CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.2628902

Available online at: http://www.iajps.com *Research Article*

MODELING AND FORECASTING SOCIO-ECONOMIC PROCESSES IN THE REGION

Alexander Shuvaev[1], Olga Butova[2], Victor Lebedev[3], Inna Lebedeva[3], Tamara Skrebtsova[1]

[1]Stavropol State Agrarian University, Stavropol, Russia, [2]Stavropol Institute of Cooperation (branch) of Belgorod University of Cooperation, Economics & Law, Stavropol, Russia, [3]North-Caucasian Federal University, Stavropol, Russia.

Article Received: February 2019 **Accepted:** March 2019 **Published:** April 2019

Abstract:

Modeling socio-economic processes is an important methodological tool that allows you to formalize the development of this process or phenomenon in a certain time period. This makes it possible to adequately assess the main characteristics and properties of the control object, to determine the vector of its development for the future, to formulate the optimal management decision. The model of the socio-economic process can be used in predicting the production activity of an object, reflecting the main trends of its life cycle.

Meanwhile, at the present time, nonlinear, stochastic and bifurcation models are insufficiently studied and scientifically valid in relation to the development of various commodity markets, including financial, commodity markets, investment and consumer goods markets, the labor market, etc.

The article examines acceptable options for an open three-sector model for the development of an economic regional system that takes into account the peculiarities of the functioning of the labor market, the financial market and the market for marketable products. This made it possible to carry out a scientific forecast of the main parameters of the regional labor market in the short term.

Key words: *modeling, forecasting, socio-economic system, region, sustainability, development model.*

Corresponding author:

Alexander Shuvaev,

Stavropol State Agrarian University, Stavropol, Russia.

QR code

Please cite this article in press Alexander Shuvaev et al., ***Modeling And Forecasting Socio-Economic Processes In The Region.,*** *Indo Am. J. P. Sci, 2019; 06(04).*

INTRODUCTION:

The use of mathematics in the study of socio-economic processes and objects is often associated with obtaining numerical results, for example, in the theory of operations research. However, modern socio-economic analysis, as a rule, does not lead to an adequate description of complex multiparameter systems.

The principle of optimality, widely used in most economics and mathematics, is not always effective, due to the complexity of economic models of non-equilibrium, open, self-organizing systems. Problems such as self-oscillation of parameters, the presence of rapid changes and jumps (catastrophes) in them are not described in models using the principles of optimality [1, 2].

The qualitative phenomenological theory of socio-economic processes explores simple, little parametric models describing systems and processes in them. Often these models are restored according to the dynamic series of parameters of the systems under study. This is followed by carrying out mathematical analysis using existing methods (bifurcation analysis, catastrophe theory, etc.) and issuing recommendations for practical application. In this case, the task of qualitative analysis is the inverse of optimization problems, since it focuses on obtaining a qualitative result, on studying the characteristic features of the entire phenomenon at once, on predicting phenomena in open, nonlinear, stochastic and self-organizing systems.

MATERIALS AND METHODS:

The purpose of our analysis is to study possible scenarios for the evolution of economic systems and the possibility of influencing them. It is believed that in a market economy, socio-economic systems are open and non-equilibrium with the active exchange of information and entropy with the environment. The entropy exchange with the environment can lead to its decrease in the system, which leads to structural changes and the formation of new forms of organization and functioning.

Dynamic chaos often occurs in the structure of behavior, followed by self-organization of new optimal structures. This behavior, called strange attractors, is characterized by a fractal or multifractal structure that has a fractional dimension and changes it over time. Over time, they may turn into cyclical fluctuations of economic parameters or show turning into a behavior of a type of stable focus.

The mathematical part of the theory of qualitative research of models consists in the study of topological structures into which the phase portrait of the system is divided. An essential qualitative analysis consists in comparing the irreducible structures of the phase portrait to specific objects and the socio-economic processes occurring with them. Often enough is knowledge of the area of stability of the position of the systems [2]. These processes are investigated with the introduction of appropriate optimal control. Models of socio-economic processes involve the specification of the main objects and their connections, which allows the formalization of a qualitative theory of processes.

The classical model of market economy represents the system as the interaction of three markets: the production of goods, the labor market and the financial market. Each of the markets is described by supply and demand curves, which define points of dynamic equilibrium. Deviations from the equilibrium of any of the markets in this model are considered small and can only be evaluated qualitatively. The selection of a non-linear mathematical model of enterprise operation presents significant mathematical difficulties and can be solved using a software package analyzing the best fit of these models with existing time series.

