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Experience of Macroeconomic Models Realization in Transition Economy

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Abstract

This article represents an issue about macroeconomic model realization under transition economy of Moldova Republic. Different macroeconomic model beginning with simple monetary model and growth model, and more complicated model as financial programming models, general equilibrium model, describing complex functioning of national economy and forecasting effect of various economic policies on economy development were considered. Some comparative analysis and conclusions were presented.

1 Introduction

Macroeconomic models, dealing with aggregated indicators, describe working of the economy as a whole. Such models are accessible to the deep mathematical analysis and give an opportunity of economic system research at small volume of the initial data. Macroeconomic models are effective tools for theoretical researches of economic processes and for working out the direction of economic development and forecasting a lot of national economy indicators. Regular use of macroeconomic models in the countries with the settled market relations began in the first half of the 20-th century. At present time many macroeconomic models having both theoretical and applied value are developed. In the countries which are in the process of transition to market relations the wide use of macroeconomic models concerns to the second half of the 20-th century. In these countries macroeconomic modelling is used for creation of some analytical framework with the purpose

of co-ordinating the set of macroeconomic policies and the structural transformations necessary for maintenance the transition of the country to market economy. Wide use of macroeconomic models is explained by their simplicity from the mathematical point of view, being simultaneously useful and important tool displaying real economy. Macroeconomic models are used for support and for analysis of macroeconomic policies, and for improvement of a sequence of performances of these initiatives.

The formalised macroeconomic models represent the simple and clear analytical framework consisting of a range of economic identities and well-specified assumptions, determining interrelation between economic variables (the so-called, behavioural equations). At the same time the process of model creation and calibration for concrete economy is rather complex. It requires special economic knowledge and a certain experience: in definition of necessary changes of the models structure reflecting specific features of concrete economy, in a choice of the important economic variables in quality of exogenous. The purpose of present article is to give the summary of the macroeconomic models realised in Institute of Mathematics and Computer Science during last decade, which can be used for the co-ordination of economic policies and structural reforms at Republic Moldova transition to market relations.

2 Simple Monetary and Growth Models

For construction of the financial programming model or the financial program it is necessary to define accounting macroeconomic framework, which would cover the basic sectors of economy: private, government, monetary and foreign. Economic identities make a basis of accounting framework. The behavioural equations determining interrelation between economic variables, are specified so that to add accounting identities up to the closed system of equations. The variables identified in this framework are subdivided into exogenous, endogenous and policy. The combination of variables, economic relations and identities forms economic model, which is called to prove policy decisions. For

the realisation of financial programming model (development of the financial program) it is necessary to execute the forecast of exogenous variables, to define precisely values of target variables and to solve the model for policy variables which will provide desirable values for the target variables. In the simple monetary model of open economy [1-2] it is usually supposed that prices and output are set exogenous, and the inverse of the income velocity of money is constant. The balance of payments in such model can be represented as a difference between the flow of demand for money of the private sector and the flow of internal credits. The flow of internal credits is a policy variable. In this model the gain of the money credits offered by banking system, in a limit will be compensated due to decrease in the international credits calculated on the same base. For the formulation of the financial program the required value of the balance of payments is set, and the model is solved in scope of finding necessary increase (reduction) of internal credits. Such type of models provides motivation of substantial use of marginal credits as key policy tools. Monitoring of internal credits expansion allows to determine, whether the financial program promotes the achievement of required output at the given change in international reserves.

One of the lacks of presented model is that the nominal income is set as exogenous. In practice, certainly, financial programs treat a level of the internal prices, as endogenous one. Endogenous price level, and, hence, the nominal income demands small updating in a simple monetary framework, as now in model there are two target variables, namely the balance of payments and inflation.

One of ways of the problem solution consists in the assumption, that both prices and international reserves are crucial for violation of the money market balance. However the purposes of the balance of payments and inflation can not be achieved independently as there is only one policy variable (internal credits).

Use of the exchange rate as tool policy provides a way for achievement of independence of the balance of payments values and inflation. Change of the exchange rate has two interconnected effects: first, it improves the international competitiveness of economy; second, it in-

creases the initiative of production of the goods for export. The exchange rate policy, hence, is intended for change of production structure and expenditures in economy, decrease of import and increase of export, improve of trade balance. Having available two tools, namely, rate of inflation and rate of internal credit expansion, authorities are able to achieve the balance of payments purpose, having received expected rate of inflation.

