

The Experience of Uzbekistan in Building of Equilibrium Econometric Model for Macroeconomic Analysis and Forecasting

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The key contents of report are the questions determining the algorithms of forecasting of macroeconomic indicators, the principles of separate interaction and brief description of the model, including the results of its testing on the basis of macroeconomic statistical reports, covering the period from 1997 through 2001, and instructions for econometrics for their actual application in practice.

The content includes: Brief description of the model; Description of the blocks and model algorithms; Scheme of interrelations of indicators; The model for results testing and its quality evaluation; Alternative medium-term scenario of economic development perspective; Evaluation of the effects of implementation of alternative scenarios and forecasts of macroeconomic dynamics until the year 2005; Identifications of the further development directions for the model, conclusion.

Brief description of the model. The models are an instrument for correlating purposeful of economic development, (such as GNP growth, wages, etc.) together with the volume of potential resources and sources of economic growth (investment, fuel, energy, crediting, financial, material resource) and also the parameters of fiscal money, price, currency and foreign economic policies.

The overall goal of this study is to build an econometric model for the transitional economy of Uzbekistan, which allows analyzing and forecasting the level of macroeconomic balance and market equilibrium on the basis of the existing statistical reporting. This report is a pilot research in Uzbekistan on the building of equilibrium models, a fact that makes testing the results and closer cooperation with foreign experts within the framework of the International Conference on Policy Modeling 2003 extremely relevant.

Major principles and objectives of macroeconomic model design for Uzbekistan:

Assessment of whether various variants of GDP dynamics are realistic in short and medium term perspective;

Analysis of link degree between different macroeconomic policy parameters and outcomes estimation of their implementation

Elaboration of steps to achieve liberalization of the economy, decrease market distortions and disproportion in gaps between savings and investment, aggregated demand and supply;

Study of specific forms and macroeconomic appropriateness in Uzbekistan during transition period

General requirements to the model:

Model is oriented at available statistical reports, that is, at short term time series and National Account System, which does not fully meet international standards;

Model reflects major specifics of transitional economy of Uzbekistan (predominance of agriculture, inefficient usage of resources, low internal and external balancing, underdeveloped market institutions, etc.);

Government and private sectors are separated in the economy of the country; new sector established in the years of independence and sector of traditional production are separated in the production structure;

Ability of the model to forecast "break points" in macroeconomic indicators dynamics, evaluate impacts of liberalization in the economy and impact of declining market distortions on the macroeconomic dynamics;

Methodological principles:

Econometric approach together with principles and equilibrium ratios of the National Account System;

Adequacy of the scheme and forecast methods, some indicators (for example, indicators of export and its major elements) to the government regulation and scale of market self regulation principles operation (for example, export of cotton and other raw materials, non-centralized export);

Use of price indices, exchange rates, interest rates to model supply- demand interrelations on consumer, money and other markets in the process of achieving market equilibrium conditions;

Module principle of the model design;

Specific features of the model developed.

The model allows for evaluating the indicators that show the level of correlation between the paces of planned economic growth, on the one hand, and resource capacities, tempo of economic reforms, and the parameters of monetary, fiscal and foreign trade policy, on the other one.

Openness and transparency of the model. This means possibility of changing any equations and calculation procedures included in the model and also adding new equations and algorithms. Such changes could be implemented by both the users and the authors of the model.

High flexibility of the model structure and possibility to translate the key specific features of the transitional economy of Uzbekistan into the model terms.

Opportunity to use certain equations and model blocks for short-term forecasts as to macroeconomic indicators.

Flexible requirements for the database and its orientation to the existing statistic evidence.

Database of the model includes more than 60 types of primary macroeconomic statistical reporting, differentiated by directions (GNP and added value, inflation indicators of money market, budget statistics, etc.).

A package of research methods employed includes index methods, econometric modeling, methods and concepts of contemporary macroeconomic theory in the context transitional economies. Within the framework of designing the integrated complex of models, international experience was widely used.

Characteristics of initial information base of the model

A. List of series

Function block	Indicators
1. Analyses of demand and offer on GDP	VEIND, VEAGR, VESER C, G, I, E, ITAX, (Added value of prod, agric, services and etc.)
2. Real sector	DP, WP, QCOT, WAT, SQC, SQF, WPCOT, DPCOT, EXR, XIND, MZIND, XINDJ, XINDO, FI, VPC, TFI, EFK, DEB1, CRED1, NEPL1, SAR, EXR, EXRBM, EXRDC, XESER, WMIN (internal prices, world prices, arable fields and insolvency and etc.)

