ЭКОНОМИЧЕСКИЕ НАУКИ

УДК :330; 330.4; 336;
ГРНТИ :06.35.33; 06.35.35; 09635.51

ECONOMETRİC ANALYSİS OF THE ELASTİCİTY OF İMPORT-EXPORT OPERATİONS OF THE REPUBLİC OF AZERBAİJAN İN RELATİON TO THE EXCHANGE RATE OF THE MANAT AND THE İNCOME OF THE POPULATİON

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ЭКОНОМЕТРИЧЕСКИЙ АНАЛИЗ ЭЛАСТИЧНОСТИ ИМПОРТНО-ЭКСПОРТНЫХ ОПЕРАЦИЙ В АЗЕРБАЙДЖАНСКОЙ РЕСПУБЛИКЕ ПО ОТНОШЕНИЮ К КУРСУ МАНАТА И ДОХОДАМ НАСЕЛЕНИЯ

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DOI: 10.31618/ESU.2413-9335.2022.2.95.1628

ABSTRACT

An econometric analysis of the elasticity of import-export operations in the Republic of Azerbaijan in relation to the exchange rate of the manat and the income of the population for 1995-2020 years. Econometric research approaches are implemented using the operations of the EViews software package. In this case, the problem of time series stationarity was tested by the Dickey-Fuller test. Then, using the Granger test, causal relationships between the time series were studied.

АННОТАЦИЯ

Проведен эконометрический анализ эластичности импортно-экспортных операций в Азербайджанской Республике по отношению к обменному курсу маната и доходам населения за 1995-2020 годы. Эконометрические подходы исследования реализованы с использованием операций программного комплекса EViews. В этом случае проблема стационарности временного ряда проверялась тестом Дики-Фуллера. Затем с помощью теста Грейнджера изучались причинно-следственные связи между временными рядами.

Keywords: Import-export, exchange rate, income of population, econometric analysis, Dickey-Fuller test, Granger test.

Ключевые слова: Импорт-экспорт, обменный курс, доходы населения, эконометрический анализ, тест Дики-Фуллера, тест Грейнджера.

Purpose of research. The relevance of this research also lies in the fact that the elasticity of import-export operations of country has a significant effect on the country's exchange rate and incomes of population. We have created two mathematical statistical model and used comparative analyses between two model. The simulation used all the necessary statistical procedures required to identify and evaluate the model parameters and check its adequacy using EViews 8 tools.