Exogenous nominal income (in simple monetary model) is the potential lack of monetary model when the construction of the program has the important participation in economic growth. So, for example, it is necessary to consider models of growth in addition to the monetary analysis. Many from available, standard models of growth accent a role of savings, investments and offers of external financing. Despite of the significant success achieved in this area, this particular type of growth model is still widely used, especially for countries where the information base is insufficient. Though models which correlate economic growth extremely to increasing of physical capital stocks and therefore with availability of internal and external financing, having advantage of simplicity, are not capable to receive positive effect of growth from increasing efficiency of policies. Accordingly, these models can not provide analysis of the total growth in the countries with transitive economy.

In simple model of growth [1] the change in output is related with investments by means of the ratio of capital gain to output (ICOR). For settled value of ICOR, the increase in the level of investments will follow from the appropriate increase in growth of the real gross domestic product. As alternative, it is possible to use this ratio for reception of a "necessary" level of investments, which are consistent with desirable rate of growth. The model includes two behavioural equations. One is that import is the steady function from output. The second reflects the fact, that private savings are positively dependent from the level of available income. The model becomes closed with identity asserting that the total accumulation (equal to investments) is made of private and foreign savings.

Working of this open economy model is rather simple. We shall

assume, for example, that authorities increase a level of investments, increasing the state accumulation through reduction of the state consumption. As the change of private and state investments is assumed to be constant, the growth of state accumulation will increase the total accumulation and, hence, investments. At given ICOR, growth of investments further will be transformed into higher rate of growth of real GDP. Provided that authorities carry out some control above private inflow of capital or if the offer of foreign capital is completely elastic, the purpose of output can be co-ordinated with the purpose of the balance of payments. The practical advantage of this simple model of growth, obviously, is caused by realism of these various assumptions, as some of these assumptions are rather rigid.

Now we shall consider, how the model will be modified, if the level of net foreign inflow was fixed. In practice, certainly, acceptance of internal policies, which result in financial stability, and which raise perspective of growth, would assume production of additional external financing for the country, as well as more attractive terms of this financing. Really, even in a case when foreign creditors are not ready to expand borrowing, absence of the capital can be reduced or even inverted, if the country has provided following suitable adjustable strategy. In this sense, the assumption of a constancy of net capital inflow is used here more for an illustration of a role of other policies in liquidation of a so-called gap of foreign currency receipts, than for the description of a reality.

In condition when foreign financing is given, any additional accumulation is insufficient to achieve simultaneously both the purpose of growth, and the purpose of balance of payments, private accumulation will be adjusted to equate the total accumulation and investments. But this "necessary" level of private accumulation can be improbable in sense of concordance with a level, which follows from behavioural ratio between private accumulation and the available income. In such chance, the iterative sequence of adjustments can be accomplished either above parameters or above the growth goal until the required level of private accumulation will come in conformity with a historical behavioural ratio between private accumulation and the available income.

The alternative way of the problem solution consists in inclusion of the exchange rate change effect in trading balance. Influence of the exchange rate on export and import allows to co-ordinate the purpose of growth with an accessible level of foreign inflow actions.

The approach of financial programming described above can be generalised by introducing into it the simple growth analysis. The resulting merged approach implicitly means three fundamental purposes of financial programs: the balance of payments, inflation and rate growth of real gross domestic product inside the concordance framework. Merge of monetary and growth model [1] is rather simple. The most suitable growth model for the countries with adjustable programs is that with limited foreign financing. Suitable monetary model could be that in which both balance of payments and prices are determined inside the model. Gross domestic product can be determined from ICOR ratio. The prices are defined from monetary model. So nominal gross domestic product can be determined directly. The monetary model also determines demand for money (through a ratio income - income velocity of money), and supply for money from the balance sheet of the banking system. Definition of the balance of payments is common for both models: growth model and monetary model. Inflow of foreign capital is supposed to be exogenous, import is the subject to be influenced by internal output and real exchange rate, but export is the subject to be influenced by the real exchange rate. Meaning, that prices are exogenous in simple growth model while gross domestic product is exogenous in the simple monetary model, the merged model can be solved by it representation as two ratios between change in gross domestic product and change in prices.

In the growth model this ratio is positive. The gain of the internal level prices increases nominal gross domestic product, and through ratio accumulation - increases the income. There will be also changes in nominal accumulation. The private sector can use these savings for accumulation of the physical capital or money. While all marginal additional nominal savings are not designated for accumulation, some gain of the physical capital will take place. At positive investments, in concordance with ICOR, gross domestic product will increase also.

