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THE COINTEGRATION ANALYSIS OF PER CAPITA TRADE TURNOVER BETWEEN THE REPUBLIC OF AZERBAIJAN AND TURKEY AND THE GDPS OF THESE COUNTRIES

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The Cointegration analysis of per capita trade turnover between the Republic of Azerbaijan and Turkey and the GDPs of these countries

The article builds an ECM model (error correction model) of the relationship between Azerbaijan's trade turnover with Turkey per capita and the GDP per capita of these countries for the period 1992–2022. The presented indicators reflect the level of activity and living standards in these countries. The analyzed time series are non-stationary in terms of their levels, and their first-order differences are stationary. All time series are logarithmized. The article uses the econometric methodology of gravity modeling of the relationship between the non-stationary time series. Various methods were correctly used during the modeling, including the extended Dickey-Fuller unit root test, Granger causality test, Engle-Johansen cointegration tests, vector error correction model, and standard diagnostic tests. Stationarity, causality, and cointegration tests were conducted on the entire sample at a significance level of 10 %. The existence of a statistically significant cointegration dependence of the balanced long-term relationship between the analyzed indicators is substantiated.

Keywords: *trade turnover, GDP, non-stationary time series, cointegration, error correction model.*

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Fig.: *4.* ***Tabl.:*** *10.* ***Formulae:*** *7.* ***Bibl.:*** *14.*

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Юнісзаде Р. Коінтеграційний аналіз товарообігу на душу населення між Азербайджанською Республікою і Туреччиною та ВВП цих країн

У статті побудовано модель ECM (модель корекції помилок) взаємозв'язку між товарообігом Азербайджану з Туреччиною на душу населення та ВВП на душу населення цих країн за період 1992–2022 рр. Представлені показники відображають рівень активності та рівень життя в цих країнах. Проаналізовані часові ряди є нестаціонарними за своїми рівнями, а їх різниці першого порядку є стаціонарними. Всі часові ряди логарифмовано. У статті використано економетричну методику гравітаційного моделювання залежності між нестаціонарними часовими рядами. Під час моделювання було коректно використано різні методи, включно з розширеним тестом одиничного кореня Дікі-Фуллера, тестом причинно-наслідкового зв'язку Грейнджера, тестами коінтеграції Енгле-Йохансена, моделлю корекції векторних помилок та стандартними діагностичними тестами. Тести на стаціонарність, причинно-наслідковий зв'язок та коінтеграцію було проведено по всій вибірці на рівні значущості 10 %. Обґрунтовано існування статистично значущої коінтеграційної залежності збалансованого довгострокового зв'язку між проаналізованими показниками.

Ключові слова: *товарообіг, ВВП, нестаціонарні часові ряди, коінтеграція, модель корекції помилок.*

Рис.: *4.* ***Табл.:*** *10.* ***Формул:*** *7.* ***Бібл.:*** *14.*

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Introduction. Foreign trade turnover per capita is also used in international studies as an indicator of foreign trade development. The volume of foreign trade transactions between Turkey and Azerbaijan cumulatively amounted to USD 28.4 billion during 2010-2020. Foreign trade between Azerbaijan and Turkey has decreased 6 times and increased 9 times over the past 15 years. According to the data, the highest decrease was in 2010 (10 %), and the highest increase was in 2011 (3 times). Azerbaijan's foreign trade turnover in 2020 amounted to USD 24.5 billion, which is 26.4 % less than in 2019. In 2020, due to the expansion of the pandemic, Azerbaijan's foreign trade turnover decreased and approached the level of 2017. The 20.64 % decrease in prices on the international oil market due to the pandemic was a decisive factor affecting the decrease in Azerbaijan's foreign trade turnover. According to the foreign trade data of the Turkish Statistical Institute, in 2020, the turnover of the same-named country decreased by 0.3 % to USD 389.9 billion. One of the factors affecting Turkey's trade decline during this period is also associated with the pandemic. Despite the pandemic, the reason why Turkey's foreign trade turnover decreased less (0.3 %) than that of Azerbaijan is due to the 4.3 % increase in imports. Turkey's share in Azerbaijan's total foreign trade turnover increased by 3 % in 2020 compared to 2019, reaching 17 %. The average share of Turkey in Azerbaijan's foreign trade between 2015 and 2019 was 9.5 %. According to statistical research starting in 2015, Turkey's share in Azerbaijan's total foreign trade turnover reached its highest level of 13.5 % in 2018. The reason for this is that Turkey became a consumer of Azerbaijani gas within the framework of the TANAP project in 2018.

