

Yashil IQTISODIYOT va TARAQQIYOT

Ijtimoiy, iqtisodiy, siyosiy, ilmiy, ommabop jurnal

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- 08.00.17 Turizm va mehmonxona faoliyati

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ECONOMETRIC MODELING OF CALCULATION OF GROSS DOMESTIC PRODUCT AND COST METHODS

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Abstract: The article describes the theoretical and methodological foundations for forecasting macroeconomic indicators based on the rules of the system of national accounts, the features of calculating gross domestic product, its improvement and forecasting, and highlights scientific proposals and recommendations for the development of econometric forecasting models and methodology for macroeconomic indicators.

Key words: system of national accounts, gross domestic product, production method, final consumption method, distribution method, econometric model, forecasting, comparative analysis, econometric assessment, regression model, macroeconomics, statistical analysis.

Annotatsiya: Ushbu maqolada milliy hisoblar tizimi qoidalari asosida makroiqtisodiy ko'rsatkichlarni bashorat qilishning nazariy va metodologik asoslari, yalpi ichki mahsulotni hisoblashning xususiyatlari, uni takomillashtirish va bashorat qilish haqida so'z yuritiladi, shuningdek, makroiqtisodiy ko'rsatkichlar bo'yicha ekonometrik bashoratlash modellari va metodologiyasini rivojlantirishga oid ilmiy takliflar va tavsiyalar yoritiladi.

Kalit so'zlar: milliy hisoblar tizimi, yalpi ichki mahsulot, ishlab chiqarish usuli, yakuniy iste'mol usuli, taqsimlash usuli, ekonometrik model, bashorat qilish, taqqoslash tahlili, ekonometrik baholash, regressiya modeli, makroiqtisodiyot, statistik tahlil.

Аннотация: В статье описаны теоретические и методологические основы прогнозирования макроэкономических показателей на основе правил системы национальных счетов, особенности расчета валового внутреннего продукта, его совершенствования и прогнозирования. Также изложены научные предложения и рекомендации по разработке эконометрических моделей прогнозирования и методологии макроэкономических показателей.

Ключевые слова: система национальных счетов, валовой внутренний продукт, метод производства, метод конечного потребления, метод распределения, эконометрическая модель, прогнозирование, сравнительный анализ, эконометрическая оценка, регрессионная модель, макроэкономика, статистический анализ.

INTRODUCTION

Econometric modeling plays a crucial role in understanding and forecasting a nation's economic performance, particularly when calculating Gross Domestic Product (GDP). GDP, a key indicator of a country's economic health, is measured using various methods, with the cost approach and the production approach being two of the most commonly used. The cost method involves summing the total expenditures in an economy, while the production method focuses on the value of goods and services produced. Globally, GDP is widely tracked; in 2022, the United States recorded a GDP of \$25.46 trillion, maintaining its position as the world's largest economy. Meanwhile, Uzbekistan's GDP grew by 5.7% in 2021, reflecting its expanding economic landscape through industrial and service sectors. Econometric models provide valuable insights by analyzing these figures and trends, aiding policymakers in decision-making.

Transferring the national statistics of Uzbekistan to the standards adopted in international practice and improving the development of the system of national accounts (NSA) adapted to local conditions, their macroeconomic-statistical analysis is one of the important problems of today and determines the relevance of this research.

Based on the decision No. 691 of the Cabinet of Ministers of the Republic of Uzbekistan dated August 19, 2019 «On the introduction of a modern system of national accounts in the Republic of Uzbekistan» [1], statistical data aimed at expanding the coverage of socio-economic processes studied at the macroeconomic, sectoral and regional levels by the wide introduction of modern statistical methods and methodologies in data collection and processing, the system of statistical observations will be further adapted to the generally accepted inter-



national practice. Indeed, today, the transfer of the national statistics of Uzbekistan to the standards adopted in international practice and the improvement of the development of the national accounts system (NAS) adapted to local conditions, the further improvement of the effectiveness of the use of mathematical statistics and econometric methods in the field of statistics, and the correlation and forecasting of economic processes through the data obtained on the basis of regression analysis, their macroeconomic-statistical analysis is one of the important problems of today.