3. Consumer market	TNP, PROD, NPROD, VODKA, CS ₁ , CS ₂ , CS ₃ , CPI, CP ₁ , CPI ₂ , CPI ₃ , XAGR, XSER. IM ₁ , IM ₂ , IM ₃ , CD, PC, DEFGDP, PRIM ₃ (Demand and offer on food and non-food products, share of import in consumer market and etc.)
4. Money market	M2, MO, BDEF, TSAV, SAV, DI, CRD, CRS, E, EXRBM, BCG, BCAGR, BCPS, BCD, BCF, (Money aggregates, savings, credits and etc.)
5. Investment block	TFI, PI, GI, FI, M2, MO, BDEF, PC, TSAV, SAV, GE, FD, CREGOV, SOECRE, DOCRE. (Foreign, gross, internal investment, bank loans to government and etc.)
6. People's revenues	POPU, PLBF, EMP, GAP, INC, WMIN, M2, DI, PIT, PC. (Disposable income, minimum wage, number of the employed and etc.)
7. Budget regulation block	GR, PIT, ITAX, DTAX, GE, GI, GRS, GFD, GOTH, BDEF (Direct and indirect taxes, budget deficit, government expenditures and etc.)
8. Export block	IM, IM ₁ , IM ₂ , IM ₃ , DI, EX, EXR, EXRBM, DEFGDP, EXCOT, PRCOT, EXNC, PREX (export and import by goods groups, exchange rates, export-import prices and etc.)

B. Section of series: • annual (1990-2001).

- Quarterly (1997Q1-2001Q1)
- Monthly (1997.01-2001.05).

C. Sources:

- Annual data for years 1990-2000, materials by Ministry of Macroeconomics, statistics collection "Economic trends of Uzbekistan";
- Quarterly and monthly dynamics for years 1997-2001 – Economic trends of Uzbekistan;
- Departmental statistics by Ministry of Macroeconomics, Ministry of Finance.

D. Methods of providing comparability of series:

- Majority presented in the form of real growth rate (in % as to 1990)
- Primary series formed in permanent prices and where they were not available – deflators used;
- in order to smooth quarterly fluctuations growth rates of appropriate indicators were evaluated as a ratio of the value in the current quarter to the value in the appropriate quarter of the last year.

Description the model algorithms and blocks. A brief description of calculation of key macroeconomic indicators by blocks is provided.

Savings-investment block which models the conditions of internal and external equilibrium. In this block following indicators are described:

- The share of investments to fixed capital in % of GDP;
- Fixed capital investments in prices of 2000 year;
- Accumulation of fixed capital in prices of 2000 year;
- Share of fixed capital accumulations in % of GDP;
- Share of gross savings in % of GDP.

Budget regulation block includes budget revenues, such as income, expenditures and state budget deficit. In this block following indicators are described:

- State budget income (in % of GDP, IB);
- State budget expenditures (in % of GDP, EB);
- Deficit of state budget (in % of GDP, DB).

Macroeconomic stability and financial sustainability block. The carried out econometric analysis let discover the factors that influences nonofficial currency exchange rate and consumer price index. In this block following indicators are described:

- Nonofficial exchange rate (soum/\$, EXRBM)
- Conditionally equilibrant exchange rate (soum/\$, EXRDC)
- Consumption price index (average annual) (in %, CPI)

External sector block within which export of goods and services is divided into two components: cotton and non-cotton exports, a feature that allows for determining the factors affecting exports in general terms. In this block following indicators are described:

- Noncotton export (by the dynamics of exchange rate) (mln. \$, ENCOT)
- Export of cotton (mln. \$, ECOT, line)
- Noncotton export (taking into account the development of new industrial sectors) (mln. \$, ENCOT)
- Export of goods and services (mln. \$, E)
- Import of goods and services (mln. \$, IM)

Real sector blocks. A specific feature of modeling of industrial production is that it is divided into two sectors: a new sector built on foreign investments attracted and the previously existing sector, including the traditional sectors of industrial production. Gross agricultural production was also divided into the cotton and non-cotton sectors.

Schemes of interrelations of indicators. An emphasis is placed on solution for the problem of linking macroeconomic policy instruments and domestic and foreign policy parameters with the dynamics of macroeconomist indicators, and interrelation of indicators (see Picture 1).

