FORECASTING INDICATORS OF FOREIGN TRADE ACTIVITY USING THE ARIMA MODEL

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ABSTRACT

In this article, in order to improve the effectiveness of foreign trade statistics, it is carried out on the basis of international standards and forecasting using seasonal, structural adjustments and the trend component of the ARIMA model, scientific conclusions and recommendations are given based on the results obtained using this model. Considering that foreign trade is extremely important in the development of the countries of the world, the transition to international standards for preserving differences in official reports between countries in order to increase the transparency of foreign trade processes and the level of confidence in statistical information is a very relevant issue. The fact that the development of Uzbekistan's economy also depends on foreign trade creates a demand for the introduction of international standards in this area. In the construction of the "new Uzbekistan" foreign in addition to further development of trade and statistical analysis on it, it is considered necessary to make forecasts for future periods. At the same time, the fact that our country is a "country with double access to the sea" (remote from the sea) also suggests that there is a great inconvenience in foreign trade and that a lot of statistical research is needed to eliminate it.

The development of foreign trade, of course, is of great importance in ensuring the sustainable growth of the country's output in the current period, in which we can observe a very gross economic imbalance due to various random situations in the world economy. The study of the development of foreign trade on the basis of statistical patterns, the widespread use in practice of the results of economic analysis leads to a stable growth of all macroeconomic indicators of the country.

Keywords: Foreign trade, export, import, industry, statistics of foreign trade, statistical analysis, econometric model, ARIMA model.

INTRODUCTION

The high intensity of economic globalization is a factor determining the degree of attachment and development of countries to the world market. As a result of the widespread use of the achievements of scientific potential in all spheres, economic growth is observed in the countries of the world. As a result of the current level of formation, the world economy, which shows its bright sides, discovers new forms of various economic relations, therefore, the demand for large-scale foreign trade research has been growing over the years. In general, trade is considered one of the most promising and highly developed industries in all spheres of our life, and it has had its own historical periods of development since ancient times.

Despite the incomparable importance of domestic trade in the development of the country, much attention was paid to the development of foreign trade, which is necessary to ensure national interests in relations with the state on a global scale, to create a legal basis for foreign trade and ensure its state regulation.

A statistical study of the export-import structure of foreign trade turnover and their geographical directions allows us to identify new areas of foreign trade for the country's economy. Even when the commodity structure and indicators of its development occur by year in a country or on a global scale, it is able to provide information that fully reflects the level of economic development of this country. The analysis of the brand structure of foreign trade turnover determines the competitiveness of the country and its prestige in the suburban market. It is

important to study the country's foreign trade processes using scientific research methods, to study its specific new aspects and use them in the development of our national economy.

In the economic and statistical analysis of foreign trade processes of the Republic of Uzbekistan, it is necessary to produce, analyze and effectively use them to achieve stable positive results, not limited only to data obtained from accurate statistics, for this it is necessary to carry out predictive work on them. Over the past fifty years, the methods of macroeconomic forecasting have improved significantly. The development of the country's economy and the achievement of sustainable economic growth trends are, of course, considered to be related to the proper development of economic policy. This, in turn, is based on accurate forecasts of economic conditions. Modern methods of unconditional forecasting are initially dominated by linear models, they demonstrate a connection with the model and place high demands on data. The forecast of any macroeconomic indicator should be determined by the peculiarities of the past period of this time series. If the prediction does not take into account a certain property of the time series for a given period of time, then the forecast that will be made in the future may lead to an unfavorable result. For example, if the stagnation of the time series is not taken into account, then the model developed for the forecast is biased. The resulting correlations in this forecast model are calculated as confidence.

In this part of the study, in order to predict the indicators of foreign economic activity, the specific characteristics of the dynamics of the time series included in these indicators in recent years were studied. Based on these characteristics and using the ARIMA model, a forecast of these indicators for future periods was developed.

