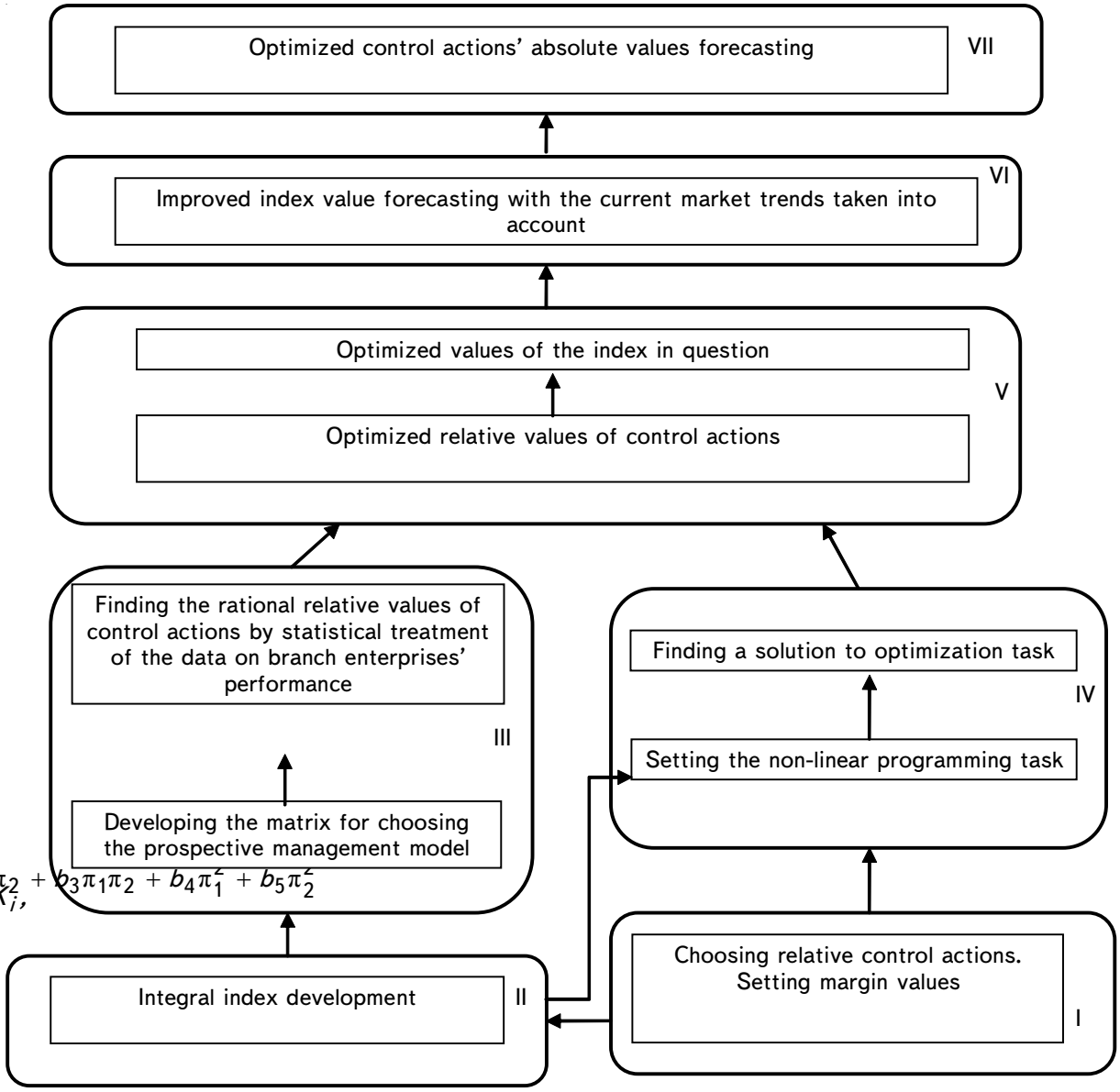

$$\hat{R}_0 = b_1\pi_1 + b_2\pi_2 + b_3\pi_1\pi_2 + b_4\pi_1^2 + b_5\pi_2^2,$$

$$R_0 = \sum_{i=1}^{n} \frac{1}{n \cdot N_i} K_i,$$

Fig. **Key stages of development and implementation of the enterprise economic indices' day-to-day management methodology**

The values of these indices can be used to characterize the kind of model used by the enterprise for choosing the rational volume of turnover means and the sources of their financing. In practice, the less turnover means an enterprise has (the less the value of π_1 is), the more aggressive is the model used. The more funds an enterprise has (both its own and long-term loan ones), the closer the more conservative is the model used.