Interrelations of the following indicators: savings, consumption, national savings, and current account.

Inflation forecast scheme (consumer price index and deflator)

Forecast of unofficial **EXBRM** and equilibrium conventional **EXRDC** national currency exchange rates.

Forecast of industrial production rate.

Scheme of interrelations of indicators in the agricultural sector.

Model testing and evaluation of its quality, for which quality could be evaluated for certain equations and the whole model.

Quality evaluation for every regression equation included in the model could done on the basis of analysis of approximation extent of depending variable to reporting dynamics and also the analysis of quantitative statistical criteria and coefficients for variables (see Pictures 2a and 2b).

Examples of modeling of the growth of money emission and changes of policy of different instruments. The model enables to evaluate the consequences of changing different regulators of economic policy or indicators of efficiency as to forecasted macroeconomic dynamics on the basis of comparative analysis of two different types of forecasts. The results of modeling of growth rate of M2 and efficient ratio investment resources ICOR have been shown in real examples (see Picture 3).

User instruction on how develop forecast types of macroeconomic dynamics, for which where core requirements, description and structure of files how to log on and download the file titling Small-size Econometric Model of Uzbekistan are given.

The directions of the further development of the model within the framework of functional capacities:

Improvement of technological and environmental aspects of economic growth;

Wider inclusion of the effects of liberalization in forecasting of the dynamics of macroeconomic indicators;

Possibility of assessment of how privatization processes and instrumental changes affect efficiency of using economic growth factors.

Enhancing functional capacities of social research and human capital quality (life quality indicators, education, development of medicine).

As to enhancing analytical capacities of the model:

Wider use of international experience in formulation of final targets and justification of the conditions essential for providing sustainable economic growth;

More user-friendly format of results of forecast calculations (diagrams, deviations of current calculations as compared with previous ones).

Logical schemes of interrelations of indicators, which allows for justification of new results.

As to improvement of the algorithms of forecast calculations. It is suggested to use wider international experience. The model that has been built needs further improvement. This is why this paper justifies expediency of the enhanced use of international experience as to the furtherance of functional and analytical capacities of the model, improvement of the algorithms of forecast estimations and the database employed for the model.

As to improvement of the database of the model. To raise reliability and to obtain more adequate correlation of the database, it is suggested to use wider international experience.

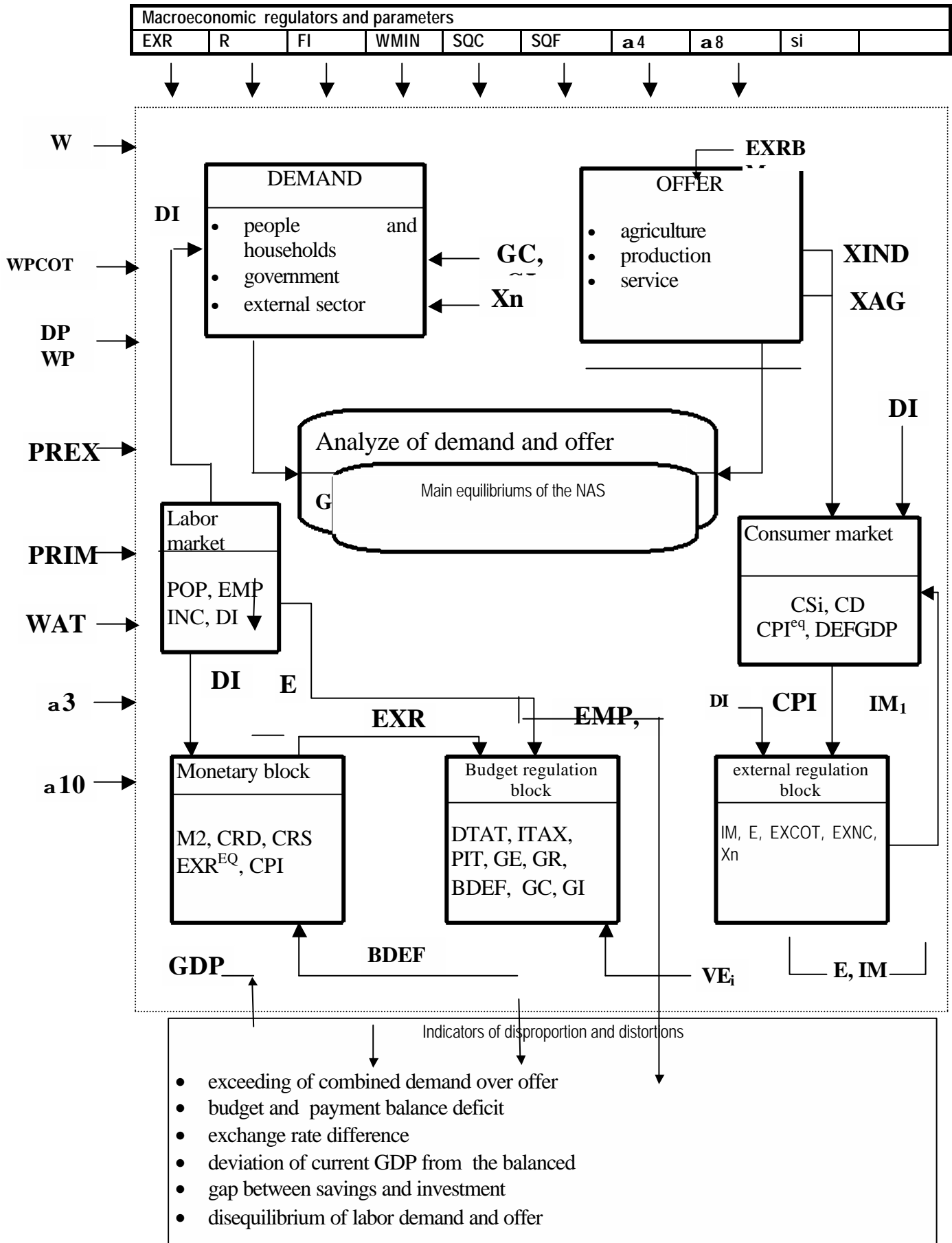
Conclusion. The main outcome of the study is that a theoretical framework and software tool (based on **EXCEL**) have been developed for the model to obtain forecast calculations of a system of interrelated macroeconomic indicators that embodies the concept of small-size equilibrium model.

