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Forecasting the population life quality as a tool of human capital management

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Abstract - In modern conditions, the competitive advantages of the economy and the possibility of its modernization are largely determined by the accumulated and realized human capital. People with their education, qualifications and experience determine the boundaries and opportunities of technological, economic and social modernization of society. At the same time, in Russia, human capital as a factor of innovative development is given only little attention.
The analysis of the innovative development prospects in Russia shows the presence of many difficulties on this way. The lack of highly skilled workers is considered as one of the main barriers to the development of knowledge-intensive production, especially in the future.
Despite the large number of scientific developments, some aspects of the problem are debatable and poorly studied. In particular, the issue of human capital management is insufficiently covered.
Insufficient knowledge of the theoretical and practical aspects of human capital management in the interests of sustainable innovation development led to defining the purpose of the study and the formulation of tasks for its solution.

Keywords: life quality, human capital, sustainable development, innovation, competitive advantages

I. INTRODUCTION

The aim of the study is to develop and justify the tools of forecasting and management of human capital in the interests of regional innovative development. In modern conditions, the competitive advantages of the economy and the possibility of its modernization are largely determined by the accumulated and realized human capital. It is people with their education, qualifications and experience that determine the boundaries and opportunities of technological, economic and social modernization of society. At the same time, in Russia, human capital as a factor of innovative development is given only little attention. The main focus is on the development of innovation infrastructure, the formation of effective institutions and improving the efficiency of the national innovation system. Such a "technical" approach to the problems of Russian regions development and no estimation of human capital role are not able to provide the structural changes necessary for the sustainable development of Russian regions and the transition to innovative development [20, 1].

II. METHODS AND RESULTS

The information basis of the study was the official data of federal and regional state statistics authorities, state authorities of the Krasnoyarsk region, as well as monographic studies of local and foreign scientists.

The scientific novelty of the study consists in the theoretical justification and development of methods for assessing and forecasting the life quality of the region population as a tool of human capital management [15, 2].

The practical significance of the study is in the application possibility of suggestions and insights article as a theoretical basis for developing strategies to improve the life quality of the region's population and human development.

The main provisions and recommendations of the scientific research presented in the article are focused on the range of specialists involved in the management of socio-economic development in the region [17, 19].

III. DISCUSSION

In order to manage the transition for sustainable development and assess of the effectiveness in the means used, targets and constraints should be established, with a procedure for monitoring their achievement (compliance). Targets can be expressed in indicators characterizing the life quality and the level of economic development.

Thus, public recognition of these provisions allows us to understand the sustainable innovative development as ability of the regional socio-economic system in the course of qualitative changes in its functioning to switch from one non-equilibrium situation to another, reaching a higher level and quality of life, sustainable, balanced reproduction of social, economic, resource and environmental potentials of the region [4, 10, 11].

The formation of a sustainable regional socio-economic system should be based on the principles of sustainable development, the main of which are the following:

1) improving quality of life;
2) guaranteed the health of the people;
3) meeting the basic living needs of both the population and future generations;
4) the fight against poverty;
5) rationalization of production and consumption structure;
6) rationalization of environmental management;
7) ecosystem conservation, climate and ozone layer protection;
8) ensuring environmental safety;
9) elimination of all violence forms against people and nature (prevention of wars, terrorism and ecocide);
10) global partnership.

The peculiarity of the intellectual economy is that its main resource – knowledge, information, unlike all other resources is not characterized by any finiteness, not depletion, not consumability in their traditional sense. The main condition limiting the introduction to such an accessible resource are the specific qualities of the person himself - the presence or absence of the ability to intellectual activity as a form of accumulation, processing and generation of new knowledge [5, 7].

The importance of formation and reproduction problem of human capital in Russia increases due to the fact that the human resource in the conditions of actively going processes in aging and depopulation of the population becomes the scarcest resource [3]. The latest version of the UNO long-term demographic forecast shows that in the future the population of Russia will decrease, the average age will grow, and the share of the working-age population will decrease (table 1).

Table 1

Population dynamics and structure of Russia according to the UNO demographic forecast (2018 version)

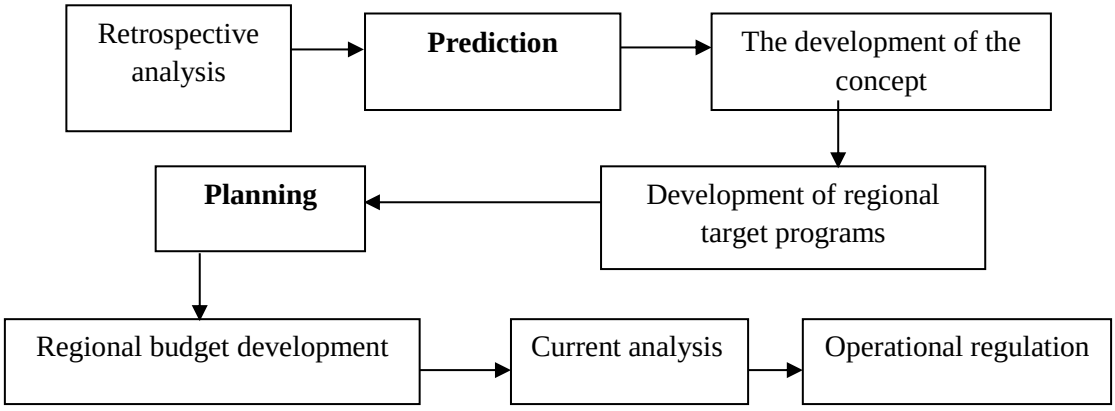
	2018 year	2020 year			2030 year			2050 year		
		a	b	c	a	b	c	a	b	c
Population size										
World, million people	6514	7667	7966	7364	8318	8914	7727	9191	10756	7791
Russia, million people	144	132	138	127	124	133	114	108	130	89
% towards word	2,21	1,72	1,73	1,72	1,49	1,50	1,48	1,18	1,21	1,14

