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Эконометрический анализ и моделирование динамики развития платежного баланса в Азербайджане

Цель исследования. *Исследование посвящено эконометрическому анализу и моделированию динамики развития платежного баланса Азербайджана, формированию математико-статистического тренда, способной дать перспективную оценку развития платежного баланса. В соответствии с целью были поставлены задачи выбора наилучшего состава объясняющих факторов для модели, с помощью характеристик и критериев корреляционного и регрессионного анализа, эконометрических тестов расчет оценок характера и тесноты связи между объясняющими факторами, зависимым и независимыми факторами, проверки стационарности ряда.*

Материалы и методы. *Использованы официальные статистические данные Государственного Комитета Статистики и Центрального Банка Азербайджана, научные труды и исследования ученых, специалистов, как азербайджанских, так и зарубежных, в областях экономики и математико-экономического моделирования. Для эмпирического анализа нестационарных временных рядов в работе применены статистические методы обработки информации, для проверки адекватности и тестирования многомерной модели использованы соответствующие критерии и современные эконометрические процедуры с учетом воздействия экзогенных факторов. Для расчетов использованы пакеты прикладных программ, таких как Excel и Eviews 8.*

Результаты. *Создана многомерная регрессионная модель, позволяющая проводить экономико-статистический анализ динамики счета текущих операций платежного баланса; определены форма и направления функциональной зависимости между зависимыми и независимыми переменными, оценена изменчивость переменных, проанализированы результаты многомерного регрессионного анализа по эконометрическим методикам; измерены и интерпретированы количественные характеристики механизмов влияния объясняющих факторов на платежный баланс; в модели исследованы корреляционные зависимости для причинно-следственных зависимостей, выполнен тест Грейнджера и выявлены факторы, достоверно объясняющие исход с высокими вероятностями на основе критерия Фишера; стационарность модели измерялась на основе теста Дики-Фуллера. При разностях первой и второй степени стационарность модели авторегрессии определялась на основе критерия Стьюдента путем изменения величины лага.*

В процессе моделирования изначально построенная модель, охватывающая 1995–2017-е годы с 5-ю факторами как, иностранные инвестиции, экспорт, импорт, курс маната, общие инвестиции, показала недостаточную адекватность, то есть не стационарность ряда текущего счета платежного баланса. Курс национальной валюты, который участвует в модели как объясняющий фактор, подверг значения зависимого ряда большим колебаниям, росту дисперсии в остатках, что создала не стационарность и которое можно объяснить деноминацией национальной валюты в 2006 году. В последующем шаге был исследован период охватывающий 2006–2017-е годы. Также в процессе исследования в модель были добавлены независимые факторы, как дефицит государственного бюджета и валютные резервы. В результате была построена многофакторная эконометрическая модель.

Заключение. *Построенная авторегрессионная модель достаточно адекватна, демонстрирует стационарность для временного ряда зависимой переменной и может считаться пригодной для прогнозных значений текущего счета платежного баланса.*

Для выработки конкретных рекомендаций перспективного развития платежного баланса, полученные результаты исследования, обоснованные проведенным анализом динамики развития платежного баланса, дают возможность выявить реальные тенденции платежного баланса Азербайджана по текущему счету и определить его взаимозависимость с другими макроэкономическими переменными.

Ключевые слова: *платежный баланс, текущий счет, эконометрическая модель, описательная статистика, вариабельность, стационарность, тест Дики Фуллера, тест Грейнджера.*

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Econometric analysis and modeling of the dynamics of the balance of payments' development in Azerbaijan

Purpose of the study. *The study is devoted to econometric analysis and modeling of the dynamics of the balance of payments' development of Azerbaijan, the formation of a mathematical and statistical trend that can give a perspective assessment of the development of the balance of payments. In accordance with the goal, the tasks of choosing the best composition of explanatory factors for the model were set, using the characteristics and criteria of correlation and regression analysis, econometric tests, calculating estimates of the nature and closeness of the relationship between the explanatory factors, dependent and independent factors, testing the stationarity of the series.*

Materials and methods. *The official statistical data of the State Statistics Committee and the Central Bank of Azerbaijan, scientific works and studies of scientists, specialists, both Azerbaijani and foreign, in the fields of economics, mathematical and economic modeling were used. For the empirical analysis of non-stationary time series, statistical methods of information processing are used in the work; to check the adequacy and test the multivariate model, the appropriate criteria and modern econometric procedures are used, taking into account the impact of exogenous factors. For calculations, application packages such as Excel and Eviews 8 were used.*

Results. *A multivariate regression model has been created that makes it possible to conduct an economic and statistical analysis of the dynamics of the current account of the balance of payments; the form and directions of the functional relationship between dependent*

and independent variables were determined, variability of variables was estimated, the results of multivariate regression analysis using econometric methods were analyzed; the quantitative characteristics of the mechanisms of influence of explanatory factors on the balance of payments were measured and interpreted; correlation dependencies for causal dependencies were investigated in the model, the Granger test was performed and factors were identified that reliably explain the outcome with high probabilities based on the Fisher criterion; the stationarity of the model was measured based on the Dickey-Fuller test. With differences of the first and second degree, the stationarity of the autoregressive model was determined based on the Student's criterion by changing the lag value.