The users of the model are Central Economy related institutions such as Ministry of Macroeconomics and Statistics, Ministry of Finance, the Central Bank, those directly involved in practical implementation of reforms and the development of main directions of macroeconomic policies. They will enjoy the opportunity to set the goals and guiding points for some indexes and to study the outcomes of these optional variants for the development of economy as a whole.

Requirements to the possibility of use of the models at the offices of the Ministry of Macroeconomics and Statistics, Ministry of Finance and Central bank:

- Conformity of the exogenous variables set with the real monetary, fiscal and investment policy regulators;
- Possibility of realization of scenario approach in the process of making multi-variant forecasting;
- Simplicity of correlation in the model, enabling to obtain logically non-conflicting results and possibility of their pithy interpretation.

Picture 1 – Scheme of interrelation of blocs and indicators in the model



Picture 2a – Results from identification of the model (section of blocks and equations).

Main stage of working out an econometric model is – identification its equations, that is, picking up factors explaining behavior of each endogenous variable, forming up an equation and evaluation its parameters.

Ā. Block of real sector model - agriculture

Peculiarity of the block is necessity of the use of annual statistics, also inclusion such specific features of the economy of Uzbekistan as its row material orientation, related to cotton production, dependence on year's water abundance, significant price distortions between production and agriculture. As result of econometric calculations there have been obtained following equations and ratios:

<p>Ā1. $VEGR=(1-a5)*XAGR$ Ā2. $a5=\hat{a}\hat{\sigma}\hat{\delta}(3.5132352-2.1226419e-15*LOG(XAGR))^{12+}$ (0.0510)</p> <p>R²= 0.97; SE= 0.0044; F= 45.1; DW=2.84</p> <p>Ā3. $XAGR=QCOT+QCOTH$ Ā4. $QCOT= a3*SQC*DPCOT$ Ā5. $a3=\hat{a}\hat{\sigma}\hat{\delta}(388.89836-277.84711*LOG(WAT))^{0.1-0.13046152*}$ $*LOG(DPCOT)-37.848651*LOG(a3(-1))^{0.1}$ (0.1212)</p> <p>R²= 0.99; SE= 0.0177; F= 43.0; DW=2.17</p>	<p>Ā6. $QOTH= 3617.4124+0.00098439883*TREND^6$ (0.0270)</p> <p>R²= 0.74; SE= 244.68; F= 11.6; DW=2.28</p> <p>Ā7. $DPCOT=\hat{a}\hat{\sigma}\hat{\delta}(20.466654-0.00036251619*LOG(WPCOT2)^4-$ (0.0382) (0.1950) $-0.029446386*LOG(a4)^4)$ (0.0305)</p> <p>R²= 0.98; SE= 0.2960; F= 51.4; DW=2.80</p>
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Due to the fact, that there is observed a disproportion between material resources and agricultural products prices in the country, with the growth of production in agriculture the share of material expenditures also grow in its gross product, that is why in the equation E 2 there is negative coefficient of variable XAGRI

