

Analysis of the impact of macroeconomic policy instruments on indicators of economic development of Uzbekistan based on the “Input-Output” tables and the social accounting matrix (SAM)

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Annotation

The report presents the results of the development and application of models in macroeconomic forecasting based on the Input-Output table and Social accounting matrix (SAM). The Input-Output and SAM tables have been elaborated for 79 sectors of Uzbekistan's economy in 2014. The modeling of effects from changes in macroeconomic policy instruments has been carried out. Suggestions are given in the main areas of improving intersectoral model instruments: 1) improving the information base of the model; 2) further functional linking of the model to the goals and objectives of the economy.

Keywords: intersectoral models, macroeconomic forecasting, input-output model table, SAM (social accounting matrix model), information sources, development scenarios /

Introduction

The report was prepared based on a study carried out in 2018, and the results are presented for the first time for participation at the XXI April international scientific conference on the problems of economic and social development.

The purpose of the research is to build model tools for analyzing policies, forecasting sustainable growth and inclusive development of Uzbekistan for the medium and long term using the Input-Output and SAM (Social Accounting Matrix) tables.

I. Creating a model based on Input-Output tables

The table Input-Output for Uzbekistan in 2014 was created in accordance with the methodological requirements of the UN and Eurostat.

The basis for creating the experimental table Input-Output was the data of the “Resources and Application” tables had been prepared by the State Statistics Committee according to a sample survey of direct costs for 920 enterprises and 90 types of goods and services in the context of 82 types of economic activity according to the classification of GCEA. The main components of the “Resources and Application” table system were as follows:

- 1. The data of the resources of goods and services table** reflect as resources of the supply of goods and services by products and types of their origin (domestic products and imported) in a matrix form of the industry-product type.
- 2. The table of application of goods and services** is a matrix of the industry-product type, where in the lines the products and value-added components and in the columns industries and end-use categories of products are listed.

Also, in the process of preparing the Input-Output tables and analytical goals, other separate supporting data are used.

In order to form the Input-Output tables, the data of the “Resources and Application” table are converted by performing mathematical calculations based on linear programming methods and various assumptions about the production technology of the product or industry technology.

The result is a symmetric table Input-Output, where the first quadrant of the table is presented in the form of “product-product” or “industry-industry”, i.e. the lines and columns of the first quadrant reflect the same groups of products or industries. The results of the lines and columns of the table of the first quadrant Input-Output are equal. Moreover, the choice of the type of the Input-Output table (product-product or industry-industry) depends on the objectives of the analysis. The industry-industry type is closer to the initial statistical information and real transactions in the market of goods and services. The “product-product” type is more uniform in terms of the structure of production costs and the structure of production.

The scope of the Input-Output Model

An important advantage of the model is the preparation of various scenarios based on assumptions about changing policy instruments. This makes it possible to determine an acceptable long-term strategy for the development of the economy.

Among the scopes of the model, the following should be noted:

1. **Modeling the balanced development of sectors of the economy and economic growth.** At the same time, the modelling of economic growth is being carried out both from the side of aggregate supply and aggregate demand.

Example 1. As calculations have shown, with an increase in the output of electricity and gas by 10%, respectively, an increase in the total output in the economy as a whole, taking into account all the peculiar multiplicative (indirect) effects, can be expected by about 1.12% versus 0.48% for the effect of the change in output only two industries (direct effect). A significant change in outputs was noted mainly in energy-intensive industries, such as mining of other minerals (1.8%), in oil refining (3.43%), chemical products (3.1%), building materials (1.07%), in the electric power industry (2.59%) and others (table 1).

Table 1. Assessment of the impact of changes in the output of individual industries (by 10%) on the total output of the economy

| Types of activity (industry) | Initial output | New output | | |
|---------------------------------|-----------------------------|---|-----------------------------|---|
| | Share,% of the total output | Change in industry output (direct effect),% | Share,% of the total output | Change in new industry output (indirect effect),% |
| | 1 | 2 | 3 | 4 |
| | | | | |