In the process of modeling, the initially constructed model, covering the years 1995-2017 with five factors such as foreign investment, exports, imports, manat exchange rate, general investments, showed insufficient adequacy, that is, non-stationarity of the current account series of the balance of payments. The exchange rate of the national currency, which is involved in the model as an explanatory factor, subjected the values of the dependent series to large fluctuations, an increase in the variance in the residue, which created non-stationarity and which can be explained by the denomination of the national currency in 2006. In the next step, the period covering 2006-2017 was examined. In addition, in the process of research, independent factors were added to the model, such as state budget deficit and foreign exchange reserves. As a result, a multifactorial econometric model was created.

Conclusion. *The constructed autoregressive model is quite adequate, demonstrates stationarity for the time series of the dependent variable and can be considered suitable for predictive values of the current account of the balance of payments. To develop specific recommendations for the long-term development of the balance of payments, the results of the study, substantiated by the analysis of the dynamics of the development of the balance of payments, make it possible to identify real trends in the balance of payments of Azerbaijan on the current account and determine its interdependence with other macroeconomic variables.*

Keywords: *balance of payments, current account, econometric model, descriptive statistics, variability, stationarity, Dickey Fuller test, Granger test.*

Introduction

The dynamic integration of Azerbaijan into the world economic system, accompanied by the activation of transboundary flows of capital, the characteristics of economic development of the country's trading partners, changes in prices on world markets and other external factors has an absolute effect to the processes in the sphere of economic activity of the country.

In order to conduct analytical and scenario-forecasting researches and make management decisions, it is important to take into account the interdependencies in the domestic economy, as well as to identify the factors that shape the country's foreign relations in a comprehensive and systematic manner[1,2,3,4,5,6]. It should be noted that modern modeling "Tools" of macroeconomic analysis and forecasting are less focused on a comprehensive consideration of the characteristics of foreign economic activity and the traditional system of macroeconomic indicators. The researches conducted by experts in this area focus on the key indicators of trade balance, the mechanisms of influence of exports and imports on the development of the national economy, the identification of threats that create high dependence of production on world markets conjuncture[7,8]. The issues such as the systematic study of other aspects of foreign economic activity, as well as the establishment of econometric models, are rare.

The research on the regulation of the balance of payments in the late 1990s and early 2000s was a part of a general analysis of the transit economy. However, the recent researches ha focused on the impact of national exchange rates on the balance of payments in the context of already established market relations[9,10]. By evaluating the impact of exchange rate fluctuations on the components of the balance of payments through the researches conducted, a model was developed, the theoretical and methodological bases of exchange rates were analyzed[11], methods for estimating devaluation expectations of financial market entities were developed taking into account the dynamics of the currency structure of investment assets, an economic mathematical models has been established to determine the dependence of exchange rates on inflation processes.

The dedication of the research to the topical issue is determined by the processes in the field of foreign economic activity, which are characterized by significant and growing impact on the development of the national economy and with the importance of taking them into account in assessing the country's economic development trends in the future.

The need for modeling of processes related to foreign economic activity, assessment of socio-economic results, development of adequate management decisions to prevent risks of the economic system forms a demand for methodological and modeling tools[12,13]of forecasting researches and expansion of analytical capabilities. Based on them, it is important to create the necessary opportunities to study and fully take into account the dependences between macroeconomic indicators of development and parameters of foreign economic activity. Along with the trade balance, the parameters of foreign economic activity include indicators such as the services balance of the balance of payments, transactions with financial instruments, and the capital account.

Although the general linear trend of the balance of payments of Azerbaijan for 2012-2018 is characterized by a decrease, the increase in all items abovementioned of the balance of payments from 2017 can be seen in fig.1.