In the equation B5, the negative coefficients of variables WAT, DPCOT and lagging variable a3(-1) are explained by the fact, that negative trend of declining yield of cotton may be an outcome of exhaustion of water-land resources' potential and insufficient funding for improving the quality of these resources.

In the equation B7, the negative coefficient of the factor of variable WPCOT2 can be explained by the fact, that in present situation internal prices on cotton are not formed through demand and offer, but by government, which is interested in receiving maximum profit from selling cotton in external market and in providing replenishment of gold reserves of the country.

Obtained equations have relatively acceptable values of statistical criteria: R²;F; DW and t – statistics for equation parameters, which are shown in B2-b7 and in remaining equations in the form of "0" hypothesis of acceptance possibility. In the process of econometric analyse, in given various forms of representation of dependent variable and factors, there has not been found any statistically significant relations among dynamics of production of noncotton products QOTH and arable fields for non-cotton products SQF and water consumption WAT. This can be explained by statistic distortions and low efficiency of the use of land and water resources. The most sufficient values were obtained when using the time factor TREND (in the equation B6) as independent variable.

Ñ. Real sector block– production.

<p>C1. $\text{LOG}(XINDJtr) = -17.171 + 0.069*(dFI*0.2+0.8*dFI(-1)) +$ (ñ.í.) (-3.41) (6.77)</p> <p style="margin-left: 150px;">$+ 3.368 * \text{LOG}(0.1*EXRt+0.9*EXRt(-2))$ (3.36)</p> <p>$R^2 = 0.96$ $DW = 2.14$ $F = 43.78$</p> <p>C2. $\text{LOG}(XINDOtr) = 1.103 - 0.345*\text{LOG}(0.75*dTR(-1)+0.35*dTR(-2))$ (ñ.í) (0.23) (0.07)</p> <p style="margin-left: 150px;">$+ 0.245 * \text{LOG}(Gltr(-2))$ (0.05)</p> <p>$R^2 = 0.93$ $DW = 1.9$ $F = 19.43$</p>	<p>C3. $XIND^t = XINDJ^0 + XINDJ^t + XINDO^0 + XINDO^t$</p> <hr/> <p>C5. $\text{LOG}(a_t) = 4.39 + 0.0289 * \text{LOG}(IPL(-1)/t)$ (c.o) (0.003) (0.004)</p> <p>$R^2 = 0.93$ $DW = 2.25$ $F = 40.5$</p>
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The econometric analyze allowed to obtain not so clear results due to the fact, that devaluation of SUM by the official rate on the current stage of development of the economy on the whole supporting the growth of production in the new sector. Its controversy is due to that in condition of high devaluation of SUM by official exchange rates, on the one hand, several big foreign firms and joint companies having license for converting SUMs by official rate are bearing big financial losses when exchanging SUMs to foreign currency. But on the other hand for many production joint companies devaluation of SUM creates more convenient conditions, as a gap between official and balanced rates decreases, a degree of equilibrium of the economy on the whole grows, competitiveness of products of these firms strengthens. Given effect dominated over effect of financial losses of certain joint companies in current period, which defined general positive impact of SUM's devaluation on growth in this production sector in the current period and this is witnessed by positive coefficient of EXRt.

The similar econometric analyze has been made also for traditional (old) production sector. The negative coefficient of this factor shows reverse relation between outcome and tax pressure typical to traditional production sector. The calculations showed, that reduction of tax payments by one percent point (i.e. from 32% to 31%) increases production growth rate of production companies of this sector by one percent point, which improves their financial condition, widens tax base and with certain lagging period compensates a portion of tax arrears related to initial reduction of tax rates.

Ä. Consumer market and prices.