ANALYSIS OF LITERATURE ON THE SUBJECT

Theoretical and practical aspects of the methods of statistical calculation of macroeconomic indicators of NSA, the size of macroeconomic indicators, calculation of growth rates, Compile a set of accounts with macroeconomic indicators of study of scientific-practical aspects from foreign scientists R. Ctoun, J. Keync, V. Leontev, J. Marshall, E. Hansen, J. Hicks, R. Dorbnush, S. Fisher, V. Leontev, M. Friedman, K.R. McConnell, S. L. Brew, M. Spins, R. Solow, B. I. Bashkatov, V. I. Vidyapin, G. P. Zhuravleva, Yu. N. Ivanov, O. I. Obratzova, O. V. Kopeykina, G.S. Kulagina, M.G. Nazarov, A.I. Ponomorenko, B.T. Ryabushkin, V.N. Salin in deeply researched and studied in his scientific works..[4] In particular, the problems of ensuring stable growth of GDP through market demand J. Keynes, calculation of the gross national product by the production method based on the «cost-result» table R. Stone, modeling of factors affecting the volume of GDP J. Marshall and J. Hicks, calculation of GDP volume according to the ratio of expenditure and income E. Hansen, R. Dorbnush, S. Fisher, calculation of GDP based on intersectoral balance V. Leontev, the relationship between GDP created in the country and money supply M. Friedman, K.R. McConnell, S.L. Brew, M. Spins, R. Solow, Analyzing and assessing the network composition of macroeconomic indicators B.I. Bashkatov, V.I. Vidyapin, G.P. Juravleva, calculation of the regional composition of GDP based on the principles of the system of national accounts Yu.N. Ivanov, O.I. Obratzova, O.V. Kopeykina, calculation of GDP by quarters G.S. Kulagina, M.G. Nazarov, A.I. Ponomorenko, Calculating the share of the informal sector in GDP by B.T. Ryabushkin, V.N. Salin in scientific studies in their research.

Implementation of the system of national accounts in Uzbekistan, calculation, analysis and forecasting of its macroeconomic indicators CCG'ulomov, Yo.A. Abdullaev, A. Abdug'afarov, R.A. Alimov, T.M. Ahmedov, N.M. Makhmudov, H. Nabiev, A. A. Nabikho'jaev, B. T. Calimov, N. M. Coatov, B. Yu. Khodiev, B. K. Goyibnazarov, T. Sh. Shodiev, C. A. Chepel in scientific works researched..[5] The research works and scientific-theoretical studies carried out by them are mainly focused on the issues of increasing the volume and growth rates of macroeconomic indicators, analyzing the factors affecting it, and developing forecast indicators on this basis. But in the scientific research of the above-mentioned scientists statistical analysis of macroeconomic indicators Improvement measures of the national hijab system are new in 2008 standards acocida has not been widely studied.[6] In this context today Based on the "NSA-2008" standard, the system of national principles and recommendations of our country's macroeconomics Statistical analysis of indicators, analysis of influencing factors in statistical terms, future development Statistical forecasting of trends is of great importance. This is it determines the relevance of the selected research topic.

RESEARCH METHODOLOGY

The methodological basis of the research is based on the fundamental laws of the science of statistics, in particular the Law «On Official Statistics» dated August 11, 2021 [2], the President of the Republic of Uzbekistan dated August 3, 2020 «On the activities of the national statistical system of the Republic of Uzbekistan Based on the priority tasks set on the basis of the decision PQ-4796 «on improvement measures» [3] and the decision number 691 of the Cabinet of Ministers of the Republic of Uzbekistan dated August 19, 2019 «On the introduction of the modern system of national accounts in the Republic of Uzbekistan» [1], to ensure consideration of all aspects of macroeconomic indicators of the system of national accounts (starting with the collection of primary data and ending with the creation of balance sheets), redistribution and the interrelationship of economic figures calculated on balances of use is represented in statistical indicators. Also it is important to use correlation-regression analysis to study the relationship between the general indicators of NSA. For a real mathematical statistical study of the interrelationships between the generalized indicators of NSA in scientific observation, statistical observation, statistical grouping, dynamic series, economic-mathematical modeling, trend, forecasting and correlation-regression analysis, it is important to use scientific abstraction.

