Сумський державний університет
Навчально-науковий інститут бізнес-технологій «УАБС»

ПРОБЛЕМИ ТА ПЕРСПЕКТИВИ РОЗВИТКУ ФІНАНСОВО-КРЕДИТНОЇ СИСТЕМИ УКРАЇНИ

МАТЕРІАЛИ
IV Всеукраїнської науково-практичної on-line-конференції
(Суми, 21–22 листопада 2019 року)

У двох частинах

Частина 1

Суми
Сумський державний університет
2019

УДК 519.8:336.7

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MODELING THE INFLUENCE OF MONETARY POLICY ON REAL SECTOR USING SYSTEM DYNAMICS METHODOLOGY: CASE OF UKRAINE

The use of macroeconomic models in the decision-making process avoids costly and sometimes impossible practical experiments. In addition, modeling helps to determine the outcomes of the implementation of various economic programs, the use of certain monetary policy instruments, etc. The search for the new approaches and the use of efficient economic and mathematical tools for adequate reproduction and formalization of dynamic, nonlinear and stochastic interconnections, both between the elements within individual subsystems of the economic system and between its subsystems in general, are constantly in progress.

Price stability, provided by an effective and rational monetary policy is the foundation for the successful functioning of the country's economy [4]. At the same time, changes in monetary instruments also affect economic growth. It is important to define how real and monetary sectors are interconnected, because it ensures understanding of the main transmission channel from the key policy rate to GDP and prices. Moreover, this research takes into account level of shadowing, because it is quite significant in Ukraine and reach about 32% of official GDP [3].

To analyze the relationship between the monetary and real sectors, a macroeconomic model of system dynamics was developed. System dynamics is modeling method that allows to reproduce behavior of complex systems with many interconnections between variables [5]. The system dynamics approach has several advantages, namely: the ability to produce reliable results using a small sample, the visual representation of simulation results and model structure, and the ability to

incorporate elements of state regulation into the model [6]. The essence of the method lies in the modeling and analysis of complex structures in dynamics.

The entire model is developed on quarterly data from 2007 to second quarter of 2019 in Stella Architect software. The key relationships between variables of the system dynamics model are presented in Fig. 1.