<p>Ä1. $FOODS = \exp(0.99 + 0.81 \cdot \log(CPI(-1)) + 0.156 \cdot \log(IMFOOD(-1)))$ <small>(0.002) (0.11)</small> R²=0.99; SE=0.011; F=35.5; DW=2.04</p> <p>Ä2. $NFOODS = \exp(1.63 + 0.389 \cdot \log(CPI2)) + 0.24 \cdot \log(IMNFOOD)$ <small>(0.000) (0.086)</small> R²=0.98; SE=0.007; F=123.7; DW=2.4</p> <p>Ä3. $VODS = \exp(-3.283 + 0.84 \cdot \log(CPI1)) + 0.83 \cdot \log(IMNFOOD)$ <small>(0.018) (0.002)</small> -0.04 · log(EXRBM)) R²=0.96; SE=0.016; F=41.2; DW=2.7</p>	<p>E4. $SERS = \exp(-673.3 + 112.6 \cdot \log(DEFGDP) + 6.16 \cdot \log(VESER(-1))) + 93.5 \cdot \log(EXRBM(-1))$ <small>(0.09) (0.003)</small> R²=0.98; SE=3.18; F=42.9; DW=2.6</p> <p>Ä5. $\tilde{N}S = \tilde{n}1 \cdot FOODS + \tilde{n}2 \cdot NFOODS + \tilde{n}3 \cdot VODS + \tilde{n}4 \cdot SERS$</p> <p>E6. $CD = \exp(-161 - 48.8 \cdot \log(CPI) + 53.5 \cdot \log(DIR(-1)) + 111.2 \cdot \log(EXRBM(-1)^{0.05})$ <small>(0.06) (0.000) (0.02)</small> R²=0.95; SE=1.4; F=36.4; DW=2.27</p> <p>E7. $CS(CPI) = CD(CPI)$ Ä8. $GAP_{cpi} = CPI^{eq} - CPI^{ex}$</p>
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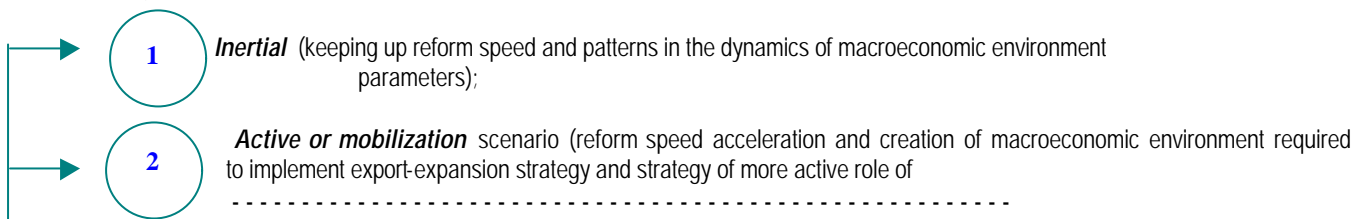
Obtained equations (E1-E4) in the first approximation allow to evaluate a dynamic of gross offer in a consumer market as medium weighted index of series of offer by its various segments (E5), where c1,...c4 – specific gravities of appropriate market segments (following the data for 2000 they were 37%,33%,10%,20% accordingly)

Unlike on offer, data on demand can only be obtained through special observations. In case of their absence, as indicator of demand we used National Accounts option “ final consumption of people and households”, which makes it possible to calculate satisfied demand (E6).