From the monetary model, on the other hand, the ratio between change in prices and change in gross domestic product is negative. Increasing in gross domestic product increases demand for money, thus, creating discrepancy of the monetary market. For the given rate of internal credit expansion, this discrepancy will create inflow of foreign reserves and will cause falling in internal prices to clear monetary market.

In summary, the basic idea consists in the simultaneous solution of these two ratios so that gross domestic product and internal prices could be expressed as function of exogenous and political variables. The structure of the merged model can be represented graphically.

Realisation of simple monetary model and incorporated model [3-4] was executed in Microsoft Office Excel application on given by Republic of Moldova data. As base year 2000 was chosen. Models are supplied with the simple and convenient interface, which help the user carry out simulations and iterative calculations, changing target, policy, exogenous and endogenous variables. Calculations were carried out also on model of World Bank RMSM-X [5], which is a version of Harrod-Domar growth model with two financial gaps.

In the approach described above, in merged monetary and growth model the simplified form of the behavioural equations is used with the purpose to receive a simple method for solution. However, model, which formed a basis for economic program creation, should be exhaustive to reflect adequate economy structure, but such a model can be received only endowing analytical solution. In that case to obtain model solution the numerical methods are used.

3 More Complicated Financial Programming Models

For operative work, including long-term planning, it would be desirable, if not necessary, to have a small calculating model. In such a model certain behavioural relation between key macroeconomic variables and control parameters are precisely determined by means of the consistent

framework. At the absence of precisely determined model it's very difficult to develop enough desagregated middle term economic program which will be co-ordinated to behavioural relationships. Moreover, a key element of the economic program designing is the ability to change an assumption, interrelations and policies to provide a number of alternatives even if the purpose of these alternatives is granting wide basis for discussion of the offered policies. Precise, completely integrated model is necessary for such type of exercises.

The represented in [6] model, though it was applied to Turkey, is sufficiently general that could be applied to a lot of developing economy. It is intended for creation of a framework for middle terms analysis with certain connections between tax, monetary, the exchange rate policies and key macroeconomic variables. The model has some considerably differing features. It unites production determined by demand, with supply that is reflected in policies, which influence investments. It allows determining relative shares of internal and external factors of production by means of their relative prices. Adjustment and growth interact with fiscal, monetary and external policies. It gives a flexible policy of the external debt.

The national economy yields unique goods, domestic goods, which either are exported, or consumed at home, or invested. It is supposed, that all import goods are intermediate, i.e. on average there is some gain of the added cost on the imported goods before their final sale. Output is carried out by means of internal factors of production and intermediate import goods. The added cost or gross domestic product minus intermediate import goods is equal to volume of output. Relative values of each used factor, factorial shares, are functions from their relative prices. The level of output is determined by a final demand for it. If output is less than capacity, so that demand does not prevail over prices, the domestic goods prices are determined by cost of two factors of production: industrial taxes and import duties. If output is more than capacities, prices are higher than cost and reflect pressure of abundant cumulative demand. The model thus is suitable for determination of the inflation caused by both demand, and cost.

The final demand consists of two parts: exogenous part, which con-

tains government consumption, government investments, and change in stocks and export. Real private consumption is the function of real available income. Real private investments are the function of real cost of internal credit flow directed to private sector. Export of goods is the function of internal key variables: real gross domestic product and relative prices. The real added cost is made due to increase in total output (endogenously determined, sensitive to the relative price), received due to internal factors of production. By means of the added cost price index, set exogenous, used basically for all calculations of wages, payments for the ground, the capital etc., the real added cost will be transformed to the nominal added cost. From total value of the nominal added cost the certain part goes directly to the private sector as the income, the rest is collected at the state. The added cost collecting in a private sector, with taking into account profit from export and factors income, transfers from abroad and state transfers, determines total private income.

After subtraction of direct taxes the available private income is determined. Then real private consumption as function from the real available income pays off. Budgetary deficit pays off as a difference between state expenditures and state revenue. The state expenditure consists of exogenously determined consumption and changes in stocks, interest payments on unpaid external public debt, transfers to private sector and endogenously determined interest payments for credit which should be received after basic year. The public revenue consists of endogenously determined direct and indirect tax incomes, transfers from abroad and parts of all added cost which concerns to the state. Subtracting from budgetary deficit the exogenously determined part of internal non banking financing, the flow of internal credit given to the state by banking system, and known external financing (disbursement minus amortisation payments), we will obtain the unpaid external financial debts. The external debt service module includes the detailed description of loan categories, grace and maturity period of loans, interests rate change, calculates foreign financing necessary to serve this deficit and government expenditure on interest payments for again acquired debt.