Integral index development (stage 2), or criterion function development is carried out as follows. The dependent variable R_j represents the enterprise rating score. The primary version of this score is the integral linear index, suggested by Sayfullin R.S. and Kadykov G.G.

As the arguments for the model the factors π_1 and π_2 are used. The regressive model is developed as a second order polynominal:

(1)

by series successive introduction of variables.

The rating score R_0 itself is devised in accordancec with the performance and is calculated by the formula:

(2)

where n is the number of indices used to constitute the rating score; N_i is the normative requirements for the financial factor

i; K_i is the *i* financial factor; $1/\ n$ DN_i is the value index of the *i* factor.

It is clear that in the case of total correspondence of the values of the factors K_1,..., K_n to their minimum positive normative levels, the rating score of an enterprise will be equal to 1. The authors of this method included the following indices as the constituents of the rating score:

K_o represents the factor of the enterprise's own capital funds reserves;

$K_л$ represents the current balance liquidity and the general times burden covered ratio;

K_u represents the intensity of advance capital turnover (sales volume per 1 rub. of total assets);

$K_м$ represents the management factor (the gross profit to net profit ratio);

K_n represents the overall profitability of an enterprise (the return on its own funds).

Allowing for the conditions of iron and steel industry in Russia in 2005-2007 and using the weighted profit average of the corresponding factors for the iron and steel enterprises in the stated period of time as the normative value, we get the following ratio for calculating the rating score R_j:

$$R_{j,чМ} = 0{,}522 \cdot K_o + 0{,}043 \cdot K_л + 0{,}177 \cdot K_u + \\ + 0{,}604 \cdot K_м + 0{,}463 \cdot K_n. \qquad (3)$$

However, the rating score R_0 calculated according to the formula (3) does not take into account any additional improved factor of the economic state of the enterprise (e.g. profitability, added value, good will etc.). To overcome this drawback, it is advisable to use the following 3 tactics that allow to substantially improve the quality of the model in development (1).

Firstly, it is recommended to design a specific model for any individual enterprise or for the enterprises of one technological group.

Secondly,it was logical to use the factors K_i while designing the ratio (2). These factors had the least correlation with the improved economic state index and were the least interrelated.

Thirdly, while designing the ratio (2) it is recommended to use one representative of each of the following 5:

1. General profitability, R_{ki}.

2. Management efficiency valuation, E_{fki}.

3. Business activity valuation, A_{ki}.

4. Financial stability valuation, F_{ki}.

5. Liquidity and financial solvency valuation, L_{ki}.

The aforementioned groups comprise 33 financial factors.

The process of defining the most informative factor K_i for the maximum value of the multivariable correlation index for the restriction (1).

The usage of the rating score, calculated according to the formula (3) ensures that the value of the multivariable correlation index for the restriction (1) equals 0,92. The application of the 3 aforementioned tactics allows to construct type (1) models with the value of the multivariable correlation index equaling 0,97-0,98.

Statistical treatment of the data on branch enterprises' performance (stage 3) with the aim of developing a matrix for choosing prospective improved economic state management index (long-term) is implemented as follows.

Each relative control action change interval (π_1^{min}, π_1^{max}) and (π_2^{min}, π_2^{max}) is divided into 3 equal periods. The first period p_1 and the second period π_2 correspond to the aggressive management model, the second one - to the medium management model, the third one - to the conservative management model. As a result we get a set of coordinates, where each square corresponds to one of the following improved index management models:

(A_1, A_2); (Y_1, A_2); (K_1, A_2)
(A_1, Y_2); (Y_1, Y_2); (K_1, Y_2)
(A_1, K_2); (Y_1, K_2); (K_1, K_2)

Here A_1 и A_2 correspond to aggressive management models of the first or second index; Y_1 и Y_2 correspond to the medium management model; K_1 и K_2 correspond to the conservative management model.