The increase in revenues from the oil and gas sector has in the past again begun to ensure an increase in the total balance of payments surplus in Azerbaijan. In the second half of 2018, the trade balance surplus compared to the appropriate period in 2017 reached to $ 3.665 mlrd. with an increase of $ 1.462 billion, thus a

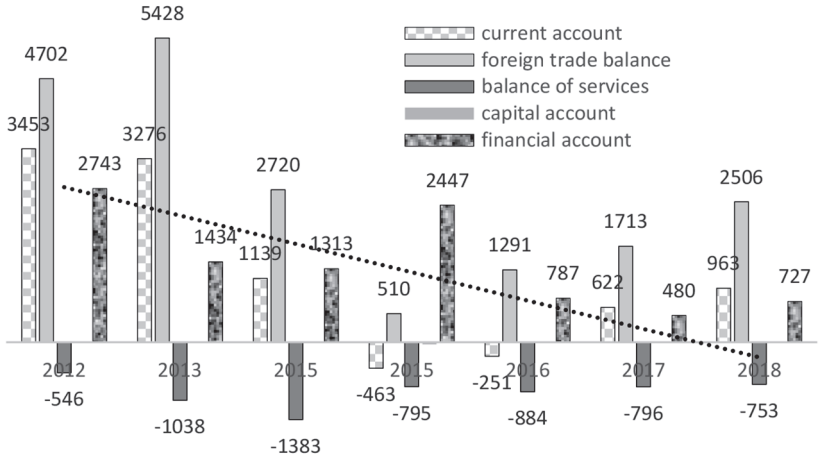

Рис. 1. Динамика ключевых показателей платежного баланса Азербайджана в 2012–2018 годы (млн долл. США)

Рис. 1. Динамика основных показателей платежного баланса Азербайджана в 2012–2018 гг. (млн долл. США)

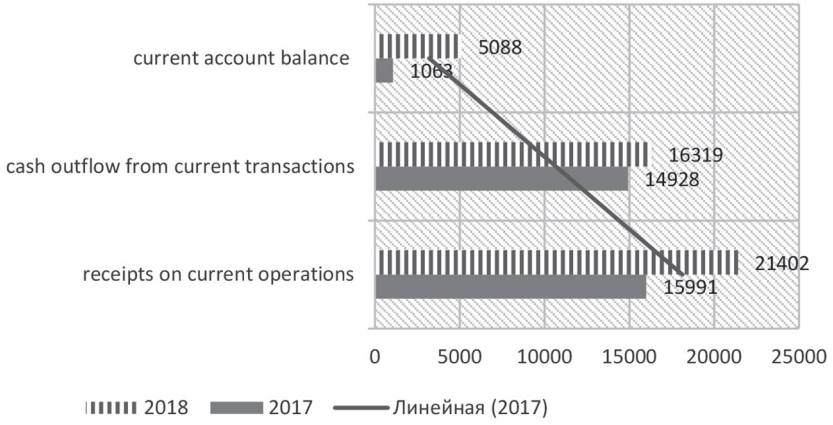

Рис. 2. Приток и отток денежных средств в страну в 2017 и 2018 гг. по текущим операциям (млн долл. США)

Fig. 2. Cash inflows and outflows to the country in 2017 and 2018 on current transactions (million US dollars)

Таблица 1 (Table 1)

Динамика изменения торгового баланса в 2016–2019 гг. по сравнению с предыдущим соответствующим периодом (тыс. долл. США и в %)

Dynamics of trade balance changes in 2016-2019 compared to the previous relevant period (thousand US dollars and in%)

	2016		2017		2018		2019	
	Total	%-with	Total	%-with	Total	%-with	Total	%-with
Export	13210511	84,8	15152059	114,7	20793769	137,2	19868261	95,5
İmport	9004176	92,1	9037316	100,4	10952441	121,2	11335316	103,5
Trade balans	4206335	-17,9	6114743	31,2	9841328	37,8	8532945	-15,3
Commersial turnover	22214687	-	16055795	-27,7	31746210	49,4	31203577	-1,73

Источник: Подготовлено автором на основе информации, полученной от Центрального банка Азербайджана (ЦБА)

Примечание: Знак «+» в табл. 1 указывает на увеличение, а знак «-» на уменьшение.

Source: Prepared by the author on the basis of information obtained from the Central Bank of Azerbaijan (CBA)

Note: The "+" sign in Table 1 indicates an increase, and the "-" sign indicates a decrease.

66% increase was achieved. During the period under review, revenues to the country reached to $ 21.407 billion, and outflows to $ 16.319 billion (see fig. 2). All statistics used in the analysis and graphs were taken from the official website of the Central Bank of Azerbaijan and State Statistical Committee of the Republic of Azerbaijan[14,15].

In 2018, compared to 2017, while the country's cash inflows from current operations increased in the amount of $ 5.416 billion or 33.9%, the increase in outflows from the country was $ 1.391 billion or 9.3%. As a result, cash inflows into the country are significantly higher than the outflows, the current account surplus has increased by almost 5 times and risen from $ 1.063 billion to $ 5.088 billion. According to experts, this factor played a decisive role in ensuring the stability of the country's national currency during the period under review.

