



CONSTRUCTION AND FORECASTING ECONOMETRIC MODELS OF MACROECONOMIC INDICATORS BASED ON INTERNATIONAL STANDARDS OF THE NATIONAL ACCOUNTING SYSTEM

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This article describes the theoretical-methodological foundations of forecasting macroeconomic indicators based on the rules of the national accounts system, specific features of gross domestic product calculation, its improvement and forecasting, scientific proposals and recommendations for the development of econometric forecasting models and methodology of macroeconomic indicators.

KEY WORDS: *system of national accounts, gross domestic product, econometric model, forecasting, comparative indicators, comparative analysis, econometric evaluation, regression model, macroeconomics, production, use, economic potential, statistical analysis, classification*

INTRODUCTION

Before moving on to the specifics of GDP calculation, it is important to define it. Therefore, GDP is one of the most basic macroeconomic indicators, and simply speaking, it expresses the level of economic development of the country in absolute terms [4]. The main content of this indicator is determined by the market price value of all final goods and services produced and used (consumed) directly on the territory of the country. It should be noted that only final (direct consumption) products and services are taken into account in the calculations, and the nationality and citizenship of the people who produced these products are not taken into account.

In the Address of the President of the Republic of Uzbekistan Shavkat Mirziyoyev to the Oliy Majlis, "It is necessary to develop the concept of improving the monetary policy and ensuring price stability by carefully studying the world experience and involving international experts." In the transition period, it is very important to keep statistical reports in the field of

economy and accurately assess the economic potential of the state. In this way, an objective assessment of the gross domestic product can be achieved. For this purpose, the United Nations Organization (UN) and the International Monetary Fund state that we should fully implement the National Accounts System in our republic from January 1, 2020 "[5], which indicates the improvement of the methodological basis of calculating the gross domestic product.

ANALYSIS OF LITERATURE ON THE TOPIC

Studies show that the GDP indicator is one of the macro-economic indicators showing the country's economic development. It is important to determine, calculate and analyze this indicator, which reflects the economic situation of the country.

The statistics service of the United Nations (UN) recommends using GDP as an indicator of total output to compare the economic potential of different

countries in the System of National Accounts (SNA). In this case, the following requirements must be met:

1. The indicators to be compared belong to the same calendar periods or years;
2. The method of calculating GDP should be the same;
3. Comparable indicators are expressed in the same monetary units, taking into account the purchasing power parity of national currencies.

In the world economy, GDP as an economic category is analyzed based on various approaches, and scientific conclusions are given to reveal its characteristics. In particular, P.Samuelson stated that "GDP is a relatively complete reflection of the gross production volume of goods and services at the national level. It is equal to the sum of national consumption, gross investment, state purchases and net exports in the value account this year" [6]. Russian scientist S.S. Nosova defines that "GDP is the market value of all final goods and services intended for consumption, export and accumulation, created in all sectors of the economy in the territory of the country during one year, regardless of whether the factors of production belong to the national economy" [7]. V.V. Zolotachuk connects GDP with the processes of reproduction of goods and services in the economy and defines it as "GDP is calculated as the sum of added values created in the economy in a certain period of time and is equal to the difference between all products and intermediate products at market prices"[8]. T.A. Agapova, S.F. Seryoginas express the following opinions about GDP: "GDP is the total sum of the market price of final goods and services produced by the country's residents for a certain period of time... all economic units (enterprises, households) are residents" [9].

Economist B.K. Goyibnazarov "National Accounts System (NAS) is a method of calculating the products and incomes created by the country, and it is a system of total economic indicators representing the processes of their formation, structure, distribution and use. This system serves to study, analyze all aspects of the socio-economic life of the republic, and define future tasks" [10].

Econometric models are one of the methodological directions of forecasting. The first correlation-regression macroeconomic models of the national economy and its subsystems were developed by L. Klein [11] in the USA in the 1950s and were successfully used to forecast the development of the national economy, economic sectors and sectors, the monetary and credit system, monopolies, corporations, etc. used. In 1980, L. Klein was awarded the title of Nobel Prize laureate for these works. The experience of using econometric models for forecasting was later used to develop similar models in other countries, including Uzbekistan. [16]

The comparative analysis of econometric literature[12;13] is dedicated to the detailed description of econometric models of national

economies and to the comparison of forecasts obtained by different models by scientific research institutes. In this regard, it is necessary to develop scientific recommendations on technologies for the development of forecasting systems and evaluation of their results.

