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Adaptive of modeling of region economic development strategy

Annotation: The article offers basic models of region economy development as one of major subsystem of national economy in the transformation state, due to which optimal trajectories of its development are grounded. Taking into account the features of informational reflection of the economic system functioning as an instrument for choice of optimal alternative of its development the use of fuzzy logic is offered for determination of the model's basic parameters.

Keywords: region, economic development, economic-mathematical models, a synergetic approach, fuzzy logic.

Transformations of Ukraine's economy, which take place due to gradual influence of external and internal factors, resulted in aggravation of disproportion of region's economies, disparities of the preliminary developed strategies of regions' economic development comparing with modern realities and resulted in a need for re-orientation of economic entities. Orientation on the foregrounding of external demand in the present situation of price liberalization speed-up and unfavorable investment climate resulted in the decline of hi-tech production [1, p. 139].

In such a dynamic situation the questions of exceptional importance are unavoidable – research of economic evolution paths, behavior of development trajectories, prognostication of indicators, assuming the presence any of the factors that influence stable economic development [2, p. 1]. Therefore complication of region's economy as a socio-economic system, instability of behavior as a result of change of functioning patterns of its elements and their co-operation, and also considerable dependence upon influence of environment's factors stipulates a need for bringing in new technologies and development of the system of region's

development optimizations models, that will be able to describe adequately difficult socio-economic processes, and timely foresee their development.

Thereby there is a necessity to develop a strategy for the steady balanced development of region's economy. Wherein, for such a strategy it is expedient to estimate the number of alternative variants with the aim to choose most optimal one considering given economic conditions.

Validity of region's economic development strategy is fully dependent upon precision of informational reflection of their processes. The economy of a region, as of any complex dynamic system, develops and functions in conditions of uncertainty [3, p. 44], which is caused by both objective impossibility to describe it's development through influence of numerous various factors at any moment of time, and insufficiency and inaccuracy of information about the parameters of regional processes. Influence of transformation processes lead to transition of region's economy from one non-equilibrium state to other that reinforces the informational uncertainty of its behavior ever greater. In view of this management of region's economic development under permanent transformation must be based on methods and models that allow taking into account complication of management object's nature and uncertainty of information on its functioning.

Theoretical, methodological and organizational fundamentals of prognostication, management methods and planning of regional and other indicators that characterize level of economic development as complex dynamic system was examined in works of Borysovych V. I. [4], Petkova L. O. [5], Topchiiev O. G. [6], Heiets V. M. [7] and other foreign and local scientists. Certain necessity of economic-mathematical modeling methods' application for use to justify the optimal economic development strategy of the region, most authors prefer balance methods. However in present time, that is characterized by the period of nonlinear behavior of economy, nonlinear logic of its development and nonlinear methods of economic situation forming requires the other newest scientific tool.

Therefore the synergy appears to be in the center of modern economic researches [8]. In particular the synergetic approach to analysis of co-operation and mutual influence of economic constituents gives the deep understanding of economy's problems, their possible decisions, by providing scenarios and short-term prognoses given different initial conditions. A synergetic economics is aimed at

description of non-equilibrium processes, on the analysis of patterns of destruction of old and forming of new socio-economic structures.

Transference of synergetic ideas in modern economic researches is related to the creation of mathematical models (MM), their qualitative and quantitative analysis.

The necessary and sufficient condition for achievement of predictability and manageability of economic processes in a region or the single economic unit is the rational and expedient use of methodology and tools of economic-mathematical modeling for development of adequate economic-mathematical models (EMM).

Scientific works on modeling of nonlinear economy's dynamics on the example of a single economic unit are numerous. For research of region's (economic agent's) economic development as basis a dynamic model was taken that is presented by the following system of differential equalizations [9]:

$$\begin{cases} \dfrac{dY_1}{dt} = \alpha Y_2 Y_3 - \gamma Y_1; \\ \dfrac{dY_2}{dt} = \mu(Y_2 + Y_3) - \beta Y_1 Y_3; \\ \dfrac{dY_3}{dt} = \delta Y_2 - \lambda Y_3, \end{cases} \quad (1)$$

that is describe the dynamics of economic object's functioning, where the following variables are indicators of the state: workers' headcount $Y_1 = Y_1(t)$ (labor component), that describes the amount of workers during time *t*; equity amount $Y_2 = Y_2(t)$ (financial component), that depicts a property asset; borrowed capital amount $Y_3 = Y_3(t)$ (investment component), namely the loan amount.

However during researches of region's economic development a question appeared: what results will be given by a dynamic system (1), if the model's variables will have a different dimension, for example, workforce will be measured by number of employees, and equity and loan amounts - in monetary units (e.g., UAH)? In this case the special role is played by dimensionless quantities. Their numerical values do not depend on the choice of the system of units [8]. Dimensionless numbers determine the terms of similarity of the different models under investigation, and also allow making a number of qualitative estimations. Qualitative study begins with an analysis of dimensionless EMM. Singling out small or large dimensionless parameters allows in a number of cases to simplify substantially an initial mathematical model as dimensionless information has a dimensionless numerical form.