In this study, we will analyze the issue of cointegration of trade relations between Azerbaijan and Turkey. In this aspect, research works [2–5] can be noted. A cointegration analysis of the main determinants of trade and economic relations between the countries of the region was carried out in these publications. In recent years, it can be seen that econometric analyses related to the interaction of growth parameters between the countries have been studied more. In the conducted studies, the country's GDP was evaluated by the components of the countries' trade turnover, the theoretical and methodological foundations of macro-variables were analyzed and a model was created.

The study determined the extent to which the oil exported by Azerbaijan to Turkey affected Azerbaijan's economic growth [6]. The study analyzed how the foreign trade relations of Turkey and Azerbaijan affected the economic development of both countries [7]. Hence, regression and correlation analysis were conducted using data from 1998-2014. As a result of the studies, it is found that bilateral trade relations increased in parallel with the growth of the economies of both countries .

Based on the data obtained in the period under review in [8], Azerbaijan's share in Turkey's foreign trade is approximately 0.57 %. Turkey's share in Azerbaijan's trade with its trading partners has increased to approximately 10 %. Considering Azerbaijan's trade volume, it is concluded that this value has a significant place.

The research used multi-factor correlation-regression analysis [1; 9; 10], the econometric methodology of gravity modeling [2; 3; 4], and the Engle-Granger-Johansen econometric cointegration methodology [11; 12].

The Aim of the Study. In this study, taking into account the per capita GDPs of the Republic of Azerbaijan and Turkey and the dependence of these countries on trade turnover and residuals, a multivariate regression model can be adopted in the following form:

$$y_t = \alpha_0 e^{\alpha t} x_{t1}^{\alpha_1} x_{t2}^{\alpha_2} d^{\alpha_3}, \quad t = \overline{1,30}. \qquad (1)$$

In the model, the per capita trade turnover of the Republic of Azerbaijan is y_t, the per capita GDP of the Republic of Azerbaijan is x_{1t}, the per capita GDP of Turkey is x_{2t}, the random residual is ε_t, and the geographical distance between Baku and Ankara (1,865 thousand kilometers) are denoted by d. Here α_0 is a free limit, α_1, α_2, α_3 are constants. It is assumed that $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_3 > 0$.

The regression equation is linear with respect to the logarithms of the original variables, the model is double logarithmic. We will transform the studied time series into logarithms. This transformation allows us to more clearly present the relationship between the considered indicators.

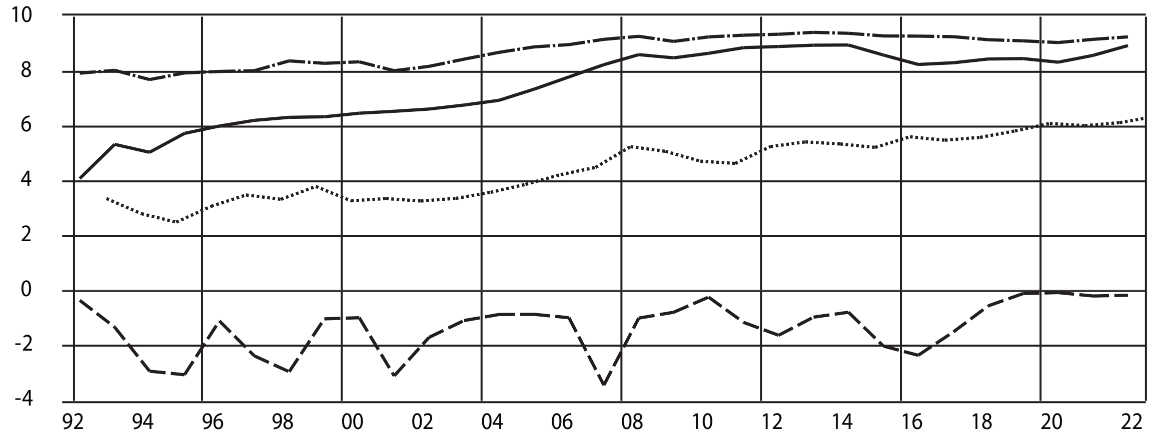

Fig. 1. Dynamic descriptions of the data

Table 1

Descriptive statistics on the logarithms of variables

	LN_TRADE _TURNOVER_ AZE	LN_GDP_AZE	LN_GDP_TUR	LN_RESIDUAL
1	2	3	4	5
Mean	4.523706	7.471824	8.780227	-1.343331
Median	4.651404	8.256174	9.064012	-1.023287
Maximum	6.363964	8.973458	9.439719	-0.067114
Minimum	2.505606	4.098256	7.714503	-3.443443

