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Macroeconomic model of national economy development

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Abstract

Same approaches to modeling of national economy development are considered. Methods and models for determination of forecasting values of macroeconomic parameters are proposed at availability or absence of external financing.

Forecasting of economic development of the country and the coordination of the main macroeconomic variables is one of the most important problems at the present stage. Instruments enabling to conduct forecasting calculations and to evaluate efficiency of the acting decisions, are necessary for solution of this problem. The two- sector macroeconomic model, describing internal economy and its connection with the external world, is offered as such instruments [1–2].

This model permits to determine the size of a gross domestic product (GDP), the overall of the balance of payment, requirement for additional financial resources and the size of the external debt at given levels of export and some parameters of the balance of payment.

The complex goods (GDP) and an asset are considered in the model. The goods can be used for consumption, and for investments inside the country and abroad. The asset is the external debt of an internal sector and is determined in foreign currency. Model keeps 11 identities and 4 behavioral functions.

The main accounting framework of the model contains:

The identity "of the national account", describing the account of national economy

$$NGDPR_t = NCONR_t + NTINVR_t + XGNFSR_t - MGNFSR_t$$

and identity of the balance of payment, describing conection of national economy with the external world

$$TAEXTD_t = TEXTVD_t - TLTDDD_t + TLTDAD_t$$

Variables, determined in this framework, are classified as exogenous, endogenous and policy variables.

Endogenous variables are:

$NGDPR_t$	-	gross domestic product, L
$NCONR_t$	-	internal consumption, L
$NTINVR_t$	-	internal investments, L
$MOILR_t$	-	import of energy, L
$MOTHR_t$	-	import of other goods, and services, L
$TAEXTD_t$	-	additional external financing, $.

Exogenous variables are:

$XGNFSR_t$	-	Export of goods and services, L
$TRESVD_t$	-	Currency reserves, $
$TFDIVD_t$	-	Direct foreign investments, $
$TOCFD_t$	-	Other capital flows , $
$TEAOD_t$	-	Errors and omissions, $
$TLTDDD_t$	-	Payment under long-term ext.loans, $
$TLTDAD_t$	-	Amortisation payments under ext.loans, $
$TCAPID_t$	-	Profit from capital, $
$TUNRTD_t$	-	Unrequited transferts, $
$GDPLP_t$	-	GDP deflator of a base year
$GDPLPR_t$	-	GDP deflator of the previous year

The policy variable is:

$REXCHI_t$	-	Exchange Rate, L/$

The target variable is:

$NGDPR_t^*t$	-	GDP

Thus, we have 6 endogenous variables and two equations for their determination. Hence, it is necessary to reveal some economic interrelations between variables, which have added these identities. As such

interrelations we have protect behavioral function:

$$NCONR_t = F1(NGDPR_t)$$
$$NTINVR_t = F2(NGDPR_t)$$
$$MOILR_t = F3(NGDPR_t)$$
$$MOTHR_t = F4(NGDPR_t)$$

These functions reflect dependence of parameters of consumption ($NCONR_t$), investments ($NTINVR_t$), import of energy ($MOILR_t$), import of other goods ($MOTHR_t$) from gross internal product ($NGDPR_t$). In this paper linear approximation of behavioral functions is offered. Thus the factors of approximation are determined by a method of the least squares.

Listed variables, behavioral functions and the identities make a basis of model, which solves a problem of the definition of main macroeconomic variables in constant, current prices, and in prices of the previous year depending on GDP. The general scheme of model implemenation is the following: in the beginning on the basis exogenuos variables, predetermined given and behavioral functions we determine the solution of the model in real terms. The transition to comparable prices and prices of the previous year is carried out with help of the corresponding deflator. The solution in real terms we obtain as follows: the investments and both import are calculated consumption, which provide an appropriate level of the GDP. Further a level of import of other goods and energy, necessary for achievement of significance GDP, determine total volume of import ($MGNFSR_t$) in real terms, which with help of the GDP deflator and exchange rate is transferred in dollar calculation ($MGNFSD_t$). By means of the exogenous given volume of export ($XGNFSD_t$) and calculated total volume of import ($MGNFSD_t$) are defined: balance of goods ($TBMCHD_t$), balance of services ($TBFSRD_t$), balance of the current account ($TBCACD_t$), external financing ($TEXTVD_t$), additional external financing ($TAEXTD_t$), volume of the external debt ($TEXTDD_t$), balance of the capital account ($TCAPD_t$) and volume

of the currency reserves ($TRESVD_t$).

The formulae for their calculation are specified as follows:

$$MGNFSR_t = MOILR_t + MOTHR_t$$

$$TBTRDD_t = XGNFSD_t - MGNFSD_t$$

$$TBCACD_t = TBMCHD_t + TBFSRD_t + TCAPID_t + TUNRTD_t$$

$$TRESVD_t = TRESVD_{t-1} + TRESDD_t$$

$$TEXTVD_t = -TBCACD_t + TRESDD_t - TFDIVD_t -$$

$$-TOCFD_t - TEAOD_t$$

$$TCAPD_t = TEXTVD_t + TLTDDD_t - TLTDAD_t +$$

$$+TFDIVD_t + TOCFD_t$$

$$TBFSRD_t = XGFSRD_t - MGFSRD_t$$

$$TBMCHD_t = XMRCHD_t - MMRCHD_t$$

$$TBTRDD_t = TBFSRD_t + TBMCHD_t$$

Exogenous variables are defined on whole forecasting period and present a separate problem. Endogenous variables are calculated by solution of the linear system equations. The policy variables are used as economic regulators, and their values are defined by the user on the whole forecasting period. Target variables define problems of researches, they may be the following: a desirable level GDP, overall of the balance of payment, rate of inflation, volume of currency reserves.