Econometric forecasting models and methodology of economic indicators is based on the use of three systems: principles and systems of econometric modeling; national hijab system (MHT) [14]; system of expert ratings (a set of scenario indicators and calculations corresponding to them).

RESEARCH METHODOLOGY

The methodological basis of the research is the fundamental laws of the science of statistics, in particular the Law "On Official Statistics" of August 11, 2021 [1], the President of the Republic of Uzbekistan dated August 3, 2020 "On measures to improve the activity of the national statistical system of the Republic of Uzbekistan" No. PQ-4796 On the basis of the decision [2] and the decision No. 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" [3], socio-economic processes studied at the macroeconomic, sectoral and regional levels through the widespread introduction of modern statistical methods and methodologies in the collection and processing of statistical data aimed at expanding coverage, the system of statistical observations is further adjusted to the generally accepted international practice.

ANALYSIS AND RESULTS

Econometric models occupy an important place among the macroeconomic models developed and used for the study of economic development. Economic events, as a rule, are determined by factors that are multi-dimensional and generally applicable at the same time. In this regard, the task of researching the dependence of one variable on several explanatory variables often arises. This task is solved using multivariate regression analysis.

The main power of these models is the possibility of quantitative assessment of indicators of system interactions. Regression equations that describe the dynamics of the economic system and its individual values with a certain probability through the change of the indicators defining the economic processes are the elements of this type of models. A powerful set of model builders and calculation bases allows you to use them as a forecasting tool.

The use of econometric models requires a qualitative analysis of the object under study, a complete interpretation of the research conditions and results, because the mathematical apparatus of the regression analysis used is given only in numerical and quantitative estimates.

The quality of econometric regression models is evaluated in the standard way for economic-mathematical models - by power and accuracy. The power of regression models can be determined by analyzing the sequence of residuals. In this case, the calculation values are obtained by putting the actual values of all the factors included in the model. The residual sequence is checked for fulfillment of the properties of the random components of the time economic series: the mathematical expectation is close to zero, the deviations are random, the absence of autocorrelation and the normality of the distribution law. This check is done in the same way as for trend models and using the same statistical criteria.

The quality of regression models can be judged by the values of the general coefficient of determination and the multivariate correlation coefficient for multivariate regression models. The closer the absolute values of the mentioned coefficients are to 1, the stronger the connection between the selected indicator and the factors that determine it. Consequently, it will be possible to judge the power of the model, which includes the most important factors, with great confidence.

The same statistical criteria as those used for trend models are generally used to evaluate the accuracy of regression models. The significance of the regression model is checked by Fisher, whose calculation value is determined by the F-criterion, which is defined as the ratio of the residual sequence of the initial series of the investigated indicator to the untargeted estimate of the indicator for this model. If the degrees of freedom $v_1 = n - 1$ and $v_2 = n - m - 1$, where n is the number of observations and m is the number of factors included in the equation, the calculated value of this criterion is greater than the tabular value at the given level of significance, the model is recognized as important.

Assessing the importance of regression coefficients in checking the quality of the regression model is also appropriate. This evaluation is performed by Student's t-test by testing the hypothesis that the k-coefficient of regression ($k = 1, 2, \dots, m$) is equal to zero. The calculation value of the t-criterion with degrees of freedom ($n - m - 1$), in turn, calculates the k-coefficient of regression, the square root of the k-diagonal element of the matrix and the difference of the residual component values, which is the inverse of the matrix of normal equations relative to the model indicators, and the coefficient of the untargeted estimation. is determined by dividing by the root mean square deviation of this coefficient. This calculated value is compared with the table value of the Student criterion for the given level, and if it is greater than the table value, the regression coefficient is considered significant. Otherwise, the factor corresponding to this regression coefficient should be excluded from the model. The quality of the model does not deteriorate.

According to our analysis, the creation of forecast models of macroeconomic indicators is carried out in several steps. That is:

In the first step, in accordance with the set goals and tasks of macroeconomic analysis and taking into account the existing information base, the level of aggregation of indicators is determined and the general structure of models is created;

In the second step in developing models is to calculate a system of equations for each forecast indicator. In this step, the coefficients of the regression equations are calculated and the quality of the regression approximation is evaluated;

In the third step, the models are tested, that is, the compatibility with the real economic system that it describes, the applicability of the researched indicators for forecasting is checked. Scenario conditions, calculation indicators, forecast range are determined and forecast calculations are performed.