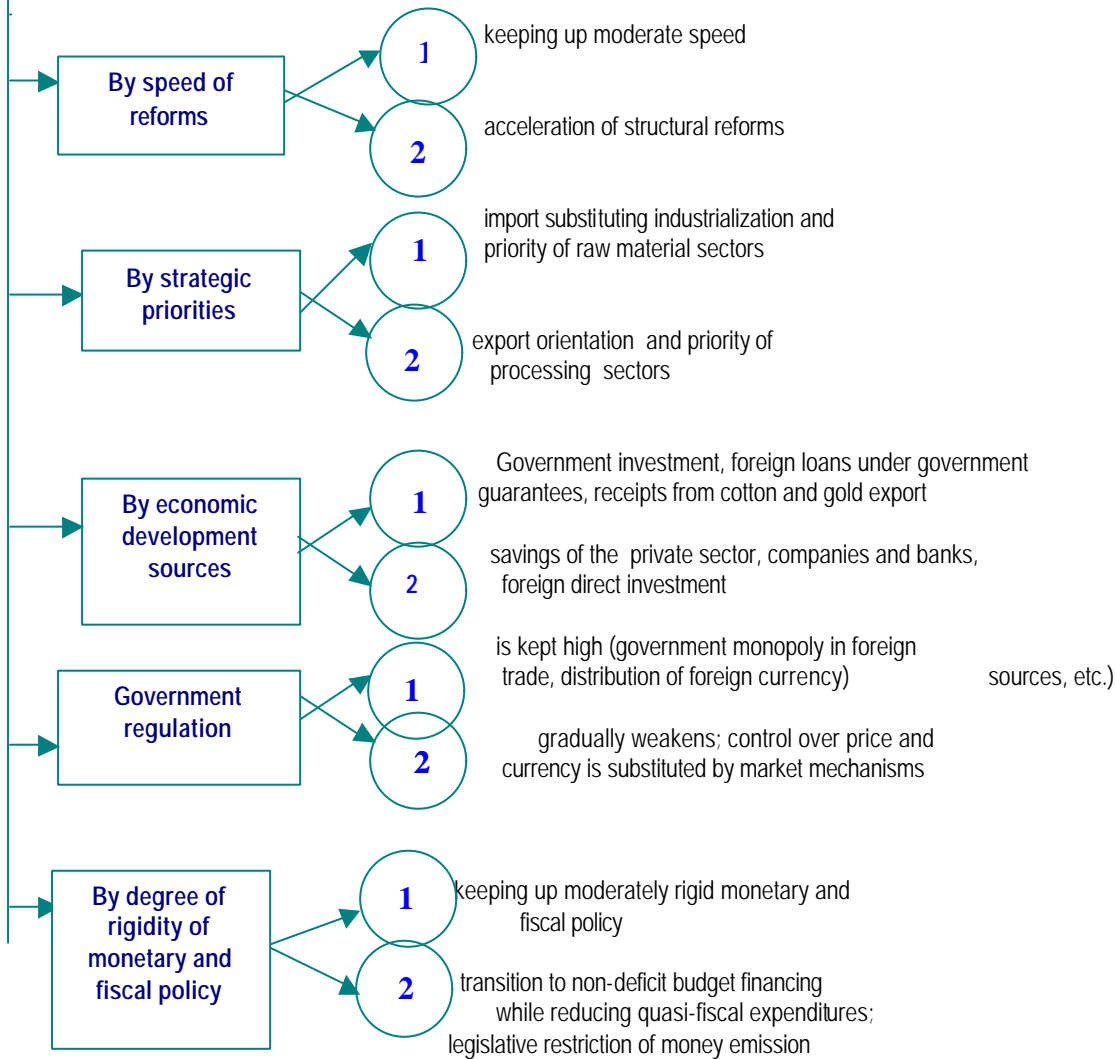
Equation E8 shows evaluation of the gap between balanced and most possible degree of prices expected in forecasting period and characterizes a degree of price distortions in the consumer market.