The forecast of the following general indicators for foreign economic activity is carried out: indicators of products of the Republic of Uzbekistan, indicators of expositions and expositions, indicators of expositions and expositions of services. Exported and imported goods include cotton fiber, chemical products, exports of non-ferrous and ferrous metals, energy and petroleum products, machinery and equipment, gold and food. ekpsorti and import services include construction, transport, tourism and other services.

The Republic of Uzbekistan announces these indicators monthly in cumulative form. We will use this information in the study. Since the data range is relatively small, we can make a prediction using the ARIMA model. Expositions and expositions of goods of the Republic of Uzbekistan, as well as expositions and expositions of services. Exported and imported goods include cotton fiber, chemical products, exports of non-ferrous and ferrous metals, energy and petroleum products, machinery and equipment, gold and food. ekpsorti and importi services include construction, transport, tourism and other services.

The Republic of Uzbekistan announces these indicators monthly in cumulative form. We will use this information in the study. Since the data range is relatively small, we can make a prediction using the ARIMA model. An important aspect of modeling and forecasting is the phrase: If we model data in a cumulative form, the seasonal component in the data will be important. As a result, the overall dynamics of time series over the past period is difficult to model using the ARIMA process. Therefore, we will enter data into the model in the form of changes relative to the previous month.

Another aspect of the ARIMA model is data stability. The variables in the ARIMA model must be stationary. In addition, the stationarity of variables in the ARIMA model will be determined using ADF (Augmented Dickie Fuller Test - additional Dickie-Fuller test), where the stasionality of variables will be measured purposefully.

The presence of strong seasonality in time series is called stochasticity and non-determinism. Stationary time series are called stochastic time series that rotate around their midpoints, and this can be seasonal (stochastic). This means that in stationary time series there will be no cases of trend, cycle, randomness and autocorrelation. If there is any of them, then a nonlinear time series is called. Checking the time series for a stationary one is the initial stage, and without this initial stage, the analysis is not carried out. Time series are basically checked for stagnation in three different ways:

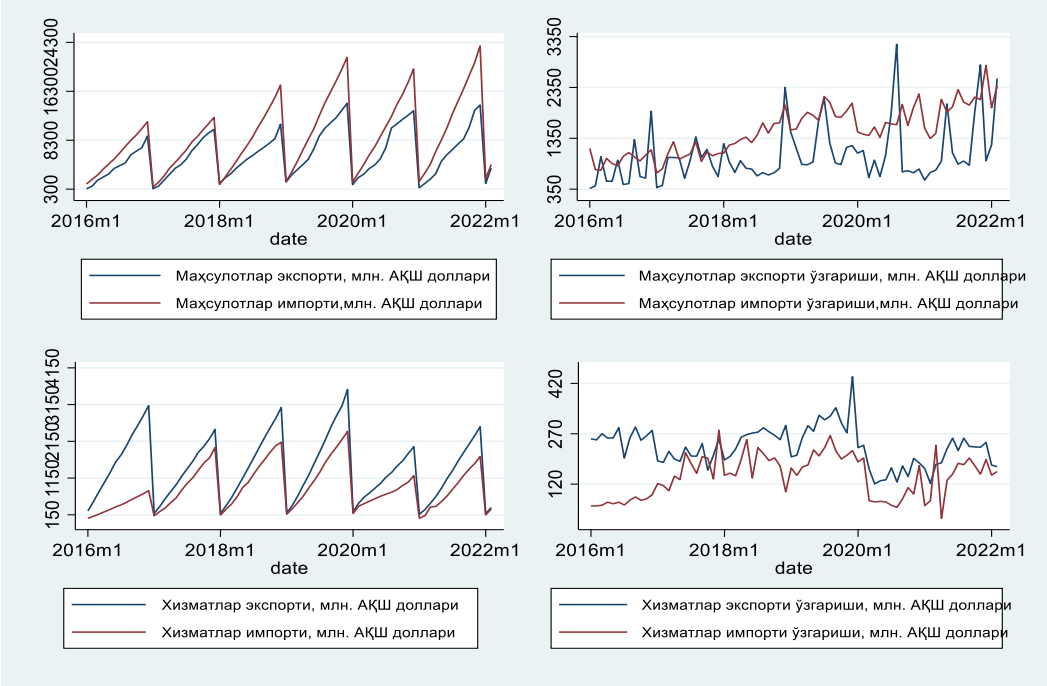
Graph (the graph is extracted by issuing the "tsline export" command in the stata-16 program);