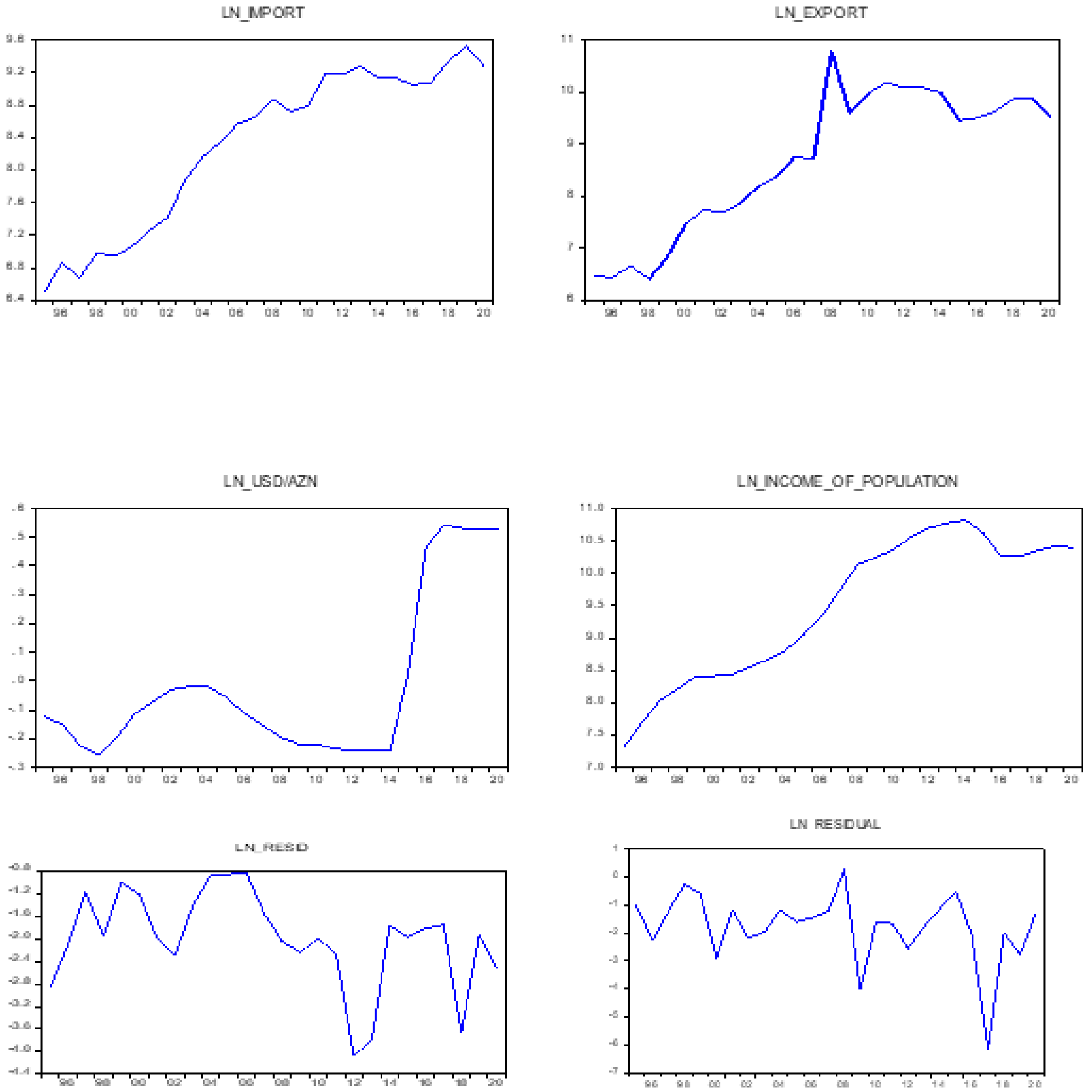
Analysis of recent research and publications. Adequate analyses of recent publications

[1-8] shows that , statistical methods of information processing are applied in relation to the empirical analysis of non-stationary time series .The research "Cointegration analysis of the impact of Azerbaijan and Ukraine GDPs on the trade turnover between these countries"[3] is used econometric methodology for modeling the relationship between non-stationary

time series. In articles are used natural logarithm of economic variables [1,2,3,5,6,7,8], based on annual data, trade and economic processes between countries are considered through indicators of GDP integration Azerbaijan, foreign trade turnover. In scientific publications "The Cointegration Relations Between Azerbaijan's GDP and the Balances of the Trade Relations of Russia and Belarus "[7] econometric analysis of GDP dependence Azerbaijan from the balance of the Russian Federation and the balance of

Belarus were carried out according to statistical indicators for 26 years. For check identification of the model, the corresponding econometric methods, non-stationary time series are checked by Dickey-Fuller test and applied causal relationships between time series using by the Granger test [9]. The growing internationalization of economic life and its globalization, deepening of integration processes, ever closer interconnection and interdependence of national economies are today the most important factors in the development of the world economy [10]. Noted to these research , formulating the linear regression model of elasticity of import-export operations of the Republic of Azerbaijan in relation to the exchange rate of manat and incomes of the population for the years 1995-2020 , we will use natural logarithms of economic variables for creating multiply regression model

The main part of the research. All statistics for econometric analysis of the elasticity of import-export operations of the Republic of Azerbaijan in relation to the exchange rate of manat and incomes of the population are taken from official sources such as the State Statistics Committee Azerbaijan (SCSA) [11], the Central Bank of Azerbaijan (CBA) [12].The time series are 26 levels that cover the years 1995-2020. The studied time series will be transformed into natural logarithmic ones. Graphical representation of Dynamic description of logarithmic time series and descriptive statistics are shown in Graph1 and Table 1



Graph 1 .Dynamic data description

Table 1.

