Investment Activity Prediction with the Use of Multiple Autoregression Models

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Abstract. *The modeling of Ukraine investment activity indicators is carried out in the paper with the use of multiple autoregression models in form of a system of multidimensional difference equations of the interdependent indicators. The combinatorial GMDH algorithm is used for models structure optimization. The statistical data of Ukraine economy for the 5 investment indicators for years 1996 to 2008 are used to construct the model system. The built models showed good accuracy on examination part of the sample (years 2007 and 2008) as well as were used to predict the indicators for 2009 and 2010 years.*

Keywords

Inductive modelling, dynamic system models,
combinatorial GMDH algorithm, economic safety,
investment activity.

1 Introduction

The main aim of the state economic safety is to guarantee its stable and maximum effective functioning now and high potential of development in the future. The investment component is a special subsystem of economic safety.

Relations in an economy between the volumes of the introduced and liquidated tangible assets testify the ageing process of fixed assets. Its renovation substantially depends on investments.

Negative consequences of internal investments insufficiency can be mitigated due to the considerable inflow of foreign investments (an order 20-30% of internal investments).

World experience indicates that countries with transition economies are unable to come out of economic recession without involvement of foreign investments, because in such a way they gain access to modern techniques, management technologies and so on. In addition, foreign investments make an important contribution to the macroeconomic stabilizing. Difficult economic state of a country as an independent state also constrains the country to apply to foreign investments.

Ukraine investment activity is characterized by a range of economic indicators. Ministry of Economy of Ukraine uses them to estimate and analyze the economic safety level. There are such indicators in this area as: accumulated depreciation level, share of direct foreign investments in general investments amount, ratio of investments amount to the fixed assets cost, ratio of investments amount in the capital asset to the Gross Domestic Product (GDP), net direct foreign investments to GDP ratio.

To enhance the effectiveness of administrative decision making support in the investment activity field, it is necessary to predict the investment indicators taking into account its dynamic interdependence. This approach leads to the necessity to analyze and solve the problem of structure-parametric identification of a system of multidimensional difference equations which is an autonomos system of multiple autoregression models for prediction of the given set of economic indicators.

2 Construction of dynamic system models for investment activity indices

The modeling of Ukraine investment activity indicators was carried out with the use of multiple autoregression models in form of multidimensional difference equations of interdependent indicators. The structural and parametrical identification with exhaustive search for model variants in form

$$x_i(t) = \sum_{j=1}^{5} \theta_{ij} x_j(t-1) + \sum_{k=1}^{5} \theta_{ik} x_k(t-2) \quad (1)$$

or in matrix form

$$X(t) = \Theta_1 X(t-1) + \Theta_2 X(t-2) \quad (2)$$

was executed using combinatorial algorithm COMBI GMDH with limitation of model complexity. Here Θ_1 and Θ_2 are 5 by 5 matrixes of parameters for model (1).

The models of the bounded complexity from s=2 to s=6 (according to observations number of the training subset) for every index were built with the use of the combinatorial algorithm for models structure optimization. After building models being optimal by the criterion of regularity (*Ar*) [1] for all indices, the one step forward system prediction for every indices were obtained. The sequential computation of all indices values enables to get predictions for some steps forward.

Ukrainian Ministry of Economy data for the 5 investment activity indicators for years 1996 to 2008 are used for modeling. The indicators are as follows:

x_1 – accumulated depreciation level;
x_2 – share of direct foreign investments in general investments amount;
x_3 – ratio of investments amount to the fixed assets cost;
x_4 – ratio of investments amount in the capital asset to GDP;
x_5 – net direct foreign investments to GDP ratio.

We have built the following dynamic system models:

$$x_1(t) = 0.524x_1(t-1) + 0.434x_1(t-2) + 0.174x_2(t-1) + 0.236x_2(t-2) - 0.281x_3(t-1),$$

$$x_2(t) = 0.408x_2(t-1) + 0.676x_2(t-2),$$

$$x_3(t) = 0.725x_1(t-1) - 1.581x_2(t-1) - 0.302x_2(t-2) - 0.345x_3(t-2) - 1.417x_4(t-1) + 8.954x_5(t-1),$$

$$x_4(t) = 0.453x_1(t-1) - 0.186x_2(t-1) - 0.482x_2(t-2) + 1.356x_3(t-1),$$

$$x_5(t) = -0.007x_2(t-1) + 1.144x_5(t-1).$$

Real values of indices are illustrated by a firm line (figures 1-5) and computed values by a dotted line. The last 4 marked values are prediction for 1 to 4 steps, respectively. Errors of developed models in examination points (2007 and 2008 years) are presented in Table 1.