Autocorrelation (checked by issuing the command "ac dexport" in the stata-16 program);

Dickey Fuller test (checked by issuing the command "dfuller export" in the stata-16 program).

When we check graphically, we will be able to check the stationary from the form that appeared on the graph. Even in the autocorrelation method, the result obtained from the "ac dexport" command remains unchanged only if our indicators are within the specified gray color. When the Dick Fuller test is checked by issuing the command "dfuller dexport" in the stata-16 program, the "test statistics" will be negative if it is less than 1%, 5% and 10%, and the "McKinnon p value" will be recognized as a stationary state if it is less than 0.05.

We use the Dyke-Fuller test to check the hospital. If the data is nonlinear, we take the differences of the variables of the first level and check again for stationary. If the difference of the first level of the variable is stationary, then we introduce the variable into the model. If not, we will continue the process described above again. An important aspect of modeling and forecasting is the phrase: If we model data in a cumulative form, the seasonal component in the data will be important. As a result, the overall dynamics of time series over the past period is difficult to model using the ARIMA process. Therefore, we will enter data into the model in the form of changes relative to the previous month.



Picture #1[1]. Dynamics of exports and imports of goods and services based on cumulative (left side) and dynamic changes (right side) in 2016-2021.

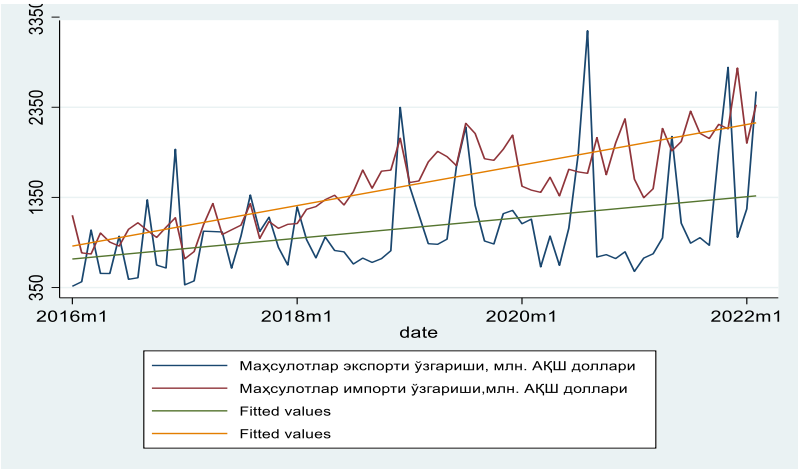
[1] Created by the author using the stata-16 programm.

In Picture 1, the indicators of foreign trade activity are cumulative and are presented in the form of changes compared to the previous month. From this figure it can be seen that in the case of data changes in cumulative form, the seasonal component focuses on the dynamics of the time series.

Also from the 2nd figure, one more thing can be seen that the export of services and impsorti indicators began to decline significantly during the coronavirus pandemic, so we will conduct a simulation by introducing a special variable that reflects this structural change in the ARIMA model. This structural variable was created due to the impact of quarantine restrictions on foreign economic activity during the coronavirus pandemic.

Picture #2[2]. Dynamics of monthly changes in exports and imports of services. 2016-2021.