| | | | | |
|---|--------------|-------------|--------------|--------------|
| Products of agriculture, forestry and fisheries, hunting | 15,3 | 0,00 | 15,2 | 0,40 |
| Crude oil and natural gas | 2,8 | 10,0 | 3,1 | 10,97 |
| Other mining | 0,6 | 0,00 | 0,6 | 1,80 |
| Food, Beverage, Tobacco Products | 7,3 | 0,00 | 7,3 | 0,36 |
| Clothing, textiles, leather and products thereof | 4,7 | 0,00 | 4,7 | 0,48 |
| Coke and refined petroleum products | 1,4 | 0,00 | 1,4 | 3,43 |
| Chemical Products | 1,9 | 0,00 | 1,9 | 3,10 |
| Mineral, non-metallic, other products | 2,0 | 0,00 | 2,0 | 1,07 |
| Base metals | 4,2 | 0,00 | 4,2 | 0,73 |
| Motor vehicles, trailers and semi-trailers | 3,8 | 0,00 | 3,7 | 0,37 |
| Repair and installation services of machinery and equipment | 0,8 | 0,00 | 0,8 | 0,46 |
| Electricity, gas and air conditioning | 2,0 | 10,0 | 2,3 | 12,59 |
| Other industrial activities | 4,4 | 0,00 | 4,4 | 0,88 |
| Buildings and construction works | 9,2 | 0,00 | 9,2 | 0,47 |
| Trade | 7,9 | 0,00 | 7,8 | 0,43 |
| Transport | 10,0 | 0,00 | 9,9 | 0,65 |
| Other types of services | 21,7 | 0,00 | 21,6 | 0,37 |
| Total | 100,0 | 0,48 | 100,0 | 1,12 |

Example 2, as calculations have shown, a change in consumer demand of the households by 10% increases the total output in the economy as a whole by 5.48%. Growth in consumer demand has a significant impact on the increase in output of industries such as agriculture, forestry and fisheries (7.14%), food products, beverages and tobacco products (10.41%), clothing, textiles, leather goods (6.98 %), petroleum products (9.36%), chemical products (8.68%), motor vehicles (6.12%), electricity, gas (6.43%), etc. (table 2.).

Table 2. Assessment of the impact of changes in consumer demand (10%) on the total output of the economy

| Types of activity (industry) | Share,% of the total output | | Change in new industry output % |
|---|-----------------------------|------------|-------------------------------------|
| | Initial output | New output | General direct and indirect effects |
| | 1 | 2 | 3 |
| Products of agriculture, forestry and fisheries, hunting | 15,3 | 15,5 | 7,14 |
| Crude oil and natural gas | 2,8 | 2,7 | 3,46 |
| Other mining | 0,6 | 0,6 | 3,32 |
| Food, Beverage, Tobacco Products | 7,3 | 7,7 | 10,41 |
| Clothing, textiles, leather and products thereof | 4,7 | 4,8 | 6,98 |
| Coke and refined petroleum products | 1,4 | 1,4 | 9,36 |
| Chemical Products | 1,9 | 1,9 | 8,68 |
| Mineral, non-metallic, other products | 2,0 | 1,9 | 2,97 |
| Base metals | 4,2 | 4,0 | 1,66 |
| Motor vehicles, trailers and semi-trailers | 3,8 | 3,8 | 6,12 |
| Repair and installation services of machinery and equipment | 0,8 | 0,8 | 5,52 |
| Electricity, gas and air conditioning | 2,0 | 2,1 | 6,43 |
| Other industrial activities | 4,4 | 4,6 | 9,72 |
| Buildings and construction works | 9,2 | 8,8 | 0,14 |
| Trade | 7,9 | 7,9 | 6,07 |

| | | | |
|-------------------------|--------------|--------------|-------------|
| Transport | 10,0 | 10,0 | 5,21 |
| Other types of services | 21,7 | 21,5 | 4,18 |
| Total | 100,0 | 100,0 | 5,48 |

2. Modeling the assessment of the impact of investment growth on the output of industries.

3. Modeling the assessment of the impact of increased exports on output industries.

4. Modeling the assessment of the impact of changes in policy instruments on macroeconomic indicators.

5. Modeling the assessment of changes in taxes on the output of industries and final demand.

Modeling is carried out by selecting in the structure of the model (3 quadrant) a block of taxes by types (indirect, direct and resource, etc.).