These three steps constitute a general interactive process. The choice of the general structure of the models reflects the nature of the demand that prevails in the market economy. The offer is taken in the form of production possibilities. General demand is divided into consumer demand, investment demand, state demand and demand by foreign trade (export and import of goods and services). The models for the formation of different categories of demand on the basis of the income obtained under the influence of factors such as the price, the economy and the general state of the economy and its individual sectors, contain equations that describe the dynamics of these factors.

Forecasting in Regression Models. Assume that the time series of the studied indicators and the factors included in the models are sufficiently accurate and correct before the models are constructed. In such a model, for forecasting, it is assumed that the relationship between the previously existing variable indicators is guaranteed for the future period.

In order to predict the variable indicator (outcome) L steps ahead, it is necessary to know the forecast values of all factors included in the model. These values can be obtained using extrapolation tools. They can also be determined by experts or provided directly by an expert-researcher of the economic process. The forecast values of the factors are included in the model and accurate forecast estimates of the studied indicator are obtained. In our model system, all equation indicators are predicted step-by-step, which means that all indicator values remain open for use as factors in the next step.

When the value of the factors is known, it is necessary to calculate two possible errors in order to determine the probability values of the resulting indicator, i.e., the confidence interval of the forecast. Errors of the first type are explained by the dispersion of the observation relative to the regression line, and they can be calculated using the mean squared error of approximation using the regression model.

The second type of error is explained by the fact that the regression coefficients in the fixed model are actually random indicators distributed according to the normal distribution law. These errors are accounted for by introducing a correction factor in the calculation of the confidence interval width; The formula for its calculation includes the value of the t-test table at the given level of significance and depends on the type of regression model.

When performing forecasting using regression models, one must decide what length of series to choose for forecasting. It can be seen that if the length of the series of economic dynamics is too small, its development trends may not be determined. On the other hand, a very large time series may cover periods with different trends, and it may be beneficial to describe it using a single equation. Therefore, it is recommended to proceed as follows: if there are no qualitative considerations, the longest possible time interval should be taken. If the development determines the cyclical character, the entire conic cycles should be taken; *Since* the series covers periods with different trends, it is better to shorten the series by excluding previous levels with different development trends .

Although regression models look very complex, forecasting macroeconomic indicators with them is a fairly simple process. But the simplicity of the forecasting process requires deception and too far-sightedness, which can lead to gross errors. The optimal length of the lead-in period is determined separately for each economic case, based on meaningful considerations about the stability of the case. The length of the forecast, as a rule, does not exceed one third of the data volume for the series of annual observations .

National system. Indicators of economic sectors are included in the National Accounts System and GDP components are calculated. All indicators used in global developments and models take a place determined by the system among other macroeconomic indicators and (in a dynamically developing system) can have a value only within the range of values given for each indicator.

System of expert evaluations (a set of options for scenario indicators and the results of calculations corresponding to them). The improvement of the forecast quality is achieved by clarifying the scenario conditions many times, using various mechanisms of softening the initial information, clarifying the system of regression equations and selecting the forecast option according to the given criteria (the level of confidence in the scenario conditions and the possibility of their implementation).

Despite the fact that the market economy is highly self-regulating, it prefers the influence of external factors to the management mechanism. A purposefully oriented interpretation of the processes taking place in the economy cannot take place without a system of scientifically balanced forecasts, which are necessary for all levels of the economy. The problem is that there is a general system for forecasting socio-economic development, which meets the accuracy and high quality of forecasts for all required indicators. The tasks of assessing the quality and accuracy of the actually used systems for forecasting such indicators are urgent [15].

Realizing the difficulty of implementing computer-technological methods for forecasting unlimited economic indicators, we expressed the goal of the research as follows: short-term forecast calculations of socio-economic development indicators on the basis of complex large-scale distributed econometric models, distributed computer-technological objects and distributed information base development of an information-analytical system on the basis of a computer-technological complex.

In order to achieve the set goal, the following tasks are solved, representing the usual set of tasks of organizing economic-mathematical models, but in a new interpretation:

1. A methodology for organizing a distributed system of short-term forecast calculations in connection with the dynamics of macro-economic indicators has been developed for large-scale complex econometric models ;
2. An information supply and tactical interview information collection system for distributed short-term forecasting systems will be formed;
3. have been developed for short-term forecasting of indicators of macroeconomics, external economic activity, financial system, population living standards, labor and employment, investments, scientific research and innovation ;
4. A methodology for making short-term forecasts and preparing scenarios for the development of Uzbekistan's economy will be created in order to take into account the effect of the indicators of the scenario conditions on the basis of the multivariate calculations;

Development of technical and technological tools for calculations using the distributed metasystem of short-term forecasting .