Till the end of 2018, the trade turnover formed as a sum of import and export indicators reached a high level and increased to 31746 billion US dollars with an increase of 9.4%(see tab.1).

The main results of the study

In our initial research on modeling the dynamics of the balance of payments [16, 17], a regression analysis was conducted in order to conduct econometric analysis of the dependence of the current account of the balance of payments on total and foreign investments, exports and imports, the exchange rate of the Azerbaijani manat. Current account of y-balance of payments involved in the analysis, x_1-foreign investment (*FORINV*), x_2-export (*EXP*), x_3-import (*IMP*), x_4-exchange rate of manat to US dollar (*MANAT*), x_5-total investment (*CENINV*) are dependent and explanatory variables covering the years of 1995-2017.

In the study, it is important to pay attention to the Darbin Watson coefficients with increased

and very low results, expressed by a very high multidimensional coefficient of determination in time series. Thus, relying on a high coefficient of determination and ignoring the low Durbin Watson coefficient, which points to autocorrelation, can lead to "false" regression and express incorrect dependencies[18].

According to the results of regression analysis with the above parameters(see tab. 2), the number of observations was 23; R^2 (determination coefficient) = 0.98; *F-statistic* (Fisher criterion) = 245.1; *prob.* = 0.00; *DW* (Durbin Watson statistics) = 2.92. The results obtained are quite satisfactory. The coefficient of determination indicates that the independent variables included in the model explain the dependent variable by 98%. Criterion F received a fairly reliable estimate with a high probability. However, the result obtained for the DW criterion can't be considered satisfactory. The critical limits for the DW criterion with $n = 23$ and $k = 5$ are $D_L = 0.90$ and $D_U = 1.92$. Since the calculated value of the *DW* criterion is greater than 2, the value $4 - DW = 1.08$ is compared with critical values: $D_L < 1{,}08 < D_U$. Alternatively, we get a analogical result: $4 - D_U < DW < 4 - D_L$: because of being $2.08 < 2.92 < 3.1$, *DW* falls into the zone of uncertainty, and it is impossible to decide whether there is an autocorrelation.

The units of measurement of the independent variables x_1, x_2, x_3, x_5 included in the model for regression analysis are expressed in US dollars. Taking into account the denomination of the Azerbaijani manat in 2006, the research period was shortened due to the fact that the exchange rate of the x_4 manat, one of the explanatory factors was expressed in the national currency, which created a problem for the stability of the time series, the number of observations was reduced to 12 and covered the years of 2006-2017.

Таблица 2 (Table 2)

Результаты регрессионного анализа за 1995–2017 гг. (с пятью объясняющими факторами)

Results of regression analysis for 1995-2017 (with five explanatory factors)

	FORINV	EXP	IMP	MANAT	CENINV	C
Coefficient	-1.041597	0.855962	0.040745	0.127631	-0.074593	-978.5116
Std. Error	0.214275	0.071390	0.054360	0.220403	0.144352	1126.953
t-Statistic	-4.861035	11.98994	0.749535	0.579079	-0.516739	-0.868281
Prob	0.0001	0.0000	0.4638	0.5701	0.6120	0.3973
R-squared		0.986318	Mean dependent var		4332.196	
Adjusted R-squared		0.982293	S.D. dependent var		6943.397	
S.E. of regression		923.9354	Akaike info criterion		16.71462	
Sum squared resid		14512163	Schwarz criterion		17.01084	
Log likelihood		-186.2181	Hannan-Quinn criter.		16.78912	
F-statistic		245.0926	Durbin-Watson stat		2.928609	
Prob(F-statistic)		0.000000				

Таблица 3 (Table 3)

Результаты регрессионного анализа за 2006–2017 гг. (с пятью объясняющими факторами)

Results of regression analysis for 2006-2017(with five explanatory factors)

	FORINV	EXP	IMP	MANAT	CENINV	C
Coefficient	-0.043786	0.940172	0.075568	-3669.255	-0.505909	-365.0545
Std. Error	0.851259	0.130751	0.097305	3126.497	0.394494	3458.028
t-Statistic	-0.051436	7.190547	0.776614	-1.173600	-1.282425	-0.105567
Prob	0.9606	0.0004	0.4669	0.2850	0.2470	
R-squared		0.977251	Mean dependent var		9106.875	
Adjusted R-squared		0.958293	S.D. dependent var		6616.478	
S.E. of regression		1351.229	Akaike info criterion		17.56227	
Sum squared resid		10954912	Schwarz criterion		17.80472	
Log likelihood		-99.37361	Hannan-Quinn criter.		17.47250	
F-statistic		51.54956	Durbin-Watson stat		2.922200	
Prob(F-statistic)		0.000075				