At the first stage, the dynamic series of these enterprises are analyzed for stationarity. In the presence of significant dispersion deviations, the series under study is not stationary and the behavior of the dynamic system is described by differential equations. The program complex processes the series to find the coefficients of the simplest nonlinear differential equations chosen as trial mathematical models of the system.

The behavior of the economic parameters of enterprises near the points of economic disasters is chaotic and is often generated not by the stochastic exogenous influence, but by the nonlinear nature of the processes occurring in them. Therefore, the economy can be considered a certain type of generator of chaotic oscillations inherent in "live" systems. The evolution of a strange attractor is often ordered or regulated when periodic auto-oscillation processes appear in the system. This process regulates the fractal set and makes it more orderly, dynamic. Regular behavior of economic systems, by which they understand their deterministic behavior, is considered to be the behavior described by the equations, allowing to calculate the dynamics of systems based on given initial conditions.

RESULTS AND DISCUSSIONS:

Consider a model of an open three-sector model of the economic system in which we take into account the entrepreneurial activity of enterprise managers in three sectors: production, characterized by output - *x (t)*, having labor resources - *y (t)*, having financial resources - *z (t)*

$$dx/dt = -\alpha_1 x + \alpha_2 y,$$

$$dy/dt = -\beta_1 y + \beta_2 x - \beta_3 xz, \quad (1)$$

$$dz/dt = -\gamma_1 z + \gamma_2 xy,$$

where: $\alpha_1 x$ – system overhead;

$\alpha_2 y$ – gross product growth associated with labor productivity;

$\beta_1 y$ – disposal of labor resources in the production process;

$\beta_2 x$ – labor force change due to gross domestic product growth;

$\beta_3 xz$ – involvement of labor resources in connection with investments and additional production of goods.

Transition to dimensionless parameters in the system of equations (1) with values $\alpha_3 = \alpha_4 = \beta_2 = 0$ leads to the Lorentz model, which is an equation for the order parameter η, mating field h and parameter of external influences or exogenous control parameter *S*. In synergy, this system in the most studied form gives the process of self-organization of systems that are in a chaotic state [2].

Consequently, an economic system in a certain range of coefficients of system (1) describes the behavior of the trajectories in the phase space of the type of dynamic chaos — the Lorenz attractor with two attracting centers. Obviously, the addition of processes such as entrepreneurial investment activity adds a regulator, leading to the emergence of new bifurcations of decisions, accompanied by the emergence of new collective processes that make the chaos more orderly [3].

Let us consider the dynamics of systems in the field of catastrophes in the approximation of the standard synergetic approach, which takes into account the principle of the subordination of all degrees of freedom of one selected - order parameter. This leads the system of equations (1) to a single equation for the order parameter.

Consider a variant of model (1), in which we explicitly take into account the innovative activities of the managers of the enterprise. Let us show under what conditions it can become a regulator of stochastic processes and an accelerator of enterprise development. We write the simplified model (1) in a synergistic approximation, taking into account innovative business activities in the form:

$$dx/dt = \alpha_1 m + \alpha_2 xm + \alpha_3 m^2 + \alpha_4 xm^2 - \alpha_5 x - \alpha_6 x^2, \quad (2)$$

$$dm/dt = \delta_1 x - \delta_2 m + \delta_3 x^2. \quad (3)$$

The system of equations (2) and (3) uses the following notation.:

x(t) – capital held by an entrepreneur;

m(t) – characteristic of enterprise management efficiency associated with the introduction of innovative production methods (varies in the interval $0 < m < 1$ and is determined by the relative number of innovations that increase profits in the enterprise; this is described by the last equation (3). The first equation (2), like the first equation of system (1), is the balance of income and expenses of the enterprise;

$\alpha_5 x$ and $\alpha_6 x^2$– non-productive system costs (personal consumption, social needs);

$\alpha_4 xm^2$ – increase in capital expenditure planning, which is used for conducting scientific and engineering innovations by enterprises;

α_2 – characteristic of innovation performance;

$\alpha_2 xm$ – innovative capital investments in fixed assets;

$\delta_1 x$ – an increase in innovative production options with an increase in production;

$\delta_2 m$ – reduction in the number of used production methods that turned out to be ineffective;

$\delta_3 x^2$ – the impact of successful capital investment in the development of new technologies that bring profit.

An analysis of the roots of the characteristic equation of system (2), (3) shows that the behavior is regular and subject to (4)

$$a_5\delta_2 < a_1\delta_1 \quad \text{and} \quad a_5\delta_2^2 - a_2\delta_1\delta_2 - a_3\delta_1 > 0 \quad (4)$$

in the model there are two positive stationary equilibrium states. The first positive steady state can be:

- a stable focus that surrounds an unstable limit cycle;
- unstable focus around which there is a single limit cycle;

- unstable focus without a loop.