The current account balance can be represented as resources balance (i.e. a difference between export and import of goods and non-factor services plus net factor income and transfers to the government and private sectors from abroad and minus interest payments for the external debt service).

The capital account of balance payments consists of a set of exogenous entrance indicators for the state and private sectors, of endogenously defined sum of the state deficit external financing and the private capital flows caused by destabilisation of the money market. Change of foreign reserves is simply the sum of the current and capital accounts. Change of reserves will reflect change in current account, in expansion of external financing of state deficit, increasing in internal monetary market discrepancy.

The real supply of money is determined by a function of real gross domestic product and inflation. The capital is in permanent movement. If, for example, the supply of money exceeds demand for money, there will be an outflow of the private capital, as local residents will try to reduce available deficit of monetary balances to balance their portfolios.

Given model was adapted to economy realities of Republic Moldova [7], and realised in system of economic modelling Javelin-Plus, using an iterative method for solving of the system of non-linear equations and econometric estimation of six behavioural equations being a component part of the model. The realised model is endowed with a set of multilevel user menus, which provides simple and effective interface for the user. The program interface enables the user to change values for exogenous, policy and target variables; to change validity of model; to modify behavioural equations, historical and base year data. Thus, the user can carry out multiple simulating calculations and to carry out on their basis the multilateral economic analysis.

Also in Javelin-Plus there was realised the W.Bier's idea [9] about creation of a set of macroeconomic models, using various updating of behavioural functions.The program and the appropriate interface was created, with their help the control calculations were carried out, according to economic development of Moldova Republic.

Further the financial programming model developed by U.S.A.D.

for Romania in 1993 [10] was considered. The model contains 82 equations, the 16 equations from which are the behavioural ones. As the purpose of model is granting the detailed and concrete data concerning intersectoral interrelations, the high degree of simultaneity was entered at the solution of the model. The model is solved taking into account the target variable gross domestic product, which is determined in nominal and in real values. Also as a target variable any other endogenous variable can be chosen. Thus, the set of decisions received with the help of the model depends on the purposes of the application.

The main indicator – gross domestic product – is calculated from the production and use side of the basic sectors and from the expenditure side on the other hand. The model gives the solution for two main blocks: the balance of payments block and the block concerning national accounts.

The balance of payments block delivers the data on the basic components and determines balance of goods and non-factor services, which then are used in the block concerning national accounts. To catch feedback effects in economy, the block of national accounts contains an essential set of relations between endogenous variables of system.

The balance of payments block. Volumes of export depend on external economic activity, and export prices are connected to world trade. Besides this, relative prices of export are important at definition of export volumes, reflecting competitiveness of national economy, thus, influencing the amount of local goods required by foreign markets, according to competitiveness of local and foreign supplies in these markets.

The imported goods are subdivided into the power goods and other goods. Import of fuel appears basically in trading exchanges. Price indexes on export were developed on the aggregated total exports, and price indexes on import were constructed for combustible and other import.

As soon as export and import of goods and non-factor services are received, the model calculates balances for goods, non-factor services, balance of material services and current account balance. Change in foreign inflow is almost always set exogenously. To the moment as

foreign reserves are established it is necessary to enter policy into the model, used for maintenance of this offered level. Model calculates total need for import, volume of external debt and capital account deficit.

The model can give information concerning necessary external financing; model solution gives total loans necessary for financing of current account deficit. It is easy to enter estimations into the model concerning need for loans, except for existing commitments. For calculation of additional loans, from the total necessary loans, calculated in the model, disbursement and amortisation payments will be taken away.

Investments. Total investments are broken into gross investments and change in stocks both of them are represented by behavioural equations. Total investments are determined by gross surpluses of exploitation, by general level of economic activity and by interest rate. General level of economic activity also determines changes in stocks. As total gross surpluses of exploitation represent difference between gross domestic product and net profit of domestic economy to which taxes from income are added, investments are closely interconnected to economic activity of the state and private sectors.

Private consumption depends on net profit of household, relative prices and uncertainty in prices. Net profit of households consists of salary and other incomes. Wage rate depends on the added cost which, in turn, depends on the general level of economic activity.