Average annual population growth over the previous five years, %										
World	1,24	1,00	1,32	0,65	0,75	1,07	0,42	0,36	0,87	-0,17
Russia	-0,48	-0,61	-0,28	-0,97	-0,68	-0,34	-1,04	-0,72	-0,09	-1,41
Proportion of population aged 60 and over, %										
World	10,3	13,5	13,0	14,1	16,5	15,4	17,8	21,8	21,8	25,7
Russia	17,1	21,9	21,0	22,9	24,6	22,8	26,6	32,4	26,8	39,2
% towards word	166	162	162	162	149	148	149	149	123	153
The average age of the population										
World	28,0	31,5	30,3	32,7	34,0	31,8	36,3	38,1	33,4	43,3
Russia	37,3	40,0	38,8	41,4	43,8	41,6	45,9	45,3	38,8	52,7
% towards word	133	127	128	127	129	131	126	116	116	122

The global trend, according to UNO experts, in all scenarios is a drop in growth rates, the population aging, and the share growth of the population over the age of 60 years. According to the forecast, if current trends continue, Russia will continue to be in a depopulation situation: the population will decrease from 144 million in 2005 to 108 in 2050 according to the average version of the forecast, 130 million - for high and 89 million - for low (by 25, 10 and 38 %, respectively), and the share of the population aged 60 years and older will grow from 17.7 to 32.4, 26.8 and 39.2 %. Even if it is possible to increase the birth rate, this may lead to an increase in the labor force only beyond 2020 the economy will feel a growing shortage of labor [6, 18].

It is the life quality indicators that should form the basis of forecasting and planning situation. Forecasting is part of the management process and one of the mandatory tools included in the system of strategic regional planning. The main stages of management, forming a "chain" of interrelated processes, are presented in figure 1.

Figure 1-Sequence of stages of process of management of regional social and economic system



Search forecasting is based on conditional continuation in the future of development tendencies for the investigated object in the past and the present. Its task is to find out how the object with study will develop while maintaining existing trends [12, 14].

Since this approach is based on analytical research, it is also called scientific and research. In literary sources, it is often called descriptive, so descriptive, as well as genetic, since it involves the development of an object in accordance with its genetics (heredity), so the potential inherent in the object itself. Search forecasting is based on the using systems of extrapolation methods, scenarios, historical analogy, etc.

Target (normative) forecasting is the determination of the optimal, desirable situation of the object in the future, characterized on the basis of scientifically reasonable needs and norms. Its task is to determine the ways and terms of achieving the possible situations of forecasting object in the future, taken as a goal [8, 9].

The choice of forecasting method is an important stage in the management of regional socio-economic systems, which, first, should ensure the functional completeness, reliability and accuracy of the

forecast, and secondly, should reduce the cost of time and money for forecasting. The problem of choosing a forecasting method is caused by a number of reasons:

1) a wide variety of forecasting methods. To date, there are about two hundred methods of forecasting, and due to the complexity of the tasks and conditions of forecasting, the number of methods will grow. Therefore, even a brief introduction to the known methods requires a lot of time and effort.

2) the complexity of the tasks and objects of forecasting increases.

3) the dynamism of regional socio-economic systems is increasing.

The socio-economic development of regions is influenced by a large number of factors that need to be taken into account when forecasting. To a large extent, these requirements are met by methods that allow, on the basis of available data on factors and results (inputs and outputs), to construct an effective surface (boundary), and then measure the effectiveness of the actual result relative to this surface (boundary). These methods allow us to determine which result (output) is optimal, identify priority areas of development, predict the result when changing a number of input parameters.

The DEA method is based on the application of linear programming methods to create a nonparametric piecewise linear surface (boundary) based on certain data. This method arose as a generalization in simple coefficients of activity analysis to the multidimensional case, so the activity of a complex object is described by a set of input parameters (x1,..., xm) and a set of output parameters (y1, …, yr). For correctness and content of such statement the set of similar difficult objects is considered. Then mathematically this approach will be reduced to solving a large family of optimization problems [13, 16].