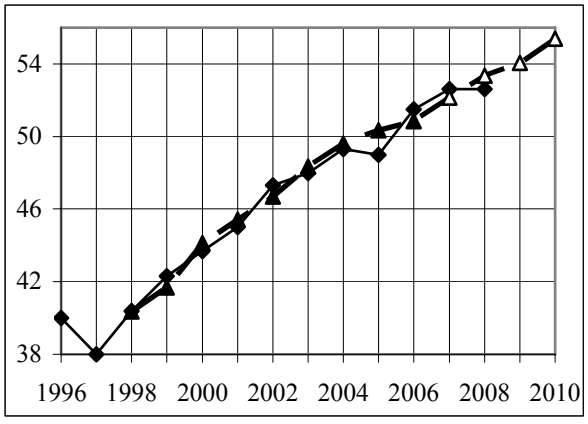

Fig.1. Accumulated depreciation level

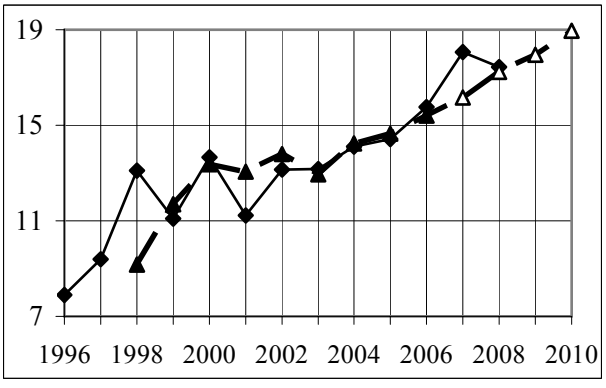

Fig.2. Share of direct foreign investments in general investments amount

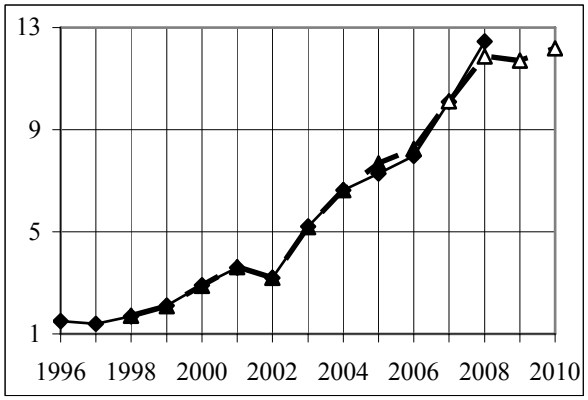

Fig.3. Ratio of investments amount to the fixed assets cost

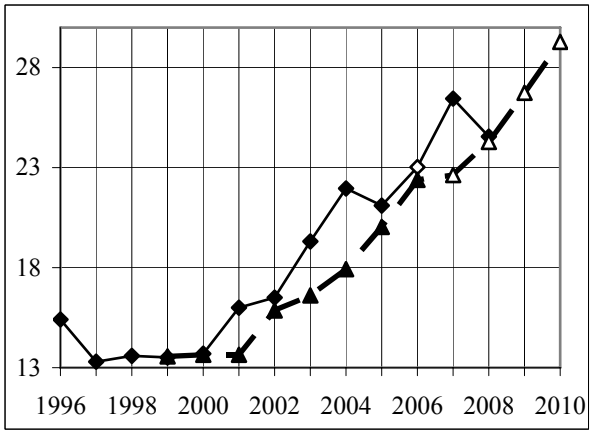

Fig.4. Ratio of investments amount in the capital asset to GDP

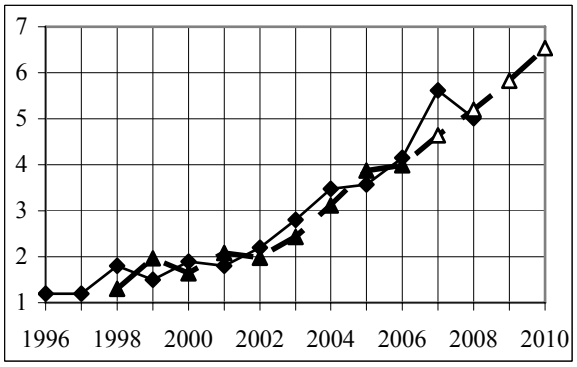

Fig.5. Net direct foreign investments to GDP ratio

Tab.1. Errors of developed models for 5 indicators in examination points, %.

Indicator	1	2	3	4	5	Total
Accuracy	1.2	5.8	2.5	8.6	10.6	5.7

3 Conclusions

The difference between the real and predicted values for some indicators can be explained by:

- too short sample,
- some economical factors substantially effecting the indicators were not taking into account.

Therefore, constructed system models can not be applied for a long-term prediction.

The improvement in accuracy of predicted values is possible sometimes when applying the built models for one step forecasting [2]. In that case the real lagging values (not predicted, as previously) of arguments are used to receive predicted value of an indicator.

References

[1] Ivakhnenko A. G., Stepashko V.S.: Pomekhoustoichivost modelirovania (Noise-immunity of modeling). Kiev: Naukova Dumka, 216 p, 1985. (In Russian).

[2] Yefimenko S. M., Kvasha T. K., Stepashko V. S. Systemne prohnozuvannya dynamiky vzajemozalezhnyh pokaznykiv enerhetychnoi sfery (System forecasting the dynamics of interdependent indices of Ukraine energy sector) // Induktyvne modeluvannia skladnyh system. Zbirnyk naukovyh prac. (Inductive modeling of complex systems. Collected articles). Kyiv: IRTC ITS, pp. 54-59, 2009. (In Ukrainian).