Macroeconomic indicators are a block of the system of short-term forecasting models It is presented in figure 1 .

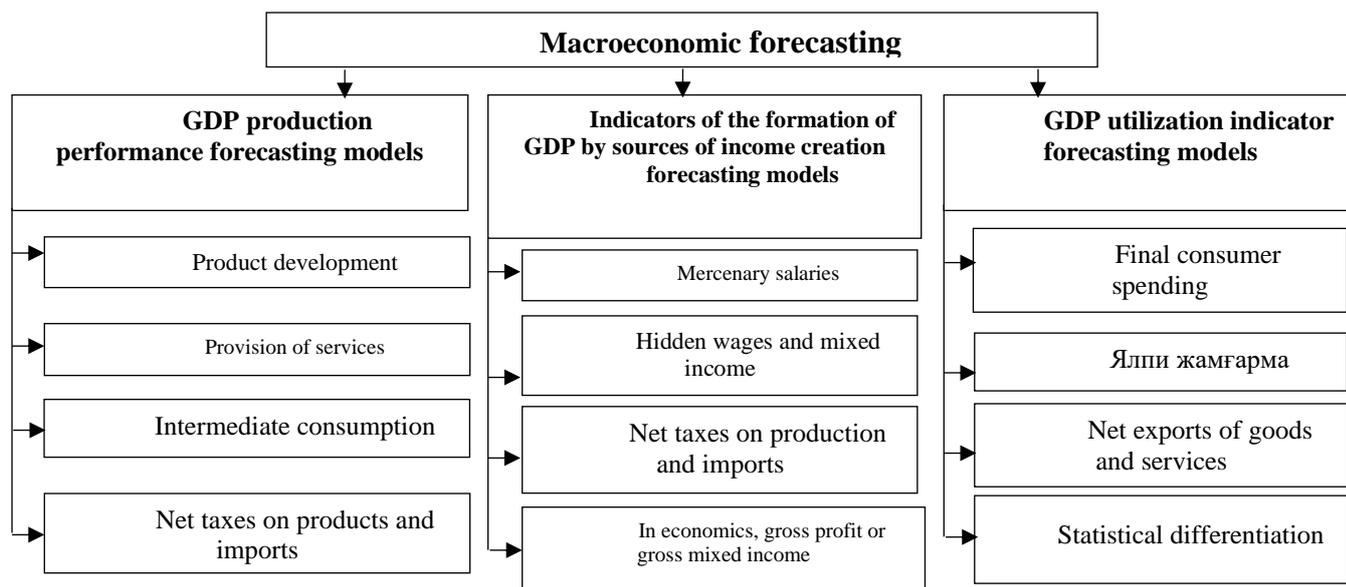


Figure 1. Macroeconomic indicators are a block diagram of short-term forecast models

The main task to be solved in this block is the quantitative description of the main directions of economic development. The block includes:

Forecasting models of "GDP production" indicators;

Forecasting models of "GDP utilization" indicators;

Forecasting models of "GDP formation by income sources" indicators.

In the GDP production block, forecast calculations of the structural components of GDP, which include: production of goods ; production of services;

calculated by the use of income, the following structural components are forecasted: final consumption expenses; gross savings; export.

The following in the block of formation of GDP by sources of income Structural components are projected:

- salary of hired employees;
- hidden wages and mixed incomes;
- production and import duties;
- gross profit and gross mixed income in economics.

The output data in this block - indicators detailing final consumer spending, gross savings, wages of hired workers, etc. - are not only of independent value, but also used as evidence in the calculation of other indicators.

Although regression models may seem complicated, computing forecasts using distributed forecasting metasystems is a relatively simple process from a technological point of view.

CONCLUSIONS AND SUGGESTIONS

Based on the analytical capabilities of MHT, it is important 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 preparation of balance sheets). In addition, it is necessary to create macroeconomic equations in the MHT conceptual framework, to express the interrelationship of economic equations calculated on the basis of monetary and credit spheres, balance of payments and state budget with production, income distribution, redistribution and use balances in statistical indicators.

Availability and development of graphical and tabular vocites for analysis of forecast indicators . After the initial phase of the calculations is completed, a number of works on the preparation of materials for analytical research of the forecast option will appear. It is necessary to have tables and graphs of forecast quality assessment of each indicator, the possibility of visual comparison of the selected number of indicators, the full accuracy of the forecast of the indicators of the studied option, the results of control of the balance ratios, the results of control of the ranges in which the individual values of each indicator can be changed.

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