Number of observations according to the results (see Table 3) of the 2nd regression analysis 12; R^2 (determination coefficient) = 0.97; F-*statistic* (Fisher criterion) = 51.5; *prob* = 0.000075; (Durbin Watson statistics) = 2.92. According to the results, no significant change is observed, so the quality of the model does not increase or decrease significantly, and *DW* statistics still fall into the zone of uncertainty. This doesn't tell us whether there is an autocorrelation over time. In such cases, steps such as extending the time series and editing the explanatory factors in the model can be used to improve the quality of the model.

In general, the current account deficit formed under the influence of the trade balance can be financed by capital inflows in the following forms: Foreign borrowings from other countries, the International Monetary Fund, the World Bank; Assets sold to foreign investors; Direct investments that provide foreign exchange inflows into the country for the establishment of new production facilities; Foreign exchange reserves.

The application of these measures supports the reduction of foreign assets of the state. However, if the government increases its foreign debt, which significantly exceeds the current account deficit, then the country is in danger of a foreign debt crisis with the balance of payments. Proper regulation of these financial processes is very important for the balance of payments and the dynamic development of the country's economy in general.

Thus, in order to improve the quality of the model, we have ad-

justed it and included in the model an important macroeconomic financial indicator of the country, the factor of state budget deficit. The indicators we received from the Central Bank of Azerbaijan for the budget deficit cover the years of 2006-2017 and the unit of measurement is million manat: -85.5; 78.6; -79.6; -12.2; -178; -363.5; 306; -135; 352.8; -308.4; -286.5; -241.2. This indicator is included in the model as x_6-budget deficit (*BD*). The changes in the regression model are shown in Table 4 below.

In the next step, the model includes a macroeconomic indicator of international foreign exchange reserves. Statistical data for official international foreign exchange reserves for 2006-2017 (in USD million) were obtained from the Central Bank and included in the model as follows: x_7-foreign exchange reserves(*REZ)* 1967.3; 4015.3; 6137; 5161.7; 6407.6; 10481.5; 11694.8; 14152; 13758.3; 5016.7; 3974.4; 5334.6.

The developmental dynamics of the explanatory factors in the model are described in a complex way in fig.3.

The model is formed as follows:

$$Y = -949.6 + 0{,}017FORINV + \\ + 0{,}99EXP + 0{,}12IMP - \\ - 3185{,}8MANAT - \\ - 0{,}55CENINV + 2{,}64BD - \\ - 0{,}12REZ$$

According to the results of the last regression analysis, the number of observations was 12; $R^2 = 0.98$; *F statistic* = 30.95; *prob.* = 0.0025; $DW = 2.66$. The critical limits for the DW criterion with $n = 12$ and $k = 7$ are $D_L = 0.103$ and $D_U = 3.033$. As the price of DW statistics is closer to 2 than the previous prices, the quality of the model is improving.

In order to build a successful model, it is important that the independent variables in the model, the regressors, have a sufficiently wide range of variations. The range of variation can be measured on the basis of variability

Таблица 4 (Table 4)

Результаты регрессионного анализа за 2006–2017 гг. (с шестью объясняющими факторами)

Results of regression analysis for 2006-2017(with six explanatory factors)

	FORINV	EXP	IMP	MANAT	CENINV	C
Coefficient	0.185987	0.995924	0.122918	-3744.041	-0.684332	-405.5565
Std. Error	0.862494	0.138169	0.104898	3074.143	0.420372	3399.490
t-Statistic	0.215638	7.208013	1.171791	-1.217914	-1.627923	-0.119299
Prob	0.8378	0.0008	0.2941	0.2776	0.1645	0.9097
R-squared		0.981681	Mean dependent var		9106.875	
Adjusted R-squared		0.959698	S.D. dependent var		6616.478	
S.E. of regression		1328.277	Akaike info criterion		17.51235	
Sum squared resid		8821597.	Schwarz criterion		17.79521	
Log likelihood		-98.07410	Hannan-Quinn criter.		17.40762	
F-statistic		44.65689	Durbin-Watson stat		2.715850	
Prob(F-statistic)		0.000348				

Таблица 5 (Table 5)

Результаты регрессионного анализа за 2006–2017 гг. (с семью объясняющими факторами)

Results of regression analysis for 2006-2017 (with seven explanatory factors)