The offered model can be used, first of all, for fulfilment of the base scripts, and in second turn, for simulation of influence of changes in policy and exogenous variables on main macroeconomic indicators. In considered case we can simulate the various, changing export, exchange rate. Executing these changes, we obtain the alternative solution, which is stored in appropriate tables.

Use of the exchange rate as policy variables provides achievement of stability of the balance of payment and inflations and has two interconnected aspects: first, increase of competitiveness of national economy

on world level, second, stimulation of production of the goods on export and reduction of the economic costs at the expense of excess of export above import, improvement of a condition of the commercial balance.

Depending on delivered problems the model can be used in two directions: for creation of the feasible macroeconomic programs, or for development of the alternate programs and analysis of offered policies.

The model can be used with restriction on external financing or without it. The model with restriction on external credits proceeds from their opportunities of national economy, and without restrictions — from its needs. In case of the restriction on external financing the problem is reduced to determination of total volume of import.

For this change we shall consider two variants, which differ one from another only by a method of definition of volumes of import of energy and other goods. In the first variant of considered model it is supposed, that there is the dependence of import of other goods on the size of GDP of the previous year, the import of energy is determined as a result of subtraction of import of other goods from total volume of import, the investments are assumed depending from import of energy, and GDP is calculated as a function of investments.

Using designations, accepted in base model, the given variant can be described by the following system of equation:

$$MGNFSR_t = XGNFSR_t + (TFDIVD_t + TUNRTD_t + TOCFD_t$$

$$+TEAOD_t - TCAPID_t - TRESDD_t)REXCHI_t/GDPLP_t$$

$$MOTHR_t = G1(NGDPR_{t-1})$$

$$MOILR_t = MGNFSR_t - MOTHR_t$$

$$NTINVR_t = G2(MOILR_t)$$

$$NGDPR_t = F(NTINVR_t)$$

$$NCONR_t = NGDPR_t - NTINVR_t - XGNFSR_t + MGNFSR_t$$

To obtain the equilibrum solution of described system of equations we proceed as follows: we set some fall of export or external financing. In this case total volume of import decreases, hence, decreases

and import of energy, that contribute to reduction of the investments, that, in turn, promote reduction of GDP volume. Reduction of volume GDP conducts to decrease of general consumption, and it causes fall of import of other goods. If the received rates of fall are sufficient for balance of systems, we receive the equilibrum decision, otherwise the iterative process proceeds. After reception of the equilibrum solution we calculate growth rates of GDP.

In second variant of considered variant it is supposed, that the import of energy is function of GDP for the previous year. Then to identities, determining general import and consumption are added the following equations:

$$\begin{aligned} MOILR_t &= g3(NGDPR_{t-1}) \\ MOTHR_t &= MGNFSR_t - MOILR_t \\ NTINVR_t &= g1(MOILR_t) \\ NGDPR_t &= f(NTINVR_t) \end{aligned}$$

To obtain the equilibrum solution, we act in the same way, as well as in previous case. The standard components of the balance of payment and external debt are defined from the same relation as in the main model.

We shall consider a case when it is necessary to find out which additional external financing is necessary for achievement of a given GDP level. For this purpose, transforming some equations of base model, we shall define necessary external financing, insuring a given GDP ($NGDPR^*t$) level.

We shall obtain a system of equations, including functions of consumption, investments, import of energy and import of other goods, but also 10 identities. As for given case GDP acts as target variable, there is no identity describing interrelation between GDP and its components. The other identities describing the balance of payment and the external debt do not vary. A kind of behavioral functions is changed: consumption ($NCONR_t$), investments ($NTINVR_t$), import

of energy ($MOILR_t$) and import of other goods ($MOTHR_t$).

$$NCONR_t = g1(NGDPR_t^*)$$
$$NTINVR_t = g2(NGDPR_{t-1}^*)$$
$$MOILR_t = g3(NGDPR_t^*)$$
$$MOTHR_t = g4(NGDPR_t^*)$$

For given variant exogenous variables are the same as in base model, but disappears GDP from the set of endogenous variables . Having established level of GDP ($NGDPR_t^*$), we determine consumption, investments, import of energy and other goods, which, in turn, determine volume of general import. The equilibrium solution, when the demand is equal to the supply, determines volumes of external financing, which provide achievement of a given level of GDP. We shall note, that the offered model has a sufficient degree of flexibility during its application for development of the forecasts and choice of the policy, endogenous and exogenous variables, given purposes intended for achievement. It can be more detailed on introduction of additional economic sectors, equations and variables, not losing thus of flexibility.

On offered model and its variants on the basis of Republic Moldova statistics experimental evaluations for determination forecasting of significances main macroeconomic parameters of national economy on period till 2000 were performed. Carrying out the calculations show, that at decrease of volume of export on 33 %, the trade balance is increased by 71 %, level GDP decreases on 24 %, the size of the investments is reduced on 19 %, volume of consumption falls on 23 %.

At absence of external financing reduction of volumes of export on 33 % results in reduction of total volume of import by 34 %, including the import of energy - on 38 %. It in turn causes fall of volume of the investments on 5 % and GDP - on 26 %. As a result consumption decreases on 38 %.

In conditions of access to external market of the credits at reduction of export on 33 % the GDP growth on 18 % causes increase of import at 6

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