ANALYSIS AND RESULTS

In econometric modeling and forecasting according to the method of production of GDP in the national economy, we can express the development of economic sectors through the following exponential models:

$$\begin{cases} Y_{san}^{(p)} = Y_{san}^{(0)} e^{b_1 t} \\ Y_{q.x}^{(p)} = Y_{q.x}^{(0)} e^{b_2 t} \\ Y_{xiz.}^{(p)} = Y_{xiz.}^{(0)} e^{b_3 t} \end{cases}$$

Here: - the gross added value of industry, agriculture, forestry and fisheries and service sector in the forecast period; $Y_{san}^{(p)}$, $Y_{q.x}^{(p)}$, $Y_{xiz.}^{(p)}$

$Y_{san}^{(0)}$, $Y_{q.x}^{(0)}$, $Y_{xiz.}^{(0)}$ - gross added value of industry (including construction), agriculture, forestry and fisheries and services sector during the reporting period at 2022 prices; b_1 , b_2 , b_3 - parameters of functions; t is time.

Also, the share of economic sectors in GDP was approximated by the following logistic function:[7]

$$Y_{st} = Y_{st}^{(0)} \cdot \frac{1 + a}{1 + \exp[-b(t - t_0)]}$$

Y_{st} – initial value ($t=t_0$), a – constant quantity, determined according to the specified initial condition; b – the diffusion coefficient, which is determined using the «addition of technologies» in traditional networks.

Above, in forecasting according to the regression model of economic sectors, it is taken into account that the development trend of the sectors of the previous period will be repeated in the following periods as well.

The study used EvIEWS software to build regression models. According to him, 2010 of the indicators selected aboveThe following regression equations were created using the statistical indicators of the dynamics of change in 2022. In this case, the gross added value of economic sectors was selected as dependent variable (Y_2) and the share of gross added value of economic sectors in GDP as independent variable.

According to the results of the constructed model, it was found that the influence of the share of industry and agriculture, forestry and fisheries in GDP on the added value is statistically significant at the 5% level of insignificance. But the impact of service sector's share of GDP on gross value added was found to be statistically insignificant even at the 10% level of significance. This can be explained by the fact that although the gross added value of the service sector increased in 2010-2022, its share in GDP had a certain dynamic and did not change (Table 1).

Table 1. (1) The result of checking the adequacy of the model according to the criteria.

Variable	Coefficient	Standard error	t-statistics	Probability
X1	50178.2	9649.89	5.200	0.001
X2	43091.26	16348.72	2.636	0.027
X3	16547.17	12984.06	1.274	0.234
C	-2405491	1004555	-2.328	0.045
R-squared	0.93	Akaike information criterion		24.40
Smoothed R-squared	0.90	Schwarz criterion		24.57
Approximation to logarithmic truth	-154.59	Hanna-Quinn criterion		24,36
F-statistics	0.00	Darbin-Watcon statistics		1.86

The coefficient of determination of the built model equal to 0.96 showed that the share of economic sectors in GDP represents the gross added value in 96% of cases. The results of testing the built model for the presence of first-order autocorrelation according to the Darbin-Watson criterion showed that there is no first-order autocorrelation in the residuals of the model. Model quality checkerAkaike information criterion, Schwarz criterion, Hanna-Quinn criterion showed that the structured model can be used in forecasting.

$$Y_2 = -1828441 + 44676.07 \cdot x_1 + 47453.80 \cdot x_2 + 388.67 \cdot x_3$$

Here: - gross added value of economic sectors; Y_2

x_1 - the share of industry (including construction) in GDP;

x_2 - share of agriculture, forestry and fisheries in GDP;

x_3 – share of the service industry in GDP;



According to the results of the developed model, increasing the share of the industry (including construction) sector in GDP by 1% increases the gross added value of the sector to 44676.07 billion on average. It was found that it will lead to an increase of soum. Increasing the gross added value of agriculture, forestry and fisheries by 1% in GDP will increase the gross added value to 47453.8 bln. It was found that it will lead to an increase of soum.