	FORINV	EXP	IMP	MANAT	CENINV	C
Coefficient	0.017248	0.997093	0.122752	-3185.879	-0.554208	2.640400
Std. Error	1.263255	0.153776	0.116669	4368.352	0.787641	2.618642
t-Statistic	0.013653	6.484073	1.052139	-0.729309	-0.703630	1.008309
Prob	0.9898	0.0029	0.3521	0.5062	0.5205	0.3703
R-squared		0.981872	Mean dependent var		9106.875	
Adjusted R-squared		0.950148	S.D. dependent var		6616.478	
S.E. of regression		1477.297	Akaike info criterion		17.66854	
Sum squared resid		8729625	Schwarz criterion		17.99181	
Log likelihood		-98.01122	Hannan-Quinn criter.		17.54885	
F-statistic		30.95050	Durbin-Watson stat		2.660883	
Prob(F-statistic)		0.002511				

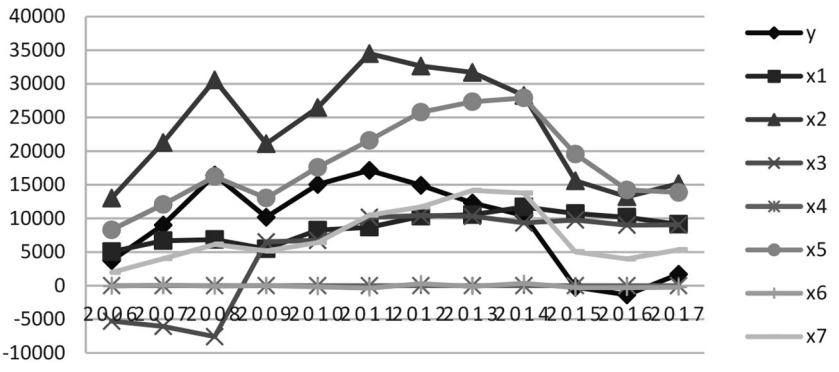

Рис. 3. Динамика развития экономических параметров, входящих в модель на 2006–2017 гг.

Fig. 3. Development dynamics of economic parameters included in the model for 2006-2017

(coefficient of variation), defined as the specific gravity of the ratio of standard variations of parameters to mathematical expectations:

$$v_{x_i} = \frac{\sigma_{x_i}}{x_i} 100\%.$$

$$\sigma_{x_i} = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}.$$

The results of the descriptive statistics in tab.6 were used to analyze the overall statistics and variability of the model. All re-

sults obtained should not be less than 10% to ensure variability, otherwise if this condition isn't met for any variable, it may be more appropriate to remove the variable from the model or replace it with another variable.

There is no need to replace all variables as the required condition is met.

A multicollinear analysis which expressing the correlation dependences between the explained and explanatory coefficients was also performed based on the Pearson coefficients. The calculated double-line correlation coefficients in tab.8 demonstrate strongly straight dependence between y and x_5 ($r = 0{,}74$) and y and x_2 ($r = 0{,}92$), strongly inverse dependence to y and x_4 ($r = -0{,}74$), dependence at straight medium density between y and x_7 ($r = 0{,}55$), weakly straight dependence between y and x_6 ($r = 0{,}32$), and very weak inverse dependence between y and x_1 ($r = -0{,}11$) and x_3 ($r = -0{,}08$). All coefficients were calculated without taking into account the lags.

To evaluate the cause-and-effect relationships between the variables in our model, we performed the Granger test based on the Fisher criterion. According to the test, the H_0 hypothesis rejects the existence of causal dependencies between all possible pairs in the model with *Prob.(F-statistic)* assumption[19].

Among the many results we obtained, the number of observations, *F-Statistic* and *Prob(F-statistic)* is indicated in the tab.9 which can be a one-sided reason for the current account of the balance of payments and formulate based on the corresponding results that reject the H_0 hypothesis. According to the *F-Statistic* criterion for the current account of the balance of payments, the pairs that confirm the H_1 hypothesis with 95% probability are *y- x_1 (foreign investments), y- x_2 (exports)*, *y- x_5 (total investments), y- x_7 (foreign exchange reserves).* Given the small number of observations *(2006-2017, annual),* the test doesn't allow for more lags, so we were able to conduct the test with only 1 lag. This necessitates an increase in the number of observations. Due to the current technical problems with the provision of statistical information, we plan to increase the number of our observations in order to address this problem in our future research. For *Y-X3(import)*, *y- x_4*

Таблица 6 (Table 6)