Picture-3 shows that the change in the volume of exports and imports of products tends to increase during the study period. Here the products are indicated with a yellow line of import change, the products are indicated with a green straight line, while the export change is a trend line. Therefore, trend compensation was taken into account in the ARIMA model when products were modeled as export and import. To account for this compensation in the ARIMA model, a special trend variable was created, which was introduced as an independent variable in the ARIMA model. The special trend variable aks reflects the number of months from 1 to the next.



Picture #3[3]. Dynamics of changes in exhibitors and imports of goods with a linear trend, 2016-2021, monthly indicator, mln. USD

[2] Created by the author using the stata-16 programm.
[3] Created by the author using the stata-16 programm.

Another aspect of the ARIMA model is data stability, as mentioned above. In the ARIMA model, the variables must be stationary. In addition, the stationary stability of variables in the ARIMA model was investigated using ADF (Supplemented Dickey Fuller Test-Additional Dickey-Fuller test). In this single-root test, a form adapted to the stationary testing trend was used. Because, as noted in the conclusions given in Figure 3 above, the trend of time series can be stationary.

In addition, taking into account the impact of the coronavirus pandemic on the export and import of services during 2020, the period up to 2020 was completed in stationary testing of these time series.

It can be seen from the data in Table 4 that in all time series data we can reject the null hypothesis of nostalgia for the trend at a significant level of 10%. So, based on this analysis, we need to study the effect of trend compensation on the ARIMA model, if the influence of the trend component is statistically significant, then we need to enter the model.

Table #4[4]. Checking the stability of variables included in the ARIMA model. Advanced Dyke-Fuller Test (ADF).

Variable	Test statistics	Critical values of the Dyke-Fuller test, degree of significance			MacKinnon *p* values
		1 %	5 %	10 %	
Change in the volume of exports of products, mln. USD	-6.542	-4.102	-3.478	-3.167	0.0000
Change in the volume of imports of products, mln. USD	-4.165	-4.102	-3.478	-3.167	0.0051
Change in the volume of exports of services EXP, mln. USD	-3.213	-4.178	-3.512	-3.187	0.0819
Change in the volume of imports of services, mln. USD	-4.985	-4.178	-3.512	-3.187	0.0002

Note: here, in the usual ADF test, the trend component was taken into account for all variables, in addition, structural changes were taken into account for the indicators of export and import of services.

It is known that in the case of a stationary test, the test statistics should be less than 1% of the critical values of the Dyke-Fuller test, 5% and 10% of the critical values, while the McKinnon p-value should be less than 0.05. Accordingly, from the data in our table, the statistics of tests in 1,2 and 4-variables showed that the Dyke-Fuller test was less than critical values, and the McKinnon p-value was less than 0.05, which indicates that they were stationary, but the indicators in the 3-variable showed signs of nostalgia just the opposite.

Table #5[5]. Visual statistics of variables entered into the ARIMA model

Variable	N	Average	Average	Min	Max
Change in the volume of exports of products, mln. USD	74	1016.897	566.398	364	3198.745

[4] Created by the author using the stata-16 programm.
[5] Муаллиф томонидан stata-16 дастури ёрдамида яратилган.

Change in the volume of imports of products, mln. USD	74	1493.78	471.315	668.442	2785.554
Change in the volume of exports of services EXP, mln. USD	74	231.422	57.545	120.614	440.168
Change in the volume of imports of services, mln. USD	74	143.149	63.267	18.157	280.492

Table #5 shows descriptive statistics of variables used in ARIMA models. The volatility of all variables in the Bund, held, in the period under review is low. Products show higher volatility compared to other indicators (coefficient of variation 566.4/1016.9*100%=55.6%).