The government consumption and transfers. The public sector consists of state and local budgets and social insurance fund. As the model assumes the representation of an opportunity of the analysis of tax policies at a national level, the basic desagregation takes place at the state level. Concerning to incomes, direct taxes are subdivided into taxes from associations and taxes from households. Modes of the taxation for these two sectors are policy variables, and they can be used for the analysis of tax initiatives on a national economy. Indirect taxes are subdivided into the tax from the added cost, excises and taxes to import. Tax tariffs also are a policy variable within the model framework. The State expenditure consists of consumption and sub-

sidy. Subsidies are subdivided into what are given to business sector and subsidy, given to household. The historical data on long prospect are available only for the state expenditures, rather than for the state consumption, and as consequence, behavioural function for the general expenditures was appreciated. And, thus, the state consumption is a result of subtraction of the subsidies, transfers and interest payments on an external and internal debt from the general expenditure.

The added cost. The system of equations simultaneously gives solution concerning total production and general expenditure in national economy. The secondary sector, which accumulates almost half of total added cost of the country, is endogenous; its level depends on investment activity and consumption. Though the tertiary sector is contained basically in the models, the initial sector is endogenous, as its level is defined by a global level of expenditure and economic activity of the remaining two sectors.

The considered model of Romanian economy was adapted for economy of Republic Moldova [11]. In Javelin-Plus system the modelling computer program having multilevel user interfaces was realised. Enclosed user menus are represented. With its help it is possible: to modify initial historical and base year data; to modify and estimate behavioural functions; to set values for exogenous variables for all period of model action; to establish values for policy variables also for all period of model action; to receive results of calculations as diagrams and tables. There is an opportunity to analyse intermediate results. The base year co-ordination matrix, for all years previous to base year is realised. Tables of results on all considered in model sectors are stipulated. There is an opportunity of viewing of intermediate results and fast diagrams. At the desire, it is possible to print out all necessary graphic and digital information. The model is realised using consecutive iteration method. Therefore in an interactive mode it is possible to change amount of iterations and accuracy of calculations. The opportunity of change of validity of model is stipulated. Calculations for the five years' period and longer forecast periods were carried out.

4 A General Equilibrium Model

In continuation, we shall state simple general equilibrium computing model [12] for small open two-sector economy. Changes in an external environment and economic policies become tool in definition of progress in economic development for less developed countries. These models give good mechanism with the help of which the external shocks and economic policies pass through all economy. Shocks include the external sector trading shocks: repeated increase of the mineral oil prices or falling of the prices for the intermediate goods in the inflow of external capitals. The reciprocal policies most frequently offered also are aimed at external sector: real exchange evaluation for the adaptation to adverse trading shocks or to reduction of foreign borrowing; reduction of the deformed taxes for increase of economic efficiency and to make economy competitive in the world markets.

Hence the model which covers the marked shocks and the appropriate policies, attaches special meaning to external sector of economy. Moreover, the decision of many problems is connected to relations between foreign sector and other economy. Thus, the model will cover, at least, two industrial sectors: one, making goods on export, and other making goods for a home market. The goods participating in circulation are useful to subdivide into imported and exported goods. Such division enables to look at trading shocks, and also on influence of tool policies, such as tariffs for import and grants for export.

The minimal model, which includes these features though is small, covers a large area of results. It is possible to investigate influence of increase in prices on mineral oil (or other prices for import and/or export). Besides these model enables to look at use of trading and financial policies: grants for export, tariffs for import and internal indirect taxes. Increase or decrease in foreign capital inflow also can be investigated within the framework of this model.

The biggest advantage of small models consists in their simplicity. They represent transparent mechanism thanks to which change in international shocks or policies influence economy.

Base model concerns one country with two industrial sectors and

three goods. There are two products made in the country: export of goods that are sold to foreigners and have not been demanded inside the country, and internal goods sold only inside the country. In the model there is one consumer which receives the income. The country, being small, in the world market, faces with the fixed world prices for export and import.

In the model three economic agents operate: producer, household and rest of the world. Marginal opportunities of local production are determined by the greatest possible combination of commodities between export and demand for the internal goods, which economy can offer. Function is supposed to be concave and will be specified as function with constant elasticity of transformation (CET). The volume of the aggregated production is fixed. As in the model the intermediate commodities are not examined, the volume of production corresponds to gross domestic product. The assumption of the fixed level of production volume is equivalent to full employment of all initial factors of production. Export-demand for internal goods ratio is function of the relative prices. The price of the composite good is determined as dual estimation for the equation determining export. The price of aggregated supply corresponds to gross domestic product deflator.