Результаты описательной статистики
Results of descriptive statistics

	y	x_7	x_6	x_5	x_4	x_3	x_2	x_1
Mean	9106.875	7341.767	-79.37500	18121.17	0.977250	5201.833	23623.33	8626.508
Median	10298.20	5735.800	-110.2500	16906.70	0.812000	9020.500	23872.50	8897.200
Maximum	17146.10	14152.00	352.8000	27907.50	1.720000	10417.00	34494.00	11697.70
Minimum	-1363.400	1967.300	-363.5000	8300.400	0.784000	-7574.000	13014.00	5052.800
Std. Dev.	6616.478	4091.665	229.6012	6393.992	0.329809	7062.213	8045.514	2190.651
Skewness	-0.383181	0.595558	0.729514	0.279494	1.579096	-1.071375	-0.086722	-0.330311
Kurtosis	1.710498	1.931446	2.479581	1.891123	3.802741	2.306700	1.456093	1.819013
Jarque-Bera	1.125064	1.280283	1.199800	0.771038	5.309284	2.536019	1.206866	0.915576
Probability	0.569765	0.527218	0.548866	0.680098	0.070324	0.281391	0.546931	0.632682
Sum	109282.5	88101.20	-952.5000	217454.0	11.72700	62422.00	283480.0	103518.1
Sum Sq. Dev.	4.82E+08	1.84E+08	579883.9	4.50E+08	1.196514	5.49E+08	7.12E+08	52788467
Observations	12	12	12	12	12	12	12	12

Таблица 7 (Table 7)

Коэффициенты вариации объясняющих переменных (в %)
Coefficients of variation on explanatory variables (in%)

x_i	x_1	x_2	x_3	x_4	x_5	x_6	x_7
υ_{x_i}	25,4	34	135,7	33,7	35,2	289,2	55,7

Таблица 8 (Table 8)

Корреляционная матрица
Correlation matrix

	y	*GENINV* x_5	*FORINV* x_1	*EXP* x_2	*IMP* x_3	*MANAT* x_4	*BD* x_5	*REZ* x_7
y	1	0.74	-0.11	0.92	-0.08	-0.77	0.32	0.55
GENIN x_5	0.74	1	0.07	0.76	0.26	-0.81	0.34	0.62
FORINV x_1	-0.11	0.07	1	0.23	0.74	0.21	0.09	0.65
EXP x_2	0.92	0.76	0.23	1	0.16	-0.68	0.32	0.79
IMP x_3	-0.08	0.26	0.74	0.16	1	0.22	-0.12	0.54
MANAT x_4	-0.77	-0.81	0.21	-0.68	0.22	1	-0.46	-0.42
BD x_6	0.32	0.34	0.09	0.32	-0.12	-0.46	1	0.4
REZ x_7	0.55	0.62	0.65	0.79	0.54	-0.42	0.4	1

Таблица 9 (Table 9)

Результаты тестов причинности Грейнджера (лаги:1)
Results of Granger Causality Tests (lags: 1)

	Null Hypothesis:	Obs	F-Statistic	Prob.
x_1	*FORINV does not Granger Cause y*	11	8.37980	0.0201
x_2	*EXP does not Granger Cause y*	11	7.20144	0.0278
x_3	*IMP does not Granger Cause y*	11	1.09125	0.3267
x_4	*MANAT does not Granger Cause y*	11	0.03827	0.8498
x_5	*CENINV does not Granger Cause y*	11	9.34623	0.0156
x_6	*BD does not Granger Cause y*	11	0.48063	0.5078
x_7	*REZ does not Granger Cause y*	11	6.41873	0.0351

(manat) and *y*- x_6 *(budget deficit)*, the test results are not very satisfactory, because the H_1 hypothesis can be accepted with very little probability.

In general, if autocorrelation is determined at the time series levels in the research process, it is important to eliminate it in some way before applying the regression equation for the forecast. If there is a strong autocorrelation between the levels, then it is better to use their differences in the calculations instead of quantitative indicators of the series. Differences in the form of $y_t = y_t - y_{t-1}$; $x_{t1} = x_{t,1} - x_{t-1,1}$; ... $x_{t7} = x_{t,7} - x_{t-1,7}$ [20] are applied instead of the y, x_1, x_2, x_3, x_4, x_5, x_6, x_7 variables in the model. The autoregression model for first-order differences is applied in the form of the following equation:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \varepsilon_t.$$

When the parameters of this model are calculated by the method of the smallest squares, the model is formed in a form of $y_t = \alpha_0 + \alpha_1 y_{t-1}$ which is suitable for forecasting. It should be noted that it is purposeful to apply the method of differences on the basis of preliminary data when *DW* statistics approach 0 or 4[18].

