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ECONOMIC AND MATHEMATICAL PRINCIPLES OF FORECASTING OF REGIONS' CONVERGENCE LEVEL

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Summary. This paper investigates the approaches to the substantiation of the essence of regional economic convergence and analyzes the main aspects of the convergence of the country's regions with the European Union Member States. The author has proposed algorithm for building a complex model for predicting the level of the regions' economic convergence, which allows to make a number of generalizations that can be applied in practice and can be used for further improvement of regional policy in terms of finding potential opportunities for convergence, levels and pace of regional economy development, opportunities to overcome significant gaps in main macroeconomic indicators.

Key words: *regional convergence, economic mathematic methods, modeling, forecasting.*

A major barrier to harmonious development of our country is the economic differences between the regions. Forecasting economic processes is a first step to overcome these disparities that requires the development of economic and mathematical instruments for predicting the dynamics of perspective convergence of the country's regions as well as convergence of Ukrainian regions with the European Union Member States.

Convergence is a term used in economics to refer to rapprochement of various economic systems, economic and social policies of different countries.

Leading Ukrainian and foreign economists are working at certain aspects related to socio-economic development and the process of regional economic convergence, however, there is a number of problems in the formalization of economic dynamics, building a perspective trajectory of change and consistency in the implementation of dependencies and model correlation that ultimately affects the accuracy and reliability of the forecast.

The purpose of the study is to justify the applicability of economic-mathematical methods for predicting the level of economic regional convergence and bringing Ukraine closer to the level of macroeconomic indicators in some countries of the European Union.

Taking into account the nature of the regional economy, there is a need for development forecasting apparatus, which together with analytical methods could be used for predicting regional convergence. The main way to study economic regional convergence is to build a model.

We propose to make modeling and forecasting of economic regional convergence in the following phases: I – formulation of economic problems, the formation of research objectives, the system of links, the hypotheses and development of a conceptual model; II – development of a mathematical model; III – development of computer models and programming; IV – results analysis and use of models for the prediction of the convergence of region.

To estimate the level of approximation of economies, the notion of real and nominal convergence is used. The first is determined by the value of real GDP per capita, which indicates the level of economic development of the region; the second is determined by five criteria: the value of the country's budget deficit, public debt, inflation, long-term nominal interest rate, the deviation of the exchange rate. Therefore, the model of economic convergence of regions will be expressed by the formula:

$$\begin{aligned} \mathrm{K_p} &= f(GDP, t) \\ K_{\text{н}} &= f(S_b, D_g, I, I_r, E_r, t) \end{aligned} \qquad (1)$$

where K_p, $K_{\text{н}}$ – ratio of real and nominal convergence;

$GDP, S_b, D_g, I, I_r, E_r$ – real GDP per capita, the country's budget deficit, public debt, inflation,

long term interest nominal rate, deviation of the exchange rate;

t – length of time series.

The development of mathematical models is a further formalization of economic development of the region and its expression in pecific mathematical correlations, formulas, equations and inequalities.

Predictive value of primary indicators y_t *(GDP,* S_b, D_g, *I,* I_r, E_r*)* can be obtained by the trend model, which includes two components: determined and stochastic.

$$y_t = f(t,a) + \varepsilon \qquad (2)$$

where $f(t,a)$ – the determined component of the process;

ε_t – stochastic component of the process.

Given the time intervals and the prehistory and forecasting horizon *(t=n+m)*, the equation will look like:

$$y_{n+m} = f(n+m) \qquad (3)$$

where n – number of years in a given time series (prehistory);

m – number of years of the forecast period (forecast horizon).

The next step in the constructing of mathematical model is the selection of quality time trend equations that would objectively describe the dependence of each parameter on the time t. By substituting in equation (2) the selected equation trend, we obtain a mathematical model of primary indicators forecasting, that characterize the level of real and nominal convergence of regions.

To ensure the principles of comprehensiveness and systematic character, the model of the region should be seen as a multidimensional process that is influenced by many factors. In further calculations function value is denoted by $S_b(t), D_g(t), I(t), I_r(t), E_r(t)j^*$. Therefore, the general form of linear parameters for single and multi-model can be written as:

$$K_{pt} = a_0 + a_1 GDP(t) + e_t$$

$$K_н = a_{0+} a_1 S_b(t) + a_2 D_g(t) + a_3 I(t) + a_4 I_r(t) + a_5 E_r(t) + e_t$$

where $a_i (i = 0,\ldots,m)$ – unknown estimates of the parameters;

$e_t (t = 1,\ldots,n)$ – the deviation (errors estimation or changes ε_t);

$GDP(t)$, $S_b(t), D_g(t), I(t), I_r(t)$, $E_r(t)$ – functions of the dynamics of influence of independent factors at the time t.

By this method the mathematical model coefficients of the real and nominal convergence of regions are calculated.

After constructing a model we move to the analysis and justification of its adequacy. Only after the mathematical model is tested on all tests and meets the proposed criteria, we can assume that it is adequate and can be used for forecasting.

Since the level of economics approximation is determined by the real and the nominal convergence, the model of economic convergence of regions will be expressed by the formula:

$$I_K(t) = \sqrt{\left(1 + K_p(t)\right)\left(1 + K_н(t)\right)} - 1 \qquad (5)$$

One should remember that at each of the intermediate stages of modeling, there may be unpredictable flaws that are found in the process of their identification. If it is not possible to correct such errors at the intermediate stage, they are removed in the next stages, and it explains the existence of feedbacks, that are to ensure the reliability of the model.

The proposed algorithm for building a complex model for predicting the level of the regions' economic convergence, which makes it possible to make a number of generalizations that can be applied in practice and can be used for further improvement of the regional policy in terms of finding potential opportunities for convergence, the level and pace of the regional economy's development, opportunities to overcome significant gaps in the main macroeconomic indicators.

References

1. Ekonomichnyi slovnyk [Economic Dictionary]. Retrieved from http://abc.informbureau.com/html/eiiaadaaioess.html.

2. Gladkiy J.N., Chistobayev A.I. (1998). Osnovy rehional'nojj politiki [Regional Policy Framework]. St. Petersburg: Mikhailova V.A.

3. Polischuk S.Z., Dolodarenko V.O., Chornobryvkina N.A., Ryabko A.I. (2001). Systemnyi analiz i modeliuvannia u rozviazanni problem staloho rozvytku terytorii [Systemic Analysis and Modeling in Solving the Problems of Sustainable Development of the Territory.]. Dnipropetrovsk: Poligraphist.

4. Maksimova T.S. (2004). Formuvannia mekhanizmu diahnostuvannia ta prohnozuvannia ekonomichnoho ta sotsialnoho rozvytku rehioniv [Formation of Mechanism for Diagnosis and Forecasting of Regions Economic and Social Development]. Unpublished doctoral dissertation, The Institute of Economic and Law Studies of The Ukrainian National Academy of Sciences, Donetsk.

5. Kharlamova G.O. (2009) Efekty konverhentsii/dyverhentsii v investytsiinomu klimati rehioniv Ukrainy [Effects of Convergence/Divergence in Investment Climate of Ukraine's Regions.] Actual Problems of Economics. 6(96), 183–190.