The composite goods consist of the local goods and the import goods. It is supposed, that import and the local goods are imperfect substitutes (are not interchangeable). Following this treatment, it is supposed, that the composite goods are defined as aggregated function with constant elasticity of substitution (CES) dependent on volume of import and volume of internal goods. Consumers maximise composite goods utilisation. Volume of import is defined from relationship between import and internal supply, which is function of the relative prices. Price of the composite goods is defined as the dual evaluation appropriate to equation for import. Price of composite goods corresponds to aggregated consumer prices index.

Separate equation determines income of domestic economy and demand of domestic economy for composite good. We shall note that income is spent for the unique composite good.

Price equations define interrelation between seven prices. In the

model world prices for export are fixed, local prices for export and import are determined; price of internal supply is calculated; price of aggregated output and price of composite good pays off. As only relative prices are considered, it is necessary to define scaling price – the exchange rate in this case.

There are determined three equations specifying markets clearing conditions. Internal demand is equal to the internal supply, composite demand is equal to composite supply and trading balance restrictions should be satisfied. The full model contains fourteen equations and thirteen endogenous variables. However three balance conditions are not independent. Any of them can be omitted and the resulting model becomes completely determined. To prove, that three conditions of equilibrium are not independent, it is enough to show that the model satisfies the Walraas law. Such model "is closed" in the sense that there is no outflow of funds inside and outside the economy. It is easy to prove it using three identities: for aggregated supply, for aggregated composite supply and aggregate profit in nominal prices.

The considered model, known as (1-2-3) model, differs from standard neo-classic models in which all commodities are sold and all sold goods are interchangeable. The commodities in it have no property of perfect substitution and perfect transformation. All commodities made inside the country which are not exported, are really treated as commodities not subject to sale and purchase. The share of the goods not subject to sale and purchase in gross domestic product is equal to difference between unit, (as all parameters are considered in shares from gross domestic product) and share of export, and all sectors are treated symmetrically.

The expanded version of model includes public revenues and expenditures, and also accumulation and investments. In new statement four tax tools are included: the tariff for import, grants for export, indirect taxes sales, direct taxes. Besides that, accumulation and investments are included. The unique representative of domestic economy saves up fixed share of income. Public savings (budgetary deficit or proficit) are balances between income from tax both foreign grants and government expenditure (all exogenous) such as the government consumption and

transfers to domestic economy. Current account balance, entered for foreign accumulation presentation, is a difference between export and import in world prices, adjusted to grants and transfers from abroad. As it was noticed earlier, output is fixed, so the model is controlled with the help of accumulation: aggregated accumulation is adjusted under the aggregated investments. In total, there are 20 equations and 19 endogenous variables. However, by means of law Walraas one of the equations – the identity of the accumulation-investment – follows from others and can be omitted.

Computing framework construction needs to carry out at modelling usual steps: announcement of parameters and variables, to find out input data; assignment of initial values to parameters and variables; equation specification. And in addition, model should be precisely determined as a set of equations; in some cases the necessity of scope function optimisation can appear. In summary computing simulation calculations will be carried out with using the built-in procedure. Other convenient feature of (1-2-3) model is the small volume of necessary data. The data on national income, financial and balance of payments accounts, which are usually enabled for publication by national governments, are sufficient.

At calibrating all the data are scaled and indexed according to output, which is accepted equal to 1 in base year. Calibrating of parameters and variables will be carried out; it is interconnected with base year data so, that calibrating will be carried out automatically when elasticity values or base year are changed. Exponent parameters of CET and CES functions are calculated under the formulas containing appropriate elasticity. Having pre-set values for export, import, supply and demand at the base year, the share parameters of internal commodities are determined. Formulas for their calculations turn out from expressions for demand for export and import functions accordingly. Other pair of share parameters is determined directly with the help of functions CET and CES. Alternative procedure for calibrating consists in establishing base year data and solving system of equations for definition the values of parameters satisfying base year equilibrium condition. In this case there is no necessity to receive explicit expres-

sions for parameter that is very useful property when more complex functional forms are considered.

The considered model was adapted to economic conditions of Moldova Republic [12]. With its help simulation calculations were spent, using as policy variables tariffs for import, direct and indirect tax rates. On the basis of these calculations the quantitative analysis was carried out.

The calculating general equilibrium model was realised in Excel application. It is endowed with multilevel user menus and user rulers that does work with model simply and conveniently even for the persons, not having special teaching. There is stipulated built-in Help for users, it contains brief description of the model and user's guide.

