Parallel algorithms of global optimization in identification of an economic model

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As a rule economic models contain a large number of unknown parameters on which value results of the forecast and of the political recommendations depend significantly. It causes a need of a careful identification of the model parameters. Only a small part of model parameters can be estimated directly from statistical data. Therefore development of indirect methods of an assessment of the remained external parameters of a model or the model identification on the basis of its verification on historical statistics is required. There are three main objectives in identification of a model: (1) developing of criteria for proximity of calculated and statistical time series for compared macroeconomic indexes of studied economic system, and also construction and approbation of various convolutions of criteria for all compared macroeconomic indexes; (2) development of parallel algorithms for an indirect identification of model parameters due to global optimization of a used convolution of criteria of proximity of calculated and statistical series; (3) the analysis of quality of forecasting on the base of a constructed identification set.

This work proposes and approves new criteria for proximity of statistical and computed macroeconomic indexes and a convolution of the criteria that can be used for indirect estimation of the economic model parameters. At indirect identification of parameters of mathematical models of economy there are used parallel algorithms of global optimization. An identified economic model can be used for analysis of specific economic problems, for the prediction of possible future development, for developing policy recommendations to decision makers.

The indirect method of parameter estimation determines unknown parameters of the Uzawa-Lucas economic model [1] by comparing of time series for macro indexes calculated by the model with statistical time series for these indexes. The Uzawa-Lucas model has two sectors: the human capital production sector and the physical capital production sector that produce human capital and physical capital, respectively. Recall that parameters of the model are the next: a technological level, a share of physical capital in production function, value of human capital per person, fraction of labor time devoted to producing output, and externality parameter in the production of human capital, schooling productivity, depreciation rates, subjective discount rate and the inverse of the inter-temporal elasticity of substitution in consumption. Only confidence intervals for the unknown parameters can be directly computed from the statistical data. The unknown parameters can be determined implicitly as those parameters, which provide an extreme value of the used measure of similarity. Parallel processing on a cluster of workstations or on a supercomputer enables to perform exhaustive

search of the parameters within their confidence intervals and estimate their values for a reasonable time. Two time-series are considered to be similar if they are close as functions of time The Theil index of inequality [2] is used as a characteristic of closeness between two time-series.

For uniqueness of choice for optimal point it is possible to use some convolution of Theil indexes for time series of compared macro indexes. For example, if for all macro parameters the adjustment of estimated by model and statistical data has about equal importance, it is possible to maximize the value of all indexes by choice of parameters.

A wavelet based measure of similarity [2] was elaborated. The unknown parameters can be determined implicitly as those parameters, which provide minimum value of the used measure of similarity. With linear trend appropriate rescaling with respect to ordinate axe two completely different time-series can become quite similar and the value of Euclidian distance between these time-series can decreases significantly. Such effect frequently occurs in many real situations. It is proposed to compute such characteristics on the basis of discrete wavelet transform. In that case these characteristics have all necessary properties. It is recommended to use Daubechies wavelet and scaling filters. If that's the case wavelet coefficients are robust for linear trend. That is if the time-series of a macro-index is simply a linear function of time, all wavelet coefficients are zero.

A reduction of computation time can be achieved by means of special computation algorithms of global optimization [4].

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