Each square has its own weighted average value of the improved index to be calculated. Then the interval of change of the relative control actions that provides relatively high values of the index in question (,) and (,) is defined. The squares that lie within the indicated are allow to identify the most pro-

spective and recommended index improvement models.

If the factual values of p_1 and $_2$ for the enterprise in question lie outside the high index value area, then it is recommended to reach the high index value areas using step-by-step turnover means management.

Non-linear programming task (stage 4) to define the rational values of the short-term relative control actions is formulated as follows:

$$\hat{\pi}_1^{min} \le \pi_1 \le \hat{\pi}_1^{\max} ;$$

$$\hat{\pi}_2^{\min} \le \pi_2 \le \hat{\pi}_2^{\max} .$$

The solution to this problem enables the implementation of improved economic state index day-to-day management procedure. The calculation is supposed to be carried out once every 24 hours. The diagnostics of the indexes of π_1 and π_2 by means of comparison of their output values from the previous short-term period to the calculated optimum values is mandatory. Then the recommendations on changing p_1 and p_2 allowing for the deviation of their factual values from the normative ones, for the opportunities the enterprise has for changing these values, and for the necessity of step-by-step implementation of the prospective management strategy are formulated.

$\hat{R}_0 = b_{04} + b_{11}\pi_1 + b_{15}\pi_2 + b_{22}\pi_1^2 + b_{23}\pi_1\pi_2 + b_{24}\pi_1^2 + b_{25}\pi_2^2 \to \max$

It is obvious that besides the task of increasing the value of the rating score the generalized methodology can be used to find the solutions to others tasks, such as improvement of other indices' values. For example, the work had an additional task of increasing the values of three relative added value indices: the added value to assets ratio, the added value to gross value ratio and the added value to net profit ratio. The rating score of the enterprise was designed with the account of these very indices. In this case it is necessary to have a model for these indicators forecasting.

The model for forecasting the improved index j (stage 5) was constructed in the form of full second order polynominal:

$$\hat{R}_j = b_{1j}\pi_1 + b_{2j}\pi_2 + b_{3j}\pi_1\pi_2 + b_{4j}\pi_1^2 + b_{5j}\pi_2^2,$$

where $j = 1, 2, 3, ..., m$.

It is obvious that the optimum values of and π_2^{onm} calculated at stage 5 must be introduced in the ratio of type(4).

The model (4) does not allow for the environmental impact on the economic state of an enterprise. The validity and accuracy of the forecast by this model can be increased substantially by introducing the indices that take into account the current market trends (stage 4), e.g. the factor of asset turnover.

Finally, the optimum values of π_1^{onm}, π_2^{onm} of the relative control actions values we have to turn to the absolute control actions values to be able to use them while calculating the enterprise management balance (stage 7).

In this particular case by means of simple transformations we can illustrate that new turnover means volume can be used as the first control action (at the next stage of system programming):

$$S_{oc}^{нов} = \pi_1^{onm} \cdot F_{нов} / (1 - \pi_1^{onm}),$$

where $F_{нов}$ is the new value of non-current assets.

The second control action is the value of short-term debt of the enterprise, which is calculated according to the formula:

$$(K_t + R_p)^{нов} = \pi_2^{onm} \cdot S_{oc}^{нов}.$$

Then the decision on the possible changes in the volume of the turnover means in use and the value of the short-term debt of the enterprise is made while planning the new management balance.

Conclusion. The generalized methodology of day-to-day economic state indices' management R_j is suggested. The indices include profitability, good will, value added, etc. The procedure of control actions value choice optimization is applied, with the values of control actions being the relative turnover means volume π_1 and the short-term sources of their financing π_2. The main criterion function is the economic state rating score R_0, which is comprised by the linear combination of financial factors, closely correlated with the improved indices R_j. The func-

tions of R_o and R_j of π_1 and π_2 are set as full second order polynominals.

In this case both short- and long-term economic indices' management is considered. To choose the long-term management strategy the matrix of prospective management models is used. The matrix is based on statistical treatment of the data on the branch enterprises' performance, and thus allows to consider their experience.

The rational short-term management style is chosen on the basis of solving non-linear programming tasks.

It is important to point out that the forecasted values of R_0 and R_j are calculated allowing for the current market trends, which proves the practical value of the suggested methodology.

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