Descriptive statistics on the logarithms of variables

	LN_IMPORT	LN_EXPORT	LN_INCOME_OF POPULATION	LN_USD/AZN	LN_RESIDUAL	LN_RESID
Mean	8.698845	8.303548	9.485630	-0.018839	-1.782149	-1.998478
Median	9.105673	8.685205	9.937521	-0.118292	-1.592607	-1.964949
Maximum	10.77386	9.522776	10.82619	0.542964	0.255402	-0.830939
Minimum	6.407045	6.503839	7.324688	-0.256442	-6.161067	-4.068092
Std. Dev.	1.378891	0.992139	1.095056	0.280512	1.266111	0.860398
Skewness	-0.405640	-0.547493	-0.390703	1.273645	-1.627744	-0.851646
Kurtosis	1.787907	1.741652	1.708641	3.022259	6.882167	3.376146
Jarque-Bera	2.304626	3.014304	2.468055	7.029952	27.80854	3.296247
Probability	0.315905	0.221540	0.291118	0.029749	0.000001	0.192411
Sum	226.1700	215.8922	246.6264	-0.489809	-46.33587	-51.96044
Sum Sq. Dev	47.53353	24.60847	29.97870	1.967175	40.07591	18.50710
Observations	26	26	26	26	26	26

The impact of logarithm import-export operations on the logarithm manat rate and logariphm income of the population described by the following linear regression model

$$lny_t = \alpha_{00} + \alpha_1 lnx_{t1} + \alpha_2 lnx_{t2} + ln\varepsilon_t,$$

$$t = \overline{1,26} \ (1)$$

y_t, x_{t1}, x_{t2} – corresponding factors, α_{00}, α_1 , α_2 – unknown model parameters; ε – residuals

We created two linear regression model . First model the impact of logarithm import operations on the logarithm manat rate and logaripthm incomes of the population and second model the impact of logarithm export operations on the logarithm manat rate and logaripthm incomes of the population.The linear regression model parameters estimated by Least Square Method and implemented by software EViews software package is described in Table 2 , Table 3:

Table 2.

Estimated multiple regression model with logarithms (model 1)

Dependent Variable: LN_IMPORT				
Method: Least Squares				
Sample :1995 – 2020 **Included observations: 26**				
Variable	Coefficient	Std. Error	t-Statistic	**Prob.**
LN_INCOME_OF_POPULATION	0.846408	0.048102	17.59627	**0.0000**
LN_USD_AZN	0.540004	0.173873	3.105737	**0.0052**
LN_RESID	0.044049	0.058842	0.748601	**0.4620**
C	0.373038	0.429325	0.868895	**0.3943**
R-squared	0.951302	Mean dependent var		**8.303548**
Adjusted R-squared	0.944661	S.D. dependent var		**0.992139**
S.E. of regression	0.233392	Akaike info criterion		**0.068446**
Sum squared resid	1.198383	Schwarz criterion		**0.261999**
Log likelihood	3.110201	Hannan-Quinn criter.		**0.124182**
F-statistic	143.2547	Durbin-Watson stat		**0.726302**
Prob(F-statistic)	**0.000000**			

and has the following formal form:

$$\text{LN\_IMPORT} = 0.846407960845*\text{LN\_INCOME\_OF\_POPULATION} + 0.540004162574*\text{LN\_USD\_AZN} + 0.0440487917852*\text{LN\_RESID} + 0.373038266874 \quad (2)$$

Table 3.

Estimated multiple regression model with logarithms of variables (model 2)

Dependent Variable: LN_IMPORT ble: LN_EXPOR				
Method: Least Squares				
Sample :1995 – 2020 **Included observations: 26**				
Variable	Coefficient	Std. Error	t-Statistic	**Prob.**
LN_INCOME_OF_POPULATION	1.206471	0.080839	14.92429	**0.0000**
LN_USD_AZN	0.009147	0.338932	0.026988	**0.9787**
LN_RESIDUAL	0.003736	0.073451	0.050869	**0.9599**
C	-2.738462	0.771418	-3.549908	**0.0018**
R-squared	0.917700	Mean dependent var		**8.698845**
Adjusted R-squared	0.906478	S.D. dependent var		**1.378891**
S.E. of regression	0.421685	Akaike info criterion		**1.251521**
Sum squared resid	3.911998	Schwarz criterion		**1.445074**
Log likelihood	-12.26977	Hannan-Quinn criter.		**1.307257**
F-statistic	81.77185	Durbin-Watson stat		**1.566510**
Prob(F-statistic)	**0.000000**			

and has the following formal form:

LN_EXPORT = 1.20647106821*LN_INCOME_OF_POPULATION + 0.00914718173195*LN_USD_AZN + 0.00373639809636*LN_RESIDUAL - 2.73846220324 (3)

Since the values of the determinants of the coefficients in Table 2 and Table 3 are 95% and 91%, both models are important, and the density of the relationship between the parameters is considered strong.