The stableness of the time series was tested on the basis of an extended Dickey-Fuller (*DF*) test. In this case, the H_0 hypothesis accepts the assumption that the time series under study has a single root. In the initial stage of the test(see tab.10), the H_0 hypothesis is accepted that the time series has a single root for the current account balance(*y*). The stationary nature of the time series is not confirmed, so the value of the *t*-Statistic criterion is obtained with a very small probability t = -3.107 with p = 0.1646. This indicates that the result obtained was observed with large errors, and the hypothesis H_0, which confirms the single root, is not allowed to be rejected. At the same time, the fact that the test result for *t-Statistic* at the 1%, 5%, and 10% significance levels is

Таблица 10 (Table 10)

Расширенный тест Дики-Фуллера (с различиями 1-й степени)
Extended Dickey-Fuller test (with 1st degree differences)

t-Statistic	-3.107422	Log likelihood	-85.97255
1% level	-5.521860	F-statistic	6.662377
5% level	-4.107833	Prob(F-statistic)	0.033771
10% level	-3.515047	Mean dependent var	-487.3889
Prob.*	0.1646	S.D. dependent var	8078.168
R-squared	0.799897	Akaike info criterion	19.99390
Adjusted R-squared	0.679835	Schwarz criterion	20.08156
S.E. of regression	4570.878	Hannan-Quinn criter.	19.80474
Sum squared resid	1.04E+08	Durbin-Watson stat	1.736959

Таблица 11 (Table 11)

Расширенный тест Дики-Фуллера (с различиями 2-й степени)
Extended Dickey-Fuller test (with 2nd degree differences)

t-Statistic	-3.550973	Log likelihood	-78.52002
1% level	-4.582648	F-statistic	17.29797
5% level	-3.320969	Prob(F-statistic)	0.005666
10% level	-2.801384	Mean dependent var	2238.012
Prob.*	0.0370	S.D. dependent var	13326.02
R-squared	0.873724	Akaike info criterion	20.38000
Adjusted R-squared	0.823214	Schwarz criterion	20.40979
S.E. of regression	5603.045	Hannan-Quinn criter.	20.17908
Sum squared resid	1.57E+08	Durbin-Watson stat	1.570826

to the left of the critical values for *t-Statistic* brings the time series closer to stationary. t = -3.107 value is to the right of three critical values, -5.521860(1%); -4.107833(5%); -3.515047(10%); It should be noted that the extended *DF* test was performed on the basis of the autoregression model(*AR*) and *Schwarz* criteria with constant and trend, 1st degree differences. The maximum number of lags was taken as 3. Due to this, the number of observations decreased to 9.

By changing the test parameters, the test in the next stage was conducted based on the autoregression model*(AR)* with 2nd degree differences, stable, without trends and here the maximum number of lags is 2(see tab.11).

From the results obtained in tab. 11, it can be seen that the stationary nature of the time series for the current account of the balance of payments can be accepted according to the results obtained. The value of the *t-Statistic* criterion is obtained with the probability t = -3.55 with p = 0.037. This indicates that the result occurred with minimal error and allows the H_0 hypothesis to be rejected. The result obtained for *t-Statistic* is to the left respectively of -3.320969; -2.801384 critical values at the 5% and 10% significance levels. The adequacy of the autoregression model is also quite satisfactory. R^2 = 0,87 indicates that the overall quality of the model is high. The corrected determination coefficient is 82%, the value *F-statistic* = 17.3 was obtained with a high *Prob(F-statistic)* = 0.005 assumption. *DW = 1.57* and is close to 2.

The main results.

A multidimensional regression model has been established that allows economic and statistical analysis of the dynamics of the current account of the balance of payments;

The form and directions of functional dependence between dependent and independent variables were determined, variability was assessed, the results of multivariate regression analysis were

analyzed according to econometric methodologies; quantitative characteristics of the mechanisms of influence of explanatory factors on the balance of payments were measured and interpreted;

Correlation dependencies for cause-and-effect dependencies in the model were investigated, a Granger test was performed, and factors that significantly explained the outcome with high probabilities were identified based on the Fisher criterion;

The stability of the model was measured based on the Dickey-Fuller test. With the first and second degree differences, the stableness of the autoregression model was determined on the basis of the Student's criterion by changing the lag sizes.

The built-in autoregression model demonstrates sufficient adequacy, the time series for the dependent variable is stationary, and can be considered suitable for the forecast values of the current account of the balance of payments.

The results of the research case provide an opportunity to identify real development trends in the balance of payments of Azerbaijan at the present stage and to determine its interdependence with other macroeconomic variables based on the analysis of the dynamics of the balance of payments and develop specific recommendations for balance of payments. The model also allows analyzing and forecasting the dynamics of Azerbaijan's national currency exchange rate and foreign economic activity within the balance of payments.

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