The forecast values of the independent variables in the model for forecasting GDP according to the models of GDP production and expenditure constructed above are determined on the basis of trend models. Fisher's criterion, which determines the significance of the trend model of independent variables, showed that the constructed models are suitable for the real process.

It can be seen that the statistical values of Fisher's criterion are greater than the critical value. At the same time, the Student's test, which checked the significance of the coefficients of the trend models, also showed that the model parameters were adequate. However, although the effect of time series in the trend model of reserve change was found to be statistically insignificant, this model can be used for forecasting as Fisher's criterion indicates that the model is adequate (Table 2).

Table 2. Results of trend models.

X1	Model type	Algebraic view of the model	R2	F
1	Final consumption	$Y_t = 258,3 + 32,4 * t$ (35,2) (35,0)	0.99	1226.7
2	Capital investment	$Y_t = 33,19 + 19,98 * t$ (2,13) (9,86)	0.90	97.21
3	Changes in reserves	$Y_t = 22,07 + 0,56 * t + 21,40 * d$ (7,55) (1,40) (21,40)	0.86	31,22
4	Industry(including construction) network's share in GDP	$Y_t = 17,34 + 1,1 * t$ (17,28) (8,7)	0.87	75,71
5	Share of agriculture, forestry and fisheries in GDP	$Y_t = 30,15 + 0,43 * t$ (34,80) (3,91)	0.59	15.3
6	Share of service industry in GDP	$Y_t = 30,3 - 0,25 * t - 2,03 * d$ (73,83) (3,64) (2,80)	0.72	12.71

Based on the established trend models, forecast values of GDP production and expenditure method were determined. In order to forecast GDP according to final consumption, the model (1) developed by the authors of [8] was used. In this case, final consumer spending is in 2026808.452 billion soums and the gross accumulation of fixed capital is forecasted to be 372,836 billion soums. It was determined that the forecast values of GDP according to the expenditure method will have an upward trend in 2023-2026. In particular, the GDP in 2026 will be 1,025,091 billion. It is forecasted to be 1.15 times its value in 2022 (Table 3).

Table 3. Forecast values of GDP by expenditure method in 2023-2026, bln. in soums (at 2022 prices).

Year	GDP	Final consumer spending	Fixed capital gross accumulation	Changes in reserves
2022 (true)	888,342	699,497	284,570	55,650
2023	914,399	711,359	312,897	51,285
2024	951,296	743,723	332,877	51,844
2025	988,194	776,088	352,856	52,402
2026	1,025,091	808,452	372,836	52,960



The forecast results determined by the production of GDP (gross added value) showed that the GDP will increase in 2023-2026. It is observed that the share of gross added value of economic sectors in GDP increases. In particular, the share of industry (including construction) in GDP will increase by an average of 1.1 p.p. annually over the next four years. as a result of its increase to 2026, this figure is predicted to be 36%. It was determined that the share of agriculture, forestry and fisheries in the GDP will decrease in the following years, and the share of the added value of this sector in the GDP will be 21.8% in 2026. The share of services in GDP is expected to be 36% in 2026. At the same time, the share of net taxes in GDP was projected to be 6.8% on average in 2023-2026 (Table 4).

Table 4. Forecast values of GDP by production method in 2023-2026 (at 2022 prices).