The DEA method has a number of attractive traits:

1) it allows one aggregate to be calculated for each object in terms of using input factors (independent variables) to produce the desired output products (dependent variables);

2) it can simultaneously process many inputs and many outputs, each of which can be measured in different units;

3) it allows to take into account external variables in relation to the considered system-environmental factors;

4) it does not require a priori indication of weight coefficients for variables corresponding to input and output parameters in solving the optimization problem;

5) it does not impose any restrictions on the functional form of dependence between inputs and outputs;

6) it allows, if necessary, to take into account the preferences of managers regarding the importance of certain input or output variables;

7) it produces specific estimates of desirable changes in inputs / outputs that would bring inefficient objects to the efficiency boundary;

8) it forms a Pareto-optimal set of points corresponding to effective objects;

9) it focuses on identifying examples of so-called best practice, rather than on any averaged trends, such as regression analysis.

As an example, it is possible to include environment variables in conventional DEA models. For example, for a model that takes into account variable economies of scale and is input-oriented, it would look like this:

$$\min \theta, \lambda (\theta),$$
$$- yi + Y\lambda \geq 0,$$
$$\theta xi - X\lambda \geq 0,$$
$$zi - Z\lambda = 0,$$
$$\sum\lambda = 0,$$
$$\lambda \geq 0.$$

In this case, Z is the matrix of environment variables for all N objects in the sample. Since in this case, environmental variables are considered unmanageable, that is, not amenable to regulation by the decision-maker, the coefficient θ before the variable zi is not put.

Another option involves solving the problem in two stages. In the first stage, the usual DEA problem is solved, in which only traditional variables are used. At the second stage, the linear regression problem is formulated, in which the efficiency indicator obtained in solving the DEA problem serves as a dependent variable, and environmental variables serve as explanatory variables. Signs at regression coefficients indicate the "direction" of influence: a "plus" sign indicates a positive influence of the environment on efficiency; a "minus" sign indicates a negative influence of the environment. Statistical

hypothesis tests are also performed, as in traditional regression analysis. These tests allow assessing the statistical significance of regression coefficients.

Historically, the Malmquist index has been used to estimate the change in the overall productivity of all production factors when the same object is considered in two different time periods or two different objects in the same time period. As you know, productivity (efficiency) is defined as the ratio of product release (output) to the resource costs (input):

Productivity = product release / resource costs

Thus, productivity may vary due to production changes and due to changes in resources. In the case where there are not scalar but vector inputs and outputs, determining productivity is a nontrivial task. The Malmquist index has an important property, namely that it can be decomposed into two factors. The first factor is an indicator of changes in the efficiency of the object, and the second factor is an indicator of technical progress achieved in the industry (in this sample of objects):

Change in productivity = change in efficiency * measure of technological progress

Various methods are used to calculate the index, including the DEA method, because this method can process many outputs and inputs at the same time. When using the DEA method, you need to solve several optimization problems for each of the objects in the sample:

$$\max \varphi, \lambda(\varphi),$$
$$-\varphi y_{it} + Y_t \lambda \geq 0,$$
$$x_{it} - X_t \lambda \geq 0,$$
$$\lambda \geq 0.$$

$$\max \varphi, \lambda(\varphi),$$
$$-\varphi y_{is} + Y_s \lambda \geq 0,$$
$$x_{is} - X_s \lambda \geq 0,$$
$$\lambda \geq 0.$$

$$\max \varphi, \lambda(\varphi),$$
$$-\varphi y_{is} + Y_t \lambda \geq 0,$$
$$x_{is} - X_t \lambda \geq 0,$$
$$\lambda \geq 0.$$

$$\max \varphi, \lambda(\varphi),$$
$$-\varphi y_{it} + Y_s \lambda \geq 0,$$
$$x_{it} - X_s \lambda \geq 0,$$
$$\lambda \geq 0.$$

In these problems, the indices s and t show the start and end time periods, the index i shows the object for which the calculations are made. As in the model, Y and X are matrices of outputs and inputs for all objects in the sample, and λ is a vector of weights that form a linear combination – a hypothetical object being the target for an inefficient object.

These models for the Malmquist index are output-oriented, so when setting targets for inefficient objects, the model seeks to primarily increase the output indicators of the object, keeping the input indicators at the same level. Input-oriented models can be constructed similarly.

When using statistical data for several years, it becomes possible to trace the movement of the efficiency boundary over time. Based on the direction of these movements, it is possible to determine whether there is progress in the studied group of objects (industry) or regression.

IV. CONCLUSIONS

The main advantages of the proposed methodology of assessment and forecasting are the following:

1) using only available information;

2) possibility of interregional comparison (clearly defines the place of the studied region among the regions of the Russian Federation on four components: population health, availability of social services, living standards, environmental situation);

3) efficiency diagnostics of the region situation and rapid identification of problem areas;

4) possibility of a comprehensive (consolidated) assessment of the regional situation;

5) possibility of using the dynamics of some indicators to assess the effectiveness of specific departments and units of regional government;

6) minimizing the use of expert subjective assessments;

7) ability to add and exclude new basic indicator without compromising the model.

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