Development of new version of RIM model and estimation of fixed capital in it

At the beginning of this year our team resumed a long sleeping work on development of the new version of interindustry macroeconomic model RIM. This model should become toolkit for forecasting dynamics of the Russian economy on intermediate term and long-term prospect. As a first step of this task, we developed a set of input output balances of the Russian Federation in 25-branch classification from 1980 till 2004 in the constant and current prices. Thus, we have created the main statistical base of our further calculations. Availability of balances allowed us to follow our work by creation a kernel of model, which one was built on the same general scheme as the previous version of model RIM. Thus "skeleton" of new model exists and functions.

The additional factor that greatly stimulated our work was development of the first official long-term forecast of the Russian economy in 15 years. This forecast was created under the initiative of the government of the Russian Federation and with support of the Ministry of Economic development and trade. The Russian Academy of Sciences and our institute actively participated in it. But making a forecast without a dynamic interindustry model was very inconvenient. And though the model wasn't directly involved in this work, the fact of presence of big complex task stimulated its development.

At the last conference our team explained in details our work on the quarterly macroeconomic model QUMMIR. It is necessary to say, that these results have been largely used and in a work on RIM model. In particular, without essential changes will be transfered and used monetary, credit and budgetary blocks and a calculation of the payments balance. By now the first variants of the equations are developed for blocks of employment and foreign trade.

Our plans include significant improvement of forecasting characteristics of the model in comparison with the previous versions. We plan to incorporate in calculations import and transport matrices, an energy balance and a matrix of the trade margins in endogenous calculation of input-output coefficients . As the model is supposed to be used for long-term forecasting, there is a discussion on scale of use exogenous factors in model. The long-term forecast is a strategy as matter of fact. So is seems necessary to assign a set of goal values for some economic indexes. Besides this, a vital issues causes to consider factors of scientific and technical progress and provide an opportunity of their use in these purposes of production functions.

It is necessary to note, that we are also experiencing a lot of obstacles from statistics. One of them - transition of the Russian statistical agency to the new branch qualifier close to the international standards(ISIC). The main problem consists that for the present moment there is no official balance of new system, moreover there are no transitive indexes and tables for the all industry parameters or their aggregations. Moreover, all rows of gross outputs have appeared broken off and are available

or up to 2003 in old system, or after 2003 in new system. In this connection we are before a heavy choice. Or to continue independent calculation of balances in old system, or to carry out recalculation of existing balances to a new system. Both variants are extremely labour and time-consuming. That is why a final decision has not accepted yet.

Nevertheless the development of mainframes of model continues. In particular a special attention is paid to the blocks of monetary, financial and credit sphere, manpower reserves and the fixes capital. At the present moment the new version totals model nearby 2349 variables and 200 equations. I would like in my further report to discuss a bit more detail the block of forecasting the balance of capital assets as its role in comparison with the previous versions has essentially increased.

The Previous version of model RIM was developed during an major economic crisis in Russia which characteristic features were a galloping inflation, reduction of final consumption and change of a interindustry prices ratio. Therefore in model RIM the main attention has been given to reflection of influence of price factors on economic dynamics while investment and financial blocks have been detailed insufficiently. It has been justified, as investment activity was in deeper crisis than manufacture, and a banking system has not been enough developed. An next model, named CONTO, was constructed during the period of regenerative economical growth. In it the greater attention is paid to influence of elements of final consumption on general economic dynamics. Blocks of the state budget and foreign trade are presented in more detail. The growth of the world prices for energy resources, especially oil prices, became one of the reasons to include in the model new block describing production and distribution of fuel and energy resources, which later evolved in a sub-model. At the same time, as economic growth in many respects was based on use idle production capacities research of fixed capital dynamics and changes of technological structure has not been carried out on enough detailed level.

A ratio between growth of gross domestic product and growth of a fixed capital now in Russia is practically twice more than for example in the United States or China. It can testify only one - high rates of economic growth are in essential measure provided by involving in operation fixed capital, idled during crisis. But by a lot of expert estimations, at the present moment the opportunities of further Russian economy growth based on idle production capacities are practically exhausted. It certainly does not mean, that the capital operating rate of whole economy has reached its limit. On averege this parameter is about 76 %. But in a number of crucial industries as, for example, electric power industry it has exceeded 98 %.

Furthermore, by now the most production assets of the Russian economy are characterized by significant age - the majority of capacities has been built in Soviet Union. At low capital

operating rate when the significant part of the industrial equipment stood idle, it did not render essential influence on volumes of capital retirement. But with increase in capital operating rate retirement of the out-of-date production assets will essentially increase. The second feature is directly connected with first. This equipment is characterized by lower efficiency and higher material and power consumption than modern western samples. Both for increase of competitiveness of the domestic industry, and reduction of internal resources consumption needed for a purpose to meet accepted export obligations, an essential technological modernization of the industrial capital is necessary.

The further economic development is possible only with creation of new capacities, which in turn causes the change of technological structure of manufacture, which is represented in model by a input-output coefficient matrix. All this demands including in the general model scheme a set of variables and equations describing amount and condition of the fixed capital and influence of the capital inputs on an input-output coefficient matrix.

The Official statistics published by the Russian statistical agency, represents an replacement cost estimation of a fixed capital by results of spent reassessments. Received dynamics of a fixed capital in the comparable prices are poorly connected with dynamics of gross output and investment after 1990. This effect of course can be connected with inertance of the industrial capital. However we believe, that during reassessments the certain distortions have taken place. It could be caused by conditional character of indexes of recalculation of balance cost or by interest of the enterprises in change of their fixed capital cost with the purpose to reduce tax payments.