Year	GDP, billion soums	Gross added value of networks, billion soums	Share of industry (including construction) in GDP, percent	Share of agriculture, forestry and fisheries in GDP, percent	Share of service industries in GDP, percent	Share of net taxes in GDP, percent
2022 (true)	888,342	828,054	31.1	23.5	38.7	5.8
2023	955,806	884,832	32.7	23.0	36.8	7.4
2024	988,396	919,136	33.8	22.6	36.5	7.0
2025	1,020,695	953,440	34.9	22.2	36.3	6.6
2026	1,052,705	987,744	36.0	21.8	36.0	6.2

In the research work, the gross added value of economic sectors was determined according to the model (3.2) in the forecasting of GDP by production method (gross added value). By 2026, the gross added value of economic sectors will reach 987,744 billion. is expected to amount to 1.2 times its value in 2022. The gross domestic product in 2026 will be 1,052,705 billion. it was found that it will amount to soums and will increase by 1.2 times its value in 2022 (Table 4).

As a result of our analysis, it was found that the forecast results of gross domestic product determined by gross added value (production method) and final consumption method (expenditure method) are not significantly different from each other. It can be seen that the statistical difference detected by the GDP production method (gross added value) was higher than the forecast results by the expenditure method, and its values decreased in 2023-2026 (Figure 1).

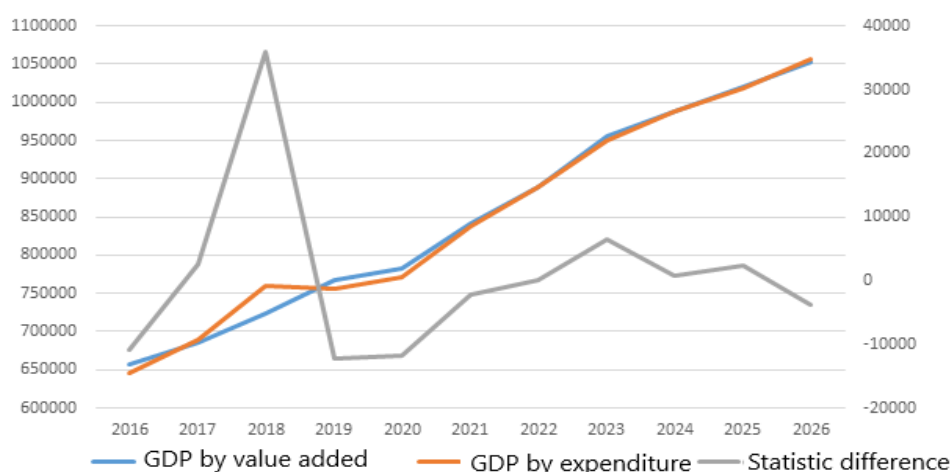


Figure 1. Dynamics of GDP and statistical difference values, bln. in soums (at 2022 prices).

Based on the analytical capabilities of the international standard NSA-2008, it is important to consider the methodological basis for calculating all stages of macroeconomic indicators of the system of national accounts (starting from obtaining primary data and ending with the preparation of balance sheets). Also, creating macroeconomic equations based on the NSA-2008 concept, money- it is necessary to express in statistical indicators the interrelationship of the main accounts calculated on the basis of production, income distribution, redistribution and use balances with the credit sectors, the balance of payments and the state budget.



CONCLUSIONS AND SUGGESTIONS

The laws and trends of economic development are analyzed using the GDP indicator. The economic development results of other countries are compared, the production structure of the economy is evaluated. Mas as a macroeconomic indicator of the annual accounts system, it is necessary to pay special attention to the methodology of calculating the gross domestic product and its components. With the help of many microeconomic indicators, the activity of enterprises is evaluated and the principles of their activity development are determined, and the state of the overall economy, its growth or decline is analyzed and a conclusion is drawn by means of macroeconomic indicators.

Analysis of the main indicators based on the methodology of the annual accounts system in various special mathematical statistical methods, their assessment is used to realistically describe the dynamics of economic development, to accurately assess the standard of living of the population, as well as statistically econometric in the analysis of data obtained on the basis of observations issues of the use of models and the problem that arises in this regard and leads to the solution of shortcomings and ways to eliminate them.

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