ARIMA models are usually expressed in the following form:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots + \alpha_p y_{t-p} + +\beta_1 u_{t-1} + \cdots + \beta_q u_{t-q} + u_t \quad (6)$$

Here is the common formula of the ARIMA process for predicting time series Y. Bunda p is the ordinal number of the autoregressive part, and q is the ordinal number of the ordinal part of the average value. this is a random fraction equal to the normal distributed mean zero. But in this analysis (6) we will make three modifications to the model: firstly, we will use the ARIMA model form for seasonal time series, and secondly, we will take into account the trend component in the ARIMA model, structural changes in the tertiary sector will be taken into account.

Taking into account the aforementioned omillarni, the seasonal ARIMA model can be avoided as follows:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots + \alpha_p y_{t-p} + +\beta_1 u_{t-1} + \cdots + \beta_q u_{t-q} + \gamma_1 y_{t-12} + \cdots \gamma_1 y_{t-12-(P-1)} + \delta_1 u_{t-12} + \cdots \delta_1 u_{t-12-(Q-1)} + \theta t + \vartheta c + u_t (7)$$

Here, the coefficients indicate the effect of non-autoregressive and moderate cross-section lag on the value of the indicator for the current period by seasonal nature. γ and δ indicate the influence of seasonal autoregression and the average slip cross-section on the value of the indicator in the current period. and although the coefficients were analyzed in various combinations of a specific trend variable and structural changes, respectively, the following seasonal ARIMA model was chosen for each macroeconomic indicator, which is key for foreign economic activity.

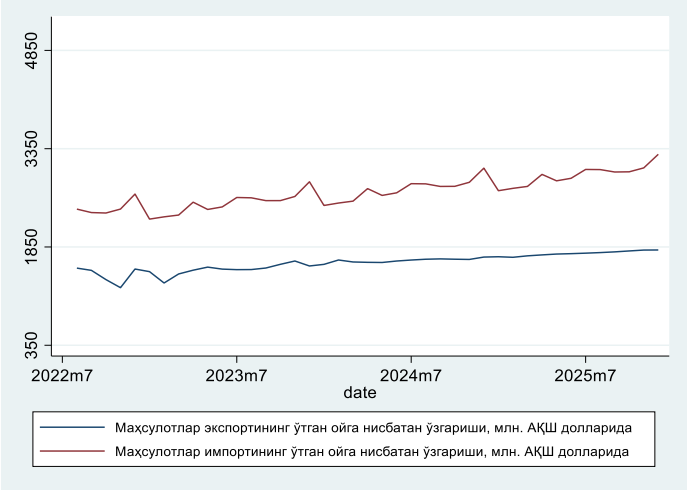
Table #6[6]. Results of the ARIMA model with a seasonal and trend component for each indicator (STATA 16)

Structure of the ARIMA model	**ARIMA models for time series**			
	Export of goods	Import of goods	Export of services	Import of services
AR(1)	-0.351	0.842***	0.604	0.916***
AR(2)	-	-	0.120	-
MA(1)	0.628*	-0.495***	-0.131	-0.529***
Seasonal AR(1)	-0.311	0.957***	-	0.069

[6] Муаллиф томонидан stata-16 дастури ёрдамида яратилган.

Seasonal MA(1)	0.167	-0.791*	0.224	-0.273
A variable indicating structural changes	-	-	-72.611***	-
Trend variable	9.570***	18.452***	-	-
Constanta	657.620***	830.955***	242.722***	137.845***
BIC	1159.984	1028.324	782.552	802.176