5 Behavioural Functions

For financial programming model (example of Turkey) the following behavioural equations were used.

Real private consumption is defined as a function of a trend component of real disposable income and a transitory or deviation from trend component of real disposable income.

$C_t = \overline{C} + k_1 * YDRP_t + k_2 * YDRT_t.$

Real private investments (in log terms) depend on the logarithm of one-two period lags of real private investments and the logarithm of real flows of credit to the private sector from the banking system $\Delta DCR_t/P_t$,

$Ln(I_t) = \overline{I} + k_3 * Ln(I_{t-2} + k_4 * Ln(I_{t-1} + k_5 * Ln(DeltaDCR_t/P_t).$

Export volume (in log terms) is determined as a function of the logarithm of real gross domestic product and the logarithm of price of exports in domestic currency terms, determined as the product of the exchange rate, and the foreign price of exports $e_t^{*E}P_t$, relative to the price of the home good P_t

$Ln(E_t^v = \overline{E} + k_6 * Ln(GDP_t/PGDP_t) + k_7 * Ln(e_t P_t^{*E}).$

Import volume M_t^v is defined by multiplying the contribution of imports to a unit of output m_t, by the level of output. The contribution of the logarithm of imports to output depends on the logarithm of price of imports in domestic currency terms $m_t X_t$, which is determined as the product of the

exchange rate, the foreign currency price of importP_t^{*M} and one plus the import duty rate t^M, relative to the price of the home good:

$$Ln(m_t) = \overline{M} + k_8 * Ln(e_t P_t^{*M}(1 + t^M)/P_t).$$

Capacity output $\bar{X}_t$, (in log terms) is a function of a time trend and the logarithm of real investments :

$$Ln(P_t^{*M}) = \overline{X} + k_{10}t + k_{11} * Ln(I_t + G_t^I).$$

The logarithm of the real demand for real money M_t^D/P_t is specified to be a function of the logarithm of real GDP and the rate of inflation:

$$Ln(M_t^D/P_t) = \overline{M^D} + k_{12} * Ln(GDP_t/PGDP_t) + k_{13} * ((P_t - P_{t-1})/P_{t-1}).$$

Behavioural Equations of the Romanian Model.

All dependencies, except those for prices, are expressed in real terms.

Real private consumption depends on the size of net profit of households and of the relative prices.

$$Ln(NPCNR_t) = \overline{CN} + g_1 * Ln(NYHSR_t) + g_2 * Ln(NPCNP_t/GDPLP_t) + \\ + g_3 * NICNP_t.$$

$$Ln(NICNP_t) = g_4 + g_5 * TREND + \nu_t.$$

Real investments consist of the total accumulation of a fixed capital and the change in stocks. Total accumulation of a fixed capital is determined as a function of the GDP, gross surplus of exploitation, and interest rate.

$$Ln(NGFIVR_t) = \overline{GFIVR} + g_6 * LN(NGDPR_t) + g_7 * Ln(NPRFTR_{t-1}) + \\ + g_8 * Ln(NINTER_{t-1}).$$

Real change in stocks is determined as a function of real gross domestic product. There was introduced one dummy variable in scope to consider some production problems in year 1989

$$Ln(NDINVR_t) = \overline{DIN} + g_9 * Ln(NGDPR_t) + g_{10} * dummy1_{98}.$$

The state operational expenditure includes consumption, percentage payments for an external and internal duty, transfers and subsidies.

$$Ln(NGCER_t) = \overline{GCE} + g_{11} * Ln(NGDPR_t) + g_{12} * dummy2_{91}.$$

Real government expenditure includes consumption, interest payments for external and internal debt, transfers and subsidies. Government expen-

diture, naturally, are defined by a level of real gross domestic product. The binary variable was put into consideration to take into account an unnatural diminishes in real government expenditures in year 1991.

Real total value added in secondary sector is determined as a function of total real consumption and of the gross fixed capital.

$$Ln(VLAD2_t) = \overline{VLAD} + g_{13} * Ln(NCONR_t) + g_{14} * Ln(NGFIVR_t).$$

Real rate of wage is determined as a function of the real value added in all sectors of economy and of one lug rate of wage.

$$Ln(NWAGER_t) = \overline{WAGER} + g_{15} * Ln(VLAD2_t) + g_{16} * Ln(NGFIVR_t).$$

Deflators of investments, private consumption and the government expenditures - everyone are considered functions of gross domestic product deflator.