Another way to check the significance of a model is F-Fisher statistics. The F-statistic shows the value of the Fisher criterion for the regression equation. If the calculated value of the F-statistic is greater than the corresponding critical value, Fcalculated>Ftable, then the model is considered significant. Let's look at the table prices at the 5% significance level of the model , $k_1 = 2, k_2 = 23$. Both regression models are important because the F-calculated 143.2547 > 3.42 in Table 2 and 81.77185> 3.42 in Table 3.

Autocorrelation was tested using Durbin-Watson d-statistics. According to the table of critical values of d-statistics for the number of observations 26, the number of explanatory variables 2 and the given significance level 0.05, the values d_lower=1.22 and d_upper=1.55, which divide the segment [0.4] into five regions, the observed value d_obs=0.72.Table 2 shows that, 0. 72< d_lower, d_upper has the place of autocorrelation of residuals .Table 3 results d-obs=1.56 ,there is no autocorrelation of the residues.

Now let's look at the task of heteroskedasticity. Heteroskedasticity leads to the fact that the estimates of regression coefficients are not effective, increase the variance of the distribution of coefficients. Here the heteroskedasticity of the remnants is tested by the White test and the results presented in Table 4 and Table 5. $nR^2 = Obs * R - squared$, where n = 26, R^2 - coefficient of determination for the auxiliary regression of the squares of the squares of the residuals and the constant is equal to 12.00616 for Table 4 and 4.386011 for Table 5 and these values are less important $\chi^2_{0,03}(5) = 12.00641$ and $\chi^2_{0,49}(5) =$ 4.38585. The corresponding P-value exceeds 0.05, the zero hypothesis about the homoskedasticity of a random member is not refuted.

Table 4.

Results of White test for heteroscedasticity (model 1)

F-statistic	3.431841	Prob. F(5.20)	0.0212
Obs*R-squared	12.00616	Prob. Chi-Square(5)	0.0347

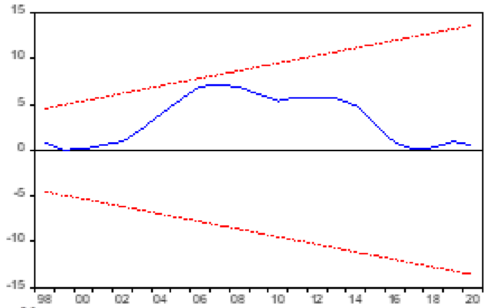
Table 5.

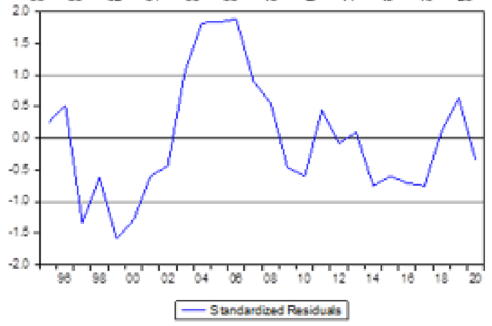
Results of White test for heteroscedasticity (model 2)

F-statistic	0.811699	Prob. F(5.20)	0.5551
Obs*R-squared	4.386011	Prob. Chi-Square(5)	0.4953

The stability of the parameters of the regression model is checked using the CUSUM test in the EViews software package. Below is a graphical description of the CUSUM model test:

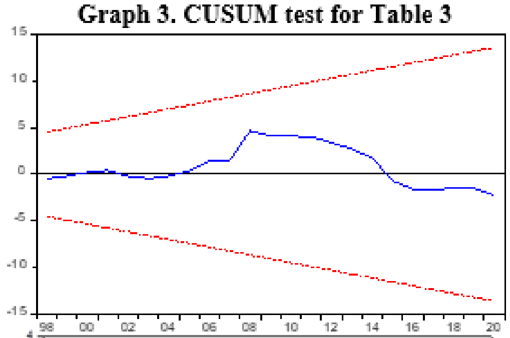
Graph 2.CUSUM test for Table 2

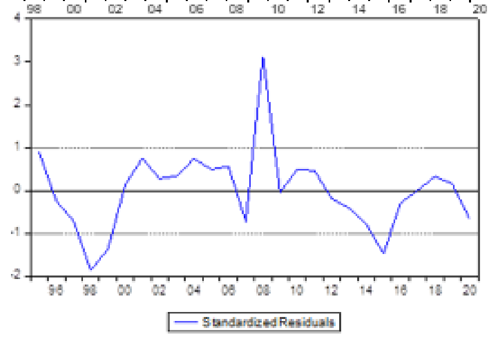




Graph 4. Standardized residuals for table 2

Graph 3. CUSUM test for Table 3





Graph 5. Standardized residuals for table3

The results of the tests are graphs of the dynamics of these values and 95% of the confidence intervals for them. If recursive assessments of residuals go beyond the critical boundaries, then this explain of the instability of the model parameters. Test results for models (2) , (3)are described in Graphs 2 and 3. In Graph 2 and Graph 3, the location of the blue line between the red lines means that the hypothesis H_0 - about the stability of the parameters is accepted, and if the blue line intersects with the red line, The hypothesis H_0 deviates to the benefit of an H_a alternative hypothesis about the instability of the parameters relative to the length of the time cut. Graph 4 and Graph 5 shows that recursive scores of remnants (CUSUM) and squares of recursive scores of remnants (CUSUM of Squares) do not appear for 95% of the confidence intervals, which once again confirms the high probability of high (2) (3) prognosis.

Table 4.

Correlation matrix (model 1)

	LN_IMPORT	LN_INCOME_OF_POPULATION	LN_USD/AZN
LN_IMPORT	1.000000	0.963548	0.419143
LN_INCOME_OF_POPULATION	0.963548	1.000000	0.288848
LN_USD/AZN	0.419143	0.288848	1.000000

Table 5.

Correlation matrix (model 2)

	LN_EXPORT	LN_INCOME_OF_POPULATION	LN_USD/AZN
LN_EXPORT	1.000000	0.957962	0.277202
LN_INCOME_OF_POPULATION	0.957962	1.000000	0.288848
LN_USD/AZN	0.277202	0.288848	1.000000

Based on the indicators of the correlation matrix, the assessment of the density of the relationship between the factors is determined by the Chaddock scale.

Based on this scale, if the value of the correlation coefficient is less than 0.3, the dependence is weak, if it is between 0.3 and 0.7, it is medium, if it is more than 0.7, it is strong and dense.

The stationarity of the time series was checked using the extended Dickey-Fuller test. The test results showed that the time series are stationary in second-order difference (trend and intercept). The test results are shown in table 5:

Table 5.

Results of the Dickey-Fuller test

Variables	Statistic Criteria	Critical value 1%	Critical value 5%	Critical value 10%	Prob
Second differences , trend and intercept					
LN_IMPORT	-9.123976	-4.416345	-3.622033	-3.248592	0.0000
LN_EXPORT	-6.605619	-4.440739	-3.632896	-3.254671	0.0001
LN_INCOME_OF_POPULATION	-4.144464	-4.440739	-3.632896	-3.254671	0.0183
LN_USD/AZN	-3.900323	-4.498307	-3.658446	-3.268973	0.0318
LN_RESID	-4.593153	-4.498307	-3.658446	-3.268973	0.0083
LN_RESIDUAL	-6.915596	-4.440739	-3.632896	-3.254671	0.0001

Checking the causal relationships between factors for lagged values m = 1,2,3,4 was carried out by the Granger test. The Granger causality test, with the exception of one direction, confirmed the presence of a two-way causal relationship, which indicates the existence of a third variable, which is the real cause of the change in the two variables under consideration. Only for the lag m = 3 between Δ LN_INCOME_OF_POPULATION and Δ LN_IMPORT are opposite causal relationships found where Δ denotes the difference operator of the corresponding variable.

Result: Created new specification of the models is relative to the logarithms of the origin of the variable.The peculiarities of the application of econometric methodology in the research of statistical interrelationships between multidimensional non-stationary time series have been studied.Tests for stationarity and determination of causal relationships were carried out both for the original and for the extended model 1 and model 2.The modeling used all the necessary statistical procedures required to identify and evaluate the model parameters using Eviews 8 tools.

As a result of the research, econometrically sound recommendations have been developed that allow for dynamic analyzes for effective state regulation of export-import transactions in relation to the exchange rate of the manat and the income of the population and improve the relevant inclusive parameters of the long-term sustainable development of country economy.

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