Unlike official statistics expert estimations show decrease of fixed capital in 1,2-1,6 times. Therefore as an additional source of the information of fixed capital changes we have chosen to use the results of the enterprises survey about their capital operating rate. A separate question is in what degree results of this polls held on some limited number of the enterprises, can be widespread to the whole industries as a whole. But we assume this hypothesis. Our calculations according were essentially based on operating rates data and were intended for estimation of the highest possible output, so we have decided to choose as units of measure for a fixed capital value of gross output in constant prices, corresponding to full capacities load. So further under capital funds we assume their maximum possible output. Using data about capital operating rate we calculated amounts of fixed capital on period from 1990 till 2006. Then we recalculated amounts and inputs of fixed capital on previous period starting from year 1960 using official indexes of their physical dynamics.

For an estimation of production assets retirement it has been decided to use a technique based on the assumption of an approximate constant length of capacities service life. Using for our calculations a data series of fixed capital total amounts and inputs from 1960 till 1990 we selected

a most fitting life-expectancy function, which describes dependence of retirement rate from the age of the equipment.

$$W(t) = \sum_{i=1}^{30} a(t-i) * V(t-i) * (f(i) - f(i-1)) * \left(\frac{OUT(t)}{K(t)} + b\right)$$

W (t) - retirement of a fixed capital in year t

$a(t)$ - a correction multiplier, which is used to consider capital retirement during transformational fall in1992-1994

f (i) - life-expectancy function

V (t) - inputs of capacities in year t

b- coefficient representing share of fixed capital retirement caused by technological obsolescence

$\frac{OUT(t)}{K(t)}$ - fixed capital operating ratio

On the next step we needed to calculate inputs and investment. Inputs of new capacities were estimated by well-known method of distributed lags.

Such as $V(t) = \alpha * Inv_{eqip}(t) + \beta * Inv_{eqip}(t-1) + \sum_{i=0}^{5} \gamma_i * Inv_{con}(t-i)$,

Where Inv_{eqip} is investment in the equipment and Inv_{con} is investment in the construction

But due to features of statistical period of 1990-2006 when a regression coefficients were estimated the equation was almost reduced to $V(t) = \alpha * Inv(t) + \beta * Inv(t-1)$

Also a taking in account of unfinished construction is also necessary, but its statistic isn't very reliable and also hard to be found in free access.

In estimation of investment we tried to take in account requirement of new capital funds as well as financial abilities of industry As a parameter representing industry resources available for investment we chosen the industry value added VA(t) with a one year lag deflated on investment goods prices index . For an estimation of an investment demand was introduces a new calculated parameter - a shortage of capacities-DC (t). This parameter is calculated as follows. We use linear interpolation of gross outputs of the previous years to receive an expected gross output for next year - $OUT^{predict}(t+1)$. As exogenous parameter φ was set a operating rate of capacities, achievement of which induces investment.

$$DC(t) = \varphi * (K(t) - W(t+1)) - OUT^{predict}(t+1)$$

Where K (t) a-fixed capital of current year

W (t+1) - expected leavings of a fixed capital in following year , estimated assuming V(t) =0;

For calculation of investments a regression equation from above-mentioned variables was used.

$$Inv(t) = a * VA(t-1) + b * DC(t) + c * K(t-1)$$

These equations are quite common to describe every industry, so we tried to replace them with equations that take in account industry specific features, as soon as such equations became developed. As it often happens the deficit of time and allows us to undertake a more detail study of some industry only during a separate sidework dedicated to this industry. This spring a research of energy balances of Russia's federal districts took a large bit of our time, but among its results new better functions for investment evaluation were developed. For electric energy generation investment was divided using exogenous preset shares in three separate groups – construction of nuclear, hydro and fuel power plants, each group with its own capital output ratio. Also in equation was included a construction of power lines.

For oil, gas and coal extraction the following procedure was used. For each resource its main deposits were divided in the groups classified by their accessibility. For each group it's reserves and capital output ratio were evaluated. We assume a hypothesis that more accessible sites are developed in first place a Then we introduced a variable – an amount of resource already extracted in previous period. As long as value of these variable was lesser then sum of reserves of a given group and previous groups we used capital output ratio of these group.

In a model estimated values of investment are separated into investment in equipment and structures, which form a significant part of final demand for machinery and construction

So the balance of a fixed capital will be defined by identity.

$$K(t) = K(t-1) + V(t) - \sum_{i=1}^{30} \alpha(t-i) * V(t-i) * (f(i) - f(i-1)) * \left(\frac{OUT(t)}{K(t)} + b\right)$$

Obtained values are used as a upper restrictions for gross output estimations

$$Out(t) = \min(K(t), Out(t))$$

If gross output of some industry must be decreased due to capital funds restriction, we also recalculate final consumption for this industry.

Inputs of new funds change the technological structure of manufacture. In model it is supposed to be reflected by change of a input-output coefficient matrix. We tried to step aside a bit from exogenous setting its dynamics and to model a process of replacement old funds with more effective new ones as step by step transition from one input-output matrix to another. For an old fixed capital we use the input-output coefficient matrix of last accounted year. The input-output matrix for new production capacities was taken from the analysis of US balance. In each year the domestic input output coefficients are determined depending on a share of new funds in economy.

$$a_{ij} = a_{ij}^{old} * \frac{K^{old}}{K^{old} + K^{new}} + a_{ij}^{new} * \frac{K^{new}}{K^{old} + K^{new}}$$

And input output coefficients are calculated from domestic, import and transportation coefficients

On the basis of this alpha-version of model RIM some scenario calculations based on previously built long-term forecast were carried. They showed in particular that in 2012-2016 high rates of economical growth predicted in long-term forecast may be not achieved due to restrictions from the lack of necessary amount of capital funds.

During further work on the new version of model RIM we plan to continue development and detailed elaboration of the investment block. Any suggestions on improving described block will be greatly appreciated.