II. Modeling of macroeconomic processes based on the matrix of social accounts (SAM)

The SAM model includes a system of interconnected macroeconomic blocks described in the income-expense format and the main identities of national accounts. The blocks of the model represent a system of linear econometric equations describing the parameters of production and use of GDP, changes in domestic prices, the formation of money supply, public finances and indicators of development of the external and private sectors.

In general, SAM involves macroeconomic accounting of operations, the relationships between various economic agents and their activities

Table 3. Sources of information for SAM

| Sources | Indicators |
|--|--|
| System of National Accounts | Production account - the release of goods and services, their use in the production process (intermediate consumption), value added. Income generation account - primary income generation, remuneration, gross profit / gross mixed income. Primary and secondary income distribution accounts - distribution of income derived from production activities Use of income account - the distribution of disposable income between final consumption and savings. |
| Intersectoral balance "Input – Output" | I quadrant - direct cost ratios intermediate consumption, intermediate demand. II quadrant - consumption of households, government, gross capital formation in new capital, changes in stocks, exports, imports. III quadrant - value added, wages, social contributions, gross profit / gross mixed income, taxes and subsidies on production, taxes and subsidies on products. The matrix of import costs - direct cost ratios - intermediate consumption, intermediate demand for imported products. |
| Data on the implementation of the state budget | Income - taxes and other income. Expenses - current expenses, salaries, transfers, subsidies, etc. |

| | |
|-----------------------------------|---|
| Income and Expenses of households | Revenues - salaries, pensions, benefits, remittances and other income. Expenses - final consumption and payments. |
| Payment balance | Current account - export and import of goods and services, money transfers, transfers Capital account - external borrowing |

In order to illustrate the structure of the matrix, an aggregation of economic activities in SAM was carried out in up to 3 sectors: agriculture, industry (including construction) and services excluding intermediate imports, which represents the income of the external sector and is considered as a separate line. (**table 4**).

Table 4. SAM matrix for Uzbekistan for 2014 (billion soums)

| | Agricultur e | Industry and construction | Service sector | Private Income Distributi on | Distributio n of state revenues | Fixed capital formation | Stock change | Distributio n of external revenue | Competiti ve import | Product Taxes (Indirect Taxes) | Direct taxes | Gross income |
|---|-----------------|------------------------------|-------------------|---------------------------------------|---------------------------------------|-------------------------------|-----------------|--|------------------------|---|-----------------|-----------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. Agriculture | 9706,1 | 7887,1 | 532,0 | 13350,0 | 240,3 | 645,4 | 408,3 | 6520,1 | -85,8 | | | 39203,4 |
| 2. Industry and construction | 2631,1 | 24809,4 | 13213,0 | 31587,1 | 16,4 | 28342,4 | 3825,7 | 16414,8 | -4827,1 | | | 116012,9 |
| 3. Service sector | 1751,8 | 12746,8 | 15965,2 | 33069,8 | 24489,2 | 4791,9 | 235,2 | 8479,4 | -7,7 | | | 101521,4 |
| Intermediate consumption (without intermediate import) | 14089,1 | 45443,2 | 29710,2 | 78006,8 | 24745,9 | 33779,6 | 4469,1 | 31414,3 | -4920,6 | | | 256737,8 |
| 4. Added value (total) | 24008,9 | 43026,1 | 64673,3 | | | | | | | | | 131708,2 |
| 5. Salary (incl. Transfers) | 6106,5 | 12620,4 | 22468,0 | | 11477,6 | | | | | | | 52672,5 |
| 5.1 government bodies | 180,7 | 12,3 | 18408,1 | | | | | | | | | 18601,1 |
| 5.2 other enterprises and organizations | 5925,8 | 12608,0 | 4059,9 | | | | | | | | | 22593,8 |
| 6. Income, other than salary | 16147,2 | 25567,8 | 35561,4 | | | | | | | | | 77276,3 |
| 7. Total - Private Income | 22253,7 | 38188,2 | 58029,4 | | 11477,6 | | | | | | | 129948,8 |
| 8. Indirect taxes | 479,9 | 10548,7 | 3392,8 | | | | | | | | | 14421,4 |
| 9. Subsidies (-) | -280,3 | 0,0 | -3,2 | | 283,5 | | | | | | | 0,0 |
| 10. Direct taxes | | | | 7433,1 | | | | | | | | 7433,1 |
| 11. Intermediate import | 905,8 | 16995,0 | 3748,4 | | | 5701,9 | | | 4920,6 | | | 32271,5 |
| 12. Government revenues | 1755,2 | 4837,9 | 6643,9 | 12686,6 | | | | | | 14421,4 | 7433,1 | 47778,2 |
| 13. Gross savings | | | | 31822,2 | 11271,2 | | | 857,2 | | | | 43950,7 |
| 14. Gross output | 39203,4 | 116012,9 | 101521,4 | 129948,8 | 47778,2 | 39481,5 | 4469,1 | 32271,5 | 0,0 | 14421,4 | 7433,1 | |