Therefore we shall limit ourselves only to enumeration of basic dimensionless numbers and characteristic model parameters that arise in case of representation of equalizations and initial conditions in a dimensionless form. Dimensionless variables will be entered [8] as follows: $Y_3 = \frac{\mu}{\alpha}x$, $Y_2 = \frac{\lambda\mu}{\alpha}y$, $Y_1 = \frac{\mu}{\beta}z$, $dt = \frac{d\tau}{\mu}$

Then the synergetic model (1) that describes the nonlinear dynamics of economic position of object in time would be the system of three ordinary first order differential equalizations (ODE) [10]:

$$\begin{cases} \dot{x} = \frac{\delta\lambda}{\mu}y - \frac{\lambda}{\mu}x; \\ \dot{y} = y + \frac{1}{\lambda}x - \frac{1}{\lambda}xz; \\ \dot{z} = -\frac{\gamma}{\mu}z + \frac{\lambda\beta}{\alpha}yx, \end{cases} \quad (2)$$

where, dimensionless variable $x = x(t)$ will correspond to borrowed capital amount (loans) during time t, variable $y = y(t)$ depicts equity amount, and $z = z$ (t) - describes labor force. Values $\dot{x}$, $\dot{y}$, $\dot{z}$ are differentials of independent variable t. Scalars $\alpha, \gamma, \mu, \beta, \delta, \lambda$ are included in this system as constant and managing parameters.

Nonlinear system (2) of first-order ODE by its structure and components resembles the classical Lorentz model [11, 13], the structure of which is exactly the same, but there are fundamental differences in the coefficients: in the first equalization of the system (2) coefficients near variables are not equal to each other; in the second and third equalizations of the system coefficients stand near nonlinear elements.

As model (2) coefficients are dimensionless, for better perception of model (2), basing on their economic essence they can be simplified.

Let $\frac{1}{\lambda} = a \rightarrow \lambda = \frac{1}{a}$. Then MM (2) takes the following view:

$$\begin{cases} \dot{x} = \frac{\delta}{a\mu}y - \frac{1}{a\mu}x; \\ \dot{y} = y + ax - axz; \\ \dot{z} = -\frac{\gamma}{\mu}z + \frac{\beta}{\alpha a}yx, \end{cases} \quad (2')$$

If $\frac{1}{a\mu} = A$; $\frac{1}{\mu} = aA$; $\frac{1}{\alpha a} = B$, we will have:

$$\begin{cases} \dot{x} = \delta Ay - Ax; \\ \dot{y} = y + ax - axz; \\ \dot{z} = -\gamma aAz + \beta Byx. \end{cases}$$

Decision on the prospect of region's (as a system) economy development are formed with regard to a number of economic factors, in particular those that appear in models (1) - (2). However models (1) - (2) cannot be calculated without basic coefficients that influence its basic factors. These are scalars $\alpha, \gamma, \mu, \beta, \delta, \lambda$ that are included to the systems (1) - (2) and are constants and managing parameters, where: α – reflects factors that determine attractiveness of original appearance of object; β – factors that depict employment potential; γ – factors that characterize different reasons employees' dismissal; μ – summarizing factors that influence on efficiency of capital investments (for example, investment climate, influence of various taxes, and others); δ – summarizing factors that influence the equity amount; λ – summarizing factors that reflects the attractiveness of object as regards loan receiving or its accessibility for borrowing.

It is necessary to notice that in the basic coefficients ($\alpha, \gamma, \mu, \beta, \delta, \lambda$,) of models (1) - (2) numerous factors are included simultaneously. Therefore there is an urgent need in reduction of their dimension. This can be reached: firstly, due to chopping off of absolutely uninteresting factors; secondly, making out of large number of indexes one integral (taking into account both quantitative and qualitative indicators). Frequently the task of choice is resolved by creation of integral (summarizing) criterion. However complications arise when those indicators are left which have different significance for the person who makes a decision.

Using this data, it is necessary to somehow consider these differences in the preparation of the integral index of alternatives' attractiveness. It is therefore advisable to apply methods of estimation of these parameters in conditions of informational uncertainty. Thus, white calculating dynamic models (1) - (2) of the region, values of numerical coefficients will be searched with use of mathematics of fuzzy sets that will define each element as a linguistic variable. It should be noted that the variable is called linguistic [12, p.7] when it is set on some quantitative scale and gains a value that is words or word-combinations of human language. Based on

fuzzy evaluation of the main factors of regional economic development is possible to quantify the constructed models (1) - (2).

Conclusions. Effective management of the region's economic development as one of the most important component of the national economy in conditions o0f constant transformation requires the use of the methodology and tools of economic-mathematical modeling to build appropriate mathematical models. For this purpose it is necessary to develop a strategy of the region's economic development, which will allow justifying the choice of optimal development trajectory for a given planning horizon. For this purpose the use of dynamic models (1) - (2) is suggested.

Given that the main coefficients of dynamic models include the large number of factors, these parameters should be calculated as an integral indicators using fuzzy logic. Implementation of the model (1) – (2) provides an opportunity to build the optimal trajectory of regional economic development, which is a complex dynamic system that operates under transformation.

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