The second positive state of equilibrium is always stable and has no limit cycles. Consequently, the system of equations (2), (3) will allow not only to build a dynamic model of innovative development of an enterprise by changing the coefficients α_2, α_2, δ_3 and other, but also to determine the specific area of the phase space in which the production is located. It will also make it possible to determine the presence of potentially dangerous neighboring areas of critical points and to take optimal management decisions to improve production activities.

The described methodology, discussed above, on the example of modeling the socio-economic system, should be considered adequate in relation to the tasks to be performed in forecasting the main parameters of the regional commodity market. The use of this technique allows you to more effectively manage the conjuncture processes in the product market and quickly regulate production activities in the regional sector of the economy as part of its sustainable development.

In this regard, we calculated the forecast of the labor market on the example of the Stavropol Territory - one of the regions of the North Caucasus Federal District (Table 1).

Table 1: Predictive estimate of the supply and distribution of labor in the regional labor market (including the confidence interval), thousand people.

Indicators	2020	2021	2022
Labor supply:	388,5 ± 19,4	382,4 ± 19,6	381,6 ± 19,7
released from businesses and organizations	4,7 ± 0,9	4,6 ± 0,8	4,4 ± 0,8
graduates of educational institutions	14,1 ± 0,5	13,7 ± 0,5	14,7 ± 0,6
laid off due to staff turnover	3,9 ± 1,5	3,5 ± 1,6	2,9 ± 1,7
migrants	7,6 ± 0,6	7,4 ± 0,6	7,4 ± 0,8
Labor distribution:	388,5 ± 19,4	382,4 ± 19,6	381,6 ± 19,7
will look for work (including - additional) independently	77,8 ± 13,5	73,1 ± 15,0	72,5 ± 14,6
through the employment service	51,4 ± 4,5	53,6 ± 4,8	56,8 ± 4,9
will find a job (including - additional) independently	68,1 ± 5,2	68,8 ± 5,2	68,9 ± 5,3
through the employment service	29,4 ± 2,5	32,3 ± 2,6	36,9 ± 2,8

Further development of the regional labor market implies an increase in the optimal and productive employment of the able-bodied population. At the same time, it is necessary to focus on the following aspects of regional policy:
- stimulate an increase in investment in the non-productive sector of the economy;
- improve the vector of innovative business orientation;
- to regulate the socially acceptable level of density, migration and natural population growth in the region;
- implement measures to increase the demand for labor services in the non-production sphere;
- pursue an effective migration policy, including aspects of internal and external labor migration.

In order to improve the methodological approach to the assessment of regional characteristics of the formation and functioning of local labor markets, it is recommended: to use the methodology of forming typologies of municipal territories on the state of local labor markets and the degree of their manageability; apply a methodical approach to the implementation of clustering of municipalities according to the level of risk in municipal labor markets; use a methodical approach to modeling and forecasting the parameters of the labor market, taking into account the proposed recommendations.

CONCLUSION:

The optimal regulation of the production activity of a socio-economic system is reduced to a decrease in the level of its stochasticity and transfer to the mode of movement towards the most stable and more balanced state. In this regard, great importance is attached to the improvement of methodological approaches to modeling and forecasting business processes in the regional complex.

The most acceptable type of production process model can be considered an open three-sector model of the economic system, the components of which are: financial resources, labor, production sector. The model includes the main characteristics of non-productive expenses, gross domestic product growth, the main phases of the reproduction of labor. This allows you to calculate the forecast of the main parameters of the commodity market in the region to make the best management decisions.

Economic-mathematical modeling and numerical analysis of models are of increasing importance for the practice of making forecasts of economic development of industries and increase the possibility and validity of a theoretical analysis of socio-economic processes in the region.

REFERENCES:

1. Berezhnaya EV, Berezhnaya VI. Mathematical Methods for Modeling Economic Systems. M. Finance and Statistics, 2002.
2. Lebedeva IV, Lebedev VI. Mathematical models of the functioning of enterprises involved in innovation activity. Bulletin of the North Caucasus Federal University. 2013; 6(39):15-18.
3. Leontiev V. Economic Essay. Trans. from English. M. Politizdat, 1990.
4. McConnell CR, Bru SL. Economics: principles, problems, politics. Trans. from English. M. Republic, 1992.
5. Prigogine I, Stangers E. Order from chaos. M. Progress, 1986..
6. Chebyshev PL. Selected Mathematical Works. M. Alfa-Kniga, 2014.
7. Shapovalov VI. Simulation of synergetic systems: monograph. Moscow. Prospect LLC. 2015.