A number of scenarios have been implemented, such as increasing internal and external investments as well as reducing indirect tax rates, using the standard GAMS software package.

Scenario 1. Growth in domestic investments by 10%. Increased domestic investment leads to the expansion of production and the provision of services. Accordingly, total income and savings are increased.

As a result, the nominal and real GDP volumes will increase, respectively, by 2.43 and 1.96 percentage points (table 5).

Table 5. Assessment of the impact on macroeconomic indicators of increased domestic investment

| Symbol | Basic data | Scenario 1. Domestic investment increased by 10% | | |
|-------------------------------------|------------|---|----------------------------|-----------------------------|
| | | Modified | Absolute deviation (+ ; -) | Relative deviation, in p.p. |
| Salary income | 52672,4 | 53438,5 | 766,2 | 1,45 |
| Income other than salary | 77276,1 | 78378,3 | 1102,2 | 1,43 |
| Disposable Salary Income | 41390,7 | 42109,4 | 718,7 | 1,74 |
| Disposable income other than salary | 68438,1 | 69480,8 | 1042,7 | 1,52 |
| Private savings | 31822,1 | 32308,3 | 486,2 | 1,53 |
| Real consumption by sector | 78006,5 | 80020,6 | 2014,2 | 2,58 |
| Direct taxes | 7433,1 | 7540,0 | 106,9 | 1,44 |
| Indirect taxes | 14421,4 | 14563,2 | 141,8 | 0,98 |
| Government revenue | 47778,2 | 48026,8 | 248,7 | 0,52 |
| General competitive imports | 27350,9 | 27922,5 | 571,6 | 2,09 |
| Net foreign exchange assets | 57170,6 | 56599,0 | -571,6 | -1,00 |
| Real GDP | 145850,0 | 148710,0 | 2860,0 | 1,96 |
| Nominal GDP | 145850,0 | 149390,0 | 3540,0 | 2,43 |

Scenario 2. Foreign direct investment growth by 10%. The inflow of foreign capital gives a more tangible effect, compared with an increase in domestic investment, given the ratio of the volumes of these exogenous variables to the total investment. As a result, real GDP growth amounted to 0.32 percentage points, and the nominal volume of GDP amounted to 0.42 percentage points relative to the basic version of economic development.

Table 6. Assessment of the impact on macroeconomic indicators of an increase in foreign capital inflows

| Symbol | Basic data | Scenario 2. 10% increase in capital inflows | | |
|-------------------------------------|------------|--|----------------------------|-----------------------------|
| | | Modified | Absolute deviation (+ ; -) | Relative deviation, in p.p. |
| Salary income | 52672,4 | 52795,2 | 122,9 | 0,23 |
| Income other than salary | 77276,1 | 77442,7 | 166,6 | 0,22 |
| Disposable Salary Income | 41390,7 | 41505,9 | 115,3 | 0,28 |
| Disposable income other than salary | 68438,1 | 68595,7 | 157,6 | 0,23 |
| Private savings | 31822,1 | 31895,7 | 73,6 | 0,23 |
| Real consumption by sector | 78006,5 | 78364,4 | 358,0 | 0,46 |
| Direct taxes | 7433,1 | 7449,7 | 16,6 | 0,22 |
| Indirect taxes | 14421,4 | 14446,9 | 25,5 | 0,18 |
| Government revenue | 47778,2 | 47820,2 | 42,1 | 0,09 |
| General competitive imports | 27350,9 | 27458,8 | 107,8 | 0,39 |
| Net foreign exchange assets | 57170,6 | 57062,7 | -107,8 | -0,19 |
| Real GDP | 145850,0 | 146320,0 | 470,0 | 0,32 |
| Nominal GDP | 145850,0 | 146460,0 | 610,0 | 0,42 |

Scenario 3. Reduced indirect tax rate by 10%. A 10% reduction in indirect taxes and preferences had a significant positive effect not only on an increase in income from wages (+0.09 percentage points), income other than wages (0.64 percentage points), and private savings (+ 0.67 percentage points), direct taxes (0.40 percentage points), but had led to an increase in the growth of real GDP by 0.11 percentage points.