Picture. 2b – Scenario approach realized on the base of a macroeconomic model

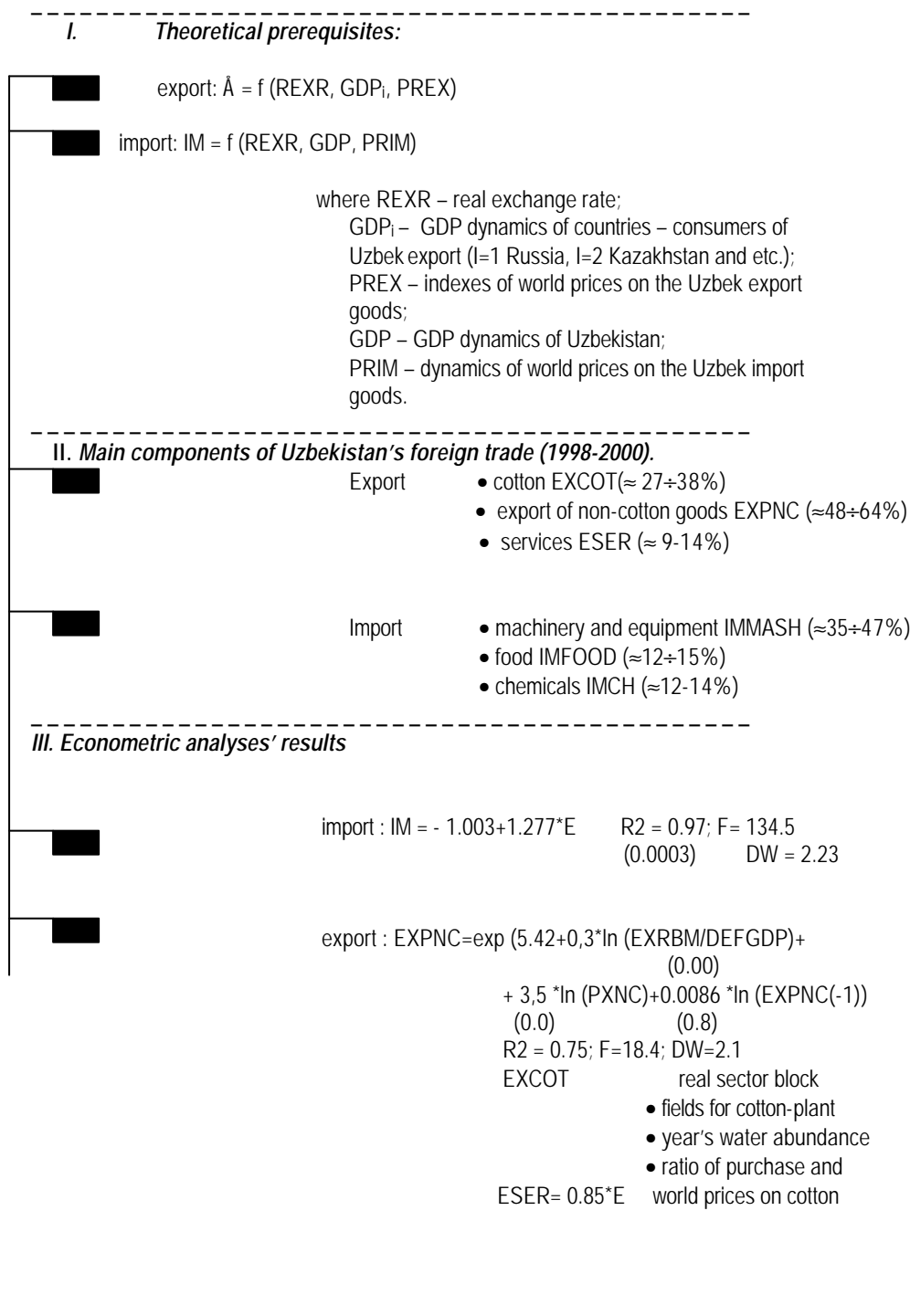
A. Major conclusions of considered scenarios:



B. Distinctive features of alternative scenarios:



Picture. 3 – Distinctive features of modeling foreign trade



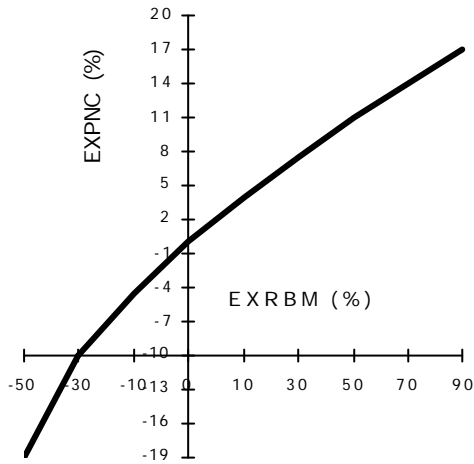
Evaluation of sensitivity of export to the changes in exchange rate and main conclusions:

- Interrelations of non-cotton export EXPNC and non-official exchange rate EXRBM
- in the export structure there is a segment – non-cotton export, the volume changes of which is caused by the exchange rate, that is, by market mechanism;
- devaluation of non-official rate of SUM by 30 % ,given that there are stable internal and external prices, increases non-cotton export on average by 8-10 % (pic.a.), or by 25 ÷ 28 mln.dollars (see pic.b). But if, at the same time,

there is a little rise in export prices and index *PNC* increases by 2 present points only (from 0.7 to 0.72 – see pic.b.), then growth of non-cotton export increases and will amount to 60-65 mln.dollars;

- low elasticity of export by the rate, which is non-official, that is, only operates within a single segment of foreign exchange market, witnesses a weak development of market mechanism. This conditions necessity of taking additional steps on deepening liberalization of foreign trade and transition to free convertibility of SUM.

a) In growth rates as to base value (%)



b) In mln.doll. for export and in % growth for exchange rate