Investment deflator

$$Ln(NINVLP_t) = \overline{INVLP} + g_{17} * Ln(GPLP_t.$$

Private consumption deflator

$$Ln(NPCNP_t) = \overline{PCNPP} + g_{18} * Ln(GPLP_t).$$

Government expenditures deflator

$$Ln(NGCNP_t) = \overline{GCNP} + g_{19} * Ln(GPLP_t).$$

Total export volume of goods is determined as a function of foreign markets economic activity, and simultaneously as a function of the time variable

$$Ln(XMRCH_t) = \overline{XMRCHR} + g_{20} * Ln(FGDPR_t) + g_{21} * TREND.$$

Price for the export is determined as a function of the international prices, and of the time variable

$$Ln(XMRCH\$P_t) = \overline{XMRCH\$P} + g_{22} * Ln(TMUVP\$_t) +$$
$$+g_{23} * TREND.$$

Total import is subdivided into two categories: petroleum and other import. These two kinds of import depend on real gross domestic product and on the relative price for import. The relative prices include the exchange rate, and also can include import tariffs. As consequence, it is possible the consideration of the effects of exchange rate policy on economic activity of particular sectors and economy as a whole.

Import of petroleum is determined as

$$Ln(MOILR_t) = g_{24} * Ln(NGDPR_t) +$$

$+g_{25} * Ln(MOIL\$P_t/(GDPLP_t/REXCHI_t))$.

Other import is determined as

$Ln(MOTHR_t) = g_{26} * Ln(NGDPR_t)+$
$+g_{27} * Ln(MOTH\$P_t/(GDPLP_t/REXCHI_t))$.

Import price depends of the international markets price.

Petroleum price is determined by the following equation:

$Ln(MOIL\$P_t) = \overline{MOIL\$P} + g_{29} * Ln(TMUVPS\$_t)$.

Other import price equation is determined by the following:

$Ln(MOTH\$P_t) = \overline{MOTH\$P} + g_{30} * Ln(TMUVPS\$_t)$.

6 Conclusions

The basic problem appearing at the realisation of enumerated model is the problem of information guarantee. We shall start with financial programming and growth models. As the basis of these models is made of calculating identities, and parameters of these models, as a rule, are estimated by calculation of simple relations between researched indicators, at the nearest moment of time, very seldom these parameters are estimated by econometric means. Therefore the basic problem at realisation of these indicators is connected to definition of exogenous variables, and, first of all, definition of growth for the short-term period on the basis of expert estimations of possible development. Comparative advantages of these models consist in their simplicity and ability to create the co-ordinated framework for estimation and monitoring of the short-term economic development allowing repeatedly and timely to overestimate both policy variables and offers which include forecasting stages of economic growth.

In economic models for Turkey and Romania the complication of the models goes on a way to completing a set of computing identities not only by the simple ratios determined by means of behavioural parameters, but also by the more complex econometric dependencies. With its help there are determined:

- prices;
- basic components of the aggregated demand, monetary and private sectors and balance of payments.

With introduction of the econometric dependencies in macroeconomic models, there are very serious problems in estimation of the coefficients of econometric equations, and especially for economies in transition to market relations. And

it is clear that at attempt to carry out econometric estimations we face with lack of the data as quantitative (a sufficient number of observation is lacking), and also qualitative (statistics on the main macroeconomic indicators are weak). The result is that a consistent and reliable time series is frequently lacking. To such indicators it is possible to attribute deflators of: gross domestic product, investments, consumption, government expenditures, added value etc. And other problem - transition economy is subject to structural reforms, which represent a particular problem.

Taking it into account, the statistical interrelations at reception of the effective econometric estimations of the model's parameters or at forecasting the future change in evolution of considered macroeconomic variables are necessary to be considered cautiously. Calculating general equilibrium models less are subject to data restrictions in comparison with other considered models. They use, basically, national accounts base year data and are constantly specified from year to year. Being based on the data of base year, on knowledge of elasticity of substitution and elasticity of transformation, factors of the behavioural functions used in model pay off. Hence, in this case it is necessary to be able to estimate elasticity of substitution and elasticity of transformation. Using the econometric estimations in transition economy imposes the necessity constantly to correct and update all historical data and, whenever possible, frequently to reconsider specification of the equations and an estimation of parameters, considering last updating of information base and having place or expected changes in structure of examined economy. Thus it is necessary to take into account the availability or presence of information in scope to specify adequately the regression equations at realisation the econometric estimations.

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