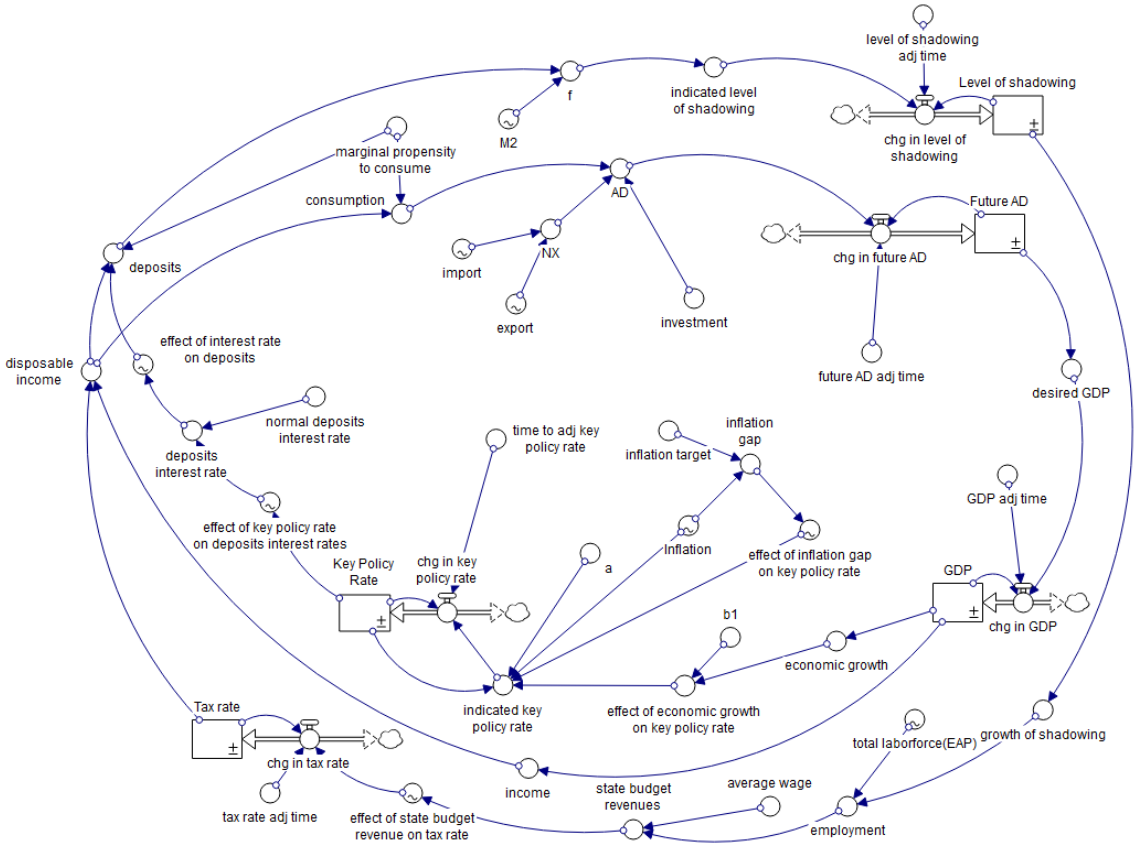

Figure 1 Structure of macroeconomic model (Source: developed by author)

The idea is to represent the interaction between four main variables: GDP, level of shadowing, key policy rate and tax rate. The existent feedback loops produce the following logic of causal connections: GDP → key policy rate → disposable income → level of shadowing → employment → tax rate → disposable income → future AD → GDP. An increase in the central bank key policy rate leads to rise of commercial banks' interest rates on loans and deposits, which has a direct impact on the real sector (level of shadowing and current GDP) through changing incentives for consumption and savings. The rise of the level of shadowing in Ukrainian economy causes an increase in the tax rate, since the state budget does not obtain part of the tax

revenues, because of augmentation of informal sector [1]. Change of the tax rate influences disposable income and therefore consumption, which is one of the main components of aggregate demand and GDP.

The formalization of relationships in the model is based on economic theory and globally recognized formulas. For example, level of shadowing of the Ukrainian economy calculated using monetary method according to the Gutmann formula provided by the Ministry for Development of Economy, Trade and Agriculture of Ukraine [3]. GDP in the model is estimated based on the volume of aggregate demand which calculates by classic formula:

$$Y = C + I + G + NX, \text{ where}$$

C – consumption, I – investments, G – government spending, NX – net exports.

The key policy rate is the main monetary policy instrument under the inflation targeting, it is determined on the basis of the Taylor rule, which normally includes retrospective key policy rate, output gap, deviation of expected inflation from the target and parameters [2].

The reproduction of historical data for endogenous variables in comparison with model behavior is an important step in diagnostic the adequacy of the developed macromodel.

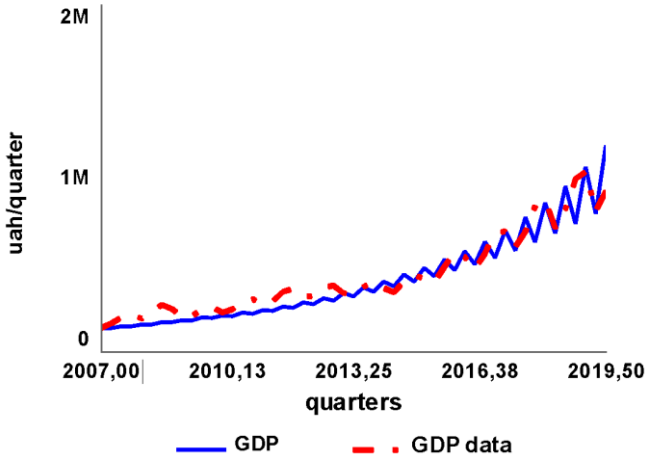

Figure 2 Dynamics of actual and estimated GDP level

Source: developed by author

Graphical representation of the behavior obtained using the model and actual values of GDP is presented on Fig.2. As can be seen from the graph, the model reproduces GDP dynamics quite well. Therefore, the macroeconomic model can be considered adequate.

To sum it up, the model of system dynamics which represents the influence of monetary policy (key policy rate) on real sector (GDP) in Ukraine was developed. The constructed model differs favorably from the existing macromodels by the presence of level of shadowing, what allows to take into account the impact of informal activity. It should be noted that the application of the developed macroeconomic model in practice is able to increase the efficiency of quantitative assessment of the effects of monetary policy through scenario analysis.

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