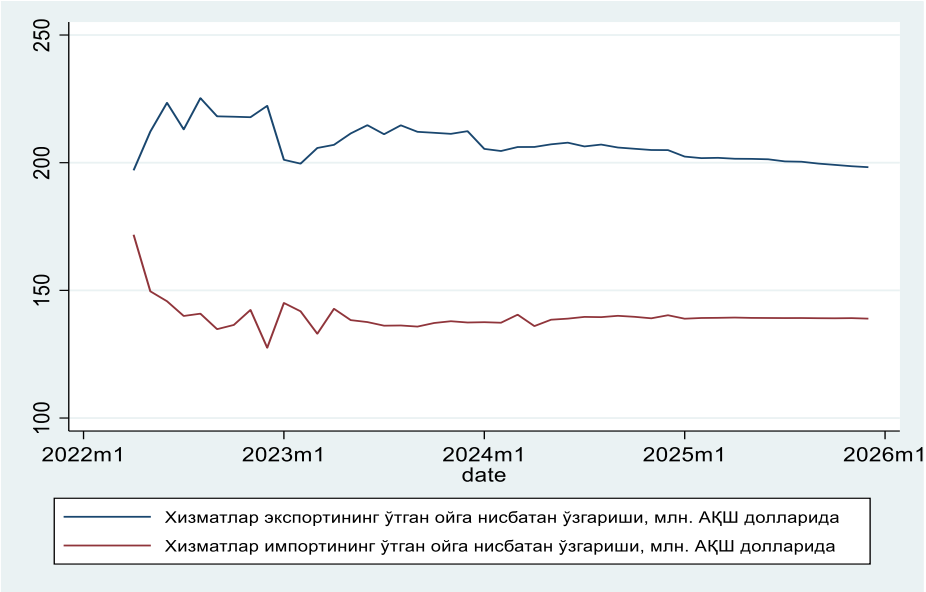
Table 6 shows ARIMA models with a seasonal and trend component for the export and import of goods and the export and import of services. From the information given in this table, it can be seen that when studying the dynamics of exports of products, the value of the moving average, as well as the trend variable, is significant. It can be seen that the influence of the autoregressive and moving average parts on the import of products is statistically significant. The importance of the coronavirus pandemic played an important role in explaining the dynamics of services exports. Services had a significant impact on the dynamics of imports, while the middle parts of autoregression and sliding. Using the ARIMA seasonal models shown in Table 6, we forecast the indicators of foreign economic activity for 2022-2025.



Picture #7[7]. Exports of products and forecast of importchanges for 2022-2025, in millions of USD

As can be seen from the information in Figure 7, according to the forecasts of the ARIMA model, products will continue to grow during the export and import period under consideration. But if there are no significant structural changes, the growth rate of imports will remain higher than the growth rate of exports. Even in 2016-2021, the growth rates of imports in most of the periods under review were still higher than the growth rates of exports. These previous trends have taken an important place in the formation of forecast indicators.

[7] Муаллиф томонидан stata-16 дастури ёрдамида яратилган.



8-picture[8]. Export of services and forecast of import changes in 2022-2025, in millions of USD

From the above data with 8 pictures, we can see that in accordance with the forecasts of changes in the seasonal component of the ARIMA ximztalar exporti and importi model in 2022-2025, services will not show significant growth or a downward trend during the period when exports and imports are considered. Services, such as 2016-2021, are projected to maintain a positive balance between the change in exports and imports in 2022-2025.

CONCLUSION

From the above information, it is logical to use one or another model only when the factor predicts foreign trade for future periods. Performing the actions of the next stage, first of all statistical evaluation of the model, and then what is statistically significant, improves the quality of our work and ensures reliable and efficient operation of our model. This, in turn, allows users of our model to get the necessary information qualitatively and use it when making future decisions.

In conclusion, when using Masumi and trend component models, it is necessary to pay great attention to the indicators of the model. We predicted the export and import of products using separate models, such as the content of the ARIMA model, such as AR(1), ar(2), ma(1), seasonal AG(1), seasonal ma(1), structural change variable, trend variable, constant and BIC, which are presented in See table 6 above. This, in turn, increases the efficiency of forecasting at exhibitions and Imp of goods and services, which are considered the main components of foreign trade. Forecasting foreign trade by dividing it into the above types makes it possible to widely use one type of indicator to prevent negative economic indicators that may arise as a result of changes in another type. We believe that the forecasts for 2022-2025 will give their effective results, since our model is recognized as statistically significant.

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