Table 7. Assessment of the impact on macroeconomic indicators of indirect taxes reduction

| Symbol | Basic data | Scenario 3. 10% reduction in indirect tax rates | | |
|-------------------------------------|------------|--|----------------------------|-----------------------------|
| | | Modified | Absolute deviation (+ ; -) | Relative deviation, in p.p. |
| Salary income | 52672,4 | 52721,0 | 48,7 | 0,09 |
| Income other than salary | 77276,1 | 77772,0 | 495,9 | 0,64 |
| Disposable Salary Income | 41390,7 | 41436,3 | 45,7 | 0,11 |
| Disposable income other than salary | 68438,1 | 68907,2 | 469,1 | 0,69 |
| Private savings | 31822,1 | 32036,7 | 214,6 | 0,67 |
| Real consumption by sector | 78006,5 | 78253,3 | 246,8 | 0,32 |
| Direct taxes | 7433,1 | 7462,9 | 29,8 | 0,40 |
| Real GDP | 145850,0 | 146010,0 | 160,0 | 0,11 |
| Nominal GDP | 145850,0 | 144610,0 | -1240,0 | -0,85 |

| | | | | |
|---------------------|------|------|------|------|
| General price index | 1,00 | 1,01 | 0,01 | 0,70 |
|---------------------|------|------|------|------|

III. The main directions of improving intersectoral model instruments in Uzbekistan.

1. Improving the information base of the model:

- implementation of works every five years on a statistical assessment of the direct costs of manufacturing products, goods, works and services, breaking down them into domestic and imported components, based on the methods of continuous examination of all enterprises and organizations regardless of their size and type.
- ensuring the coherence and balance of the statistical indicators of national accounts (production, education and use of income, capital transactions accounts) as well as the ratios of output, consumption and accumulation of goods and services produced in the economy.
- improvement of calculations in a single format of indicators of “clean” industries (structure of intermediate and final demand, value added, output, disposable resources, calculation of changes in working capital stocks, etc.);
- improving the completeness of the coverage of statistical data for an objective assessment of the indicators of industries and sectors of the economy for which one-off surveys, costs, production and sales of products, goods and services are not carried out;
- observation of changes in industry prices, determination of industry deflators for converting value indicators to constant prices;
- systematically conducting a comprehensive analysis of the cost structure, labor productivity and profitability of the output of industries.

Another direction in improving the information base in the development of models is to improve the methods of converting data "resources and application" into the "Input-Output" tables using linear programming methods and computer technology.

2. Further functional linking of the model to the goals and objectives of the economy. In order to expand the range of tasks and substantiate macroeconomic policy assessments, it is necessary to continue work on the functional linking of the model to the conditions of the economy of Uzbekistan:

- reflection in the model structure of the most important industries for which Uzbekistan has comparative advantages, as well as industries that have a significant impact on the development of other industries;
- improving the structuring of the model, its coefficients and the parameters of the equations describing the processes of investment formation, final consumption of households, government revenues and expenditures, savings, remittances and other foreign economic operations;
- improving the description of the equations of the model and deepening the degree of economic interpretation of the results.

A perspective direction in the development of the “Input-Output” and SAM models is their adaptation to assessing the interconnectedness of forecast indicators, developed within the framework of the Sustainable Development Goals of Uzbekistan (SDGs):

- sustainable economic growth,
- rationalization of employment,

- reduction of poverty and income inequality,
- improving resource and energy efficiency of the economy,
- improving the quality of services provided,
- solving environmental problems;
- and others that require the continuation of ongoing research in this direction.

The constructed model instruments are allowing in the future to move on to the construction of computable general equilibrium models (CGE) for Uzbekistan, which are aimed at ensuring a macroeconomic balance of supply and demand.

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