End tbl.1

1	2	3	4	5
Std. Dev.	1.152282	1.369485	0.565294	0.983778
Skewness	-0.051100	-0.665010	-0.464387	-0.702805
Kurtosis	1.611789	2.359798	1.605010	2.413367
Jarque-Bera	2.502700	2.814296	3.627795	2.996506
Probability	0.286118	0.244841	0.163018	0.223520
Sum	140.2349	231.6266	272.1870	-41.64325
Sum Sq. Dev.	39.83264	56.26465	9.586711	29.03460
Observations	31	31	31	31

Source: Own elaboration

In this work, taking into account the dependence of the per capita trade turnover of the Republic of Azerbaijan on the natural logarithm of the per capita GDPs of the Republic of Azerbaijan and Turkey and the natural logarithm of the residuals, a multivariate regression model is constructed as follows:

$$\ln y_t = \alpha_{00} + \alpha_1 \ln x_{t1} + \alpha_2 \ln x_{t2} + \ln \varepsilon_t, \quad t = \overline{1,25}. \quad (2)$$

where y_t, x_{1t}, x_{2t}, x_{3t} are relevant factors, $\alpha_{00} = \ln\alpha_0 + \alpha_3 \ln d$, α_1, α_2 are unknown parameters of the model ; ε_t as the residual limit includes the total effect of all factors not taken into account in the model, measurement errors, its logarithm is normally distributed, its mathematical expectation is zero, and its variance is constant.

For accuracy, let us take d = 1,865 thousand km, $\alpha_3 = -2$. The transformation of (1) into (2) leads to the transformation of random deviations from ε_t to ln ε_t:

$$M \cdot (\varepsilon_t) = e^{\frac{\sigma^2}{2}} \text{ and dispersion } D(\varepsilon_t) = e^{\sigma^2}(e^{\sigma^2} - 1)$$

The multivariate regression model using the least squares method is presented in the Table 2 using the Eviews 12 software package.

LN_TRADE_TURNOVER_AZE =
= -0.283663181447*LN_GDP_AZE +
+ 1.06583128265*LN_GDP_TUR –
– 0.0443269260359*LN_RESIDUAL + (3)
+ 0.104183954497*@TREND - 4.33735807417

As can be seen from the results obtained and presented in the Table 2, the general formal model is accurate, the coefficient of determination has a high value of 94 %. Let's check the significance of the regression equation using the Fisher criterion. With the Fisher criterion, we can determine the significance

Table 2

Estimated multiple regression model with logarithms of variables

Dependent Variable: LN_TRADE _TURNOVER_AZE				
Method: Least Squares				
Sample: 1992 2022				
Included observations: 31				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_GDP_AZE	-0.283663	0.150010	-1.890957	0.0698
LN_GDP_TUR	1.065831	0.326241	3.267004	0.0030
LN_RESIDUAL	-0.044327	0.060183	-0.736535	0.4680
@TREND	0.104184	0.013945	7.471276	0.0000
C	-4.337358	2.020658	-2.146507	0.0413
R-squared	0.949765	Mean dependent var		4.523706
Adjusted R-squared	0.942037	S.D. dependent var		1.152282
S.E. of regression	0.277418	Akaike info criterion		0.420106
Sum squared resid	2.000977	Schwarz criterion		0.651394
Log likelihood	-1.511643	Hannan-Quinn criter.		0.495500
F-statistic	122.8929	Durbin-Watson stat		1.021509
Prob(F-statistic)	0.000000			

Source: Own elaboration

of the regression model, the significance level criterion α, and the degrees of freedom *k*.

To check the significance of the regression equation using the theoretical-econometric method, the F-statistic we obtained is compared with the *F* table (with the selected significance level of 5 %) and if Prob (F-statistic) < 0.05, then the equation is significant at the 5 % significance level. From the table, F-statistic = 122.8929.

To test for the presence of autocorrelation, the hypothesis H_0 must first be established. The hypothesis H_0 about the absence of autocorrelation is determined based on the Durbin-Watson critical table value. Based on the total number of observations $n = 31$ and the number of independent explanatory variables are found as $k = 2$, $d_l = 1.30$ and $d_u = 1.57$. The value of the Durbin-Watson statistic was calculated to test for autocorrelation in the constructed model: $d_{obs} = 1.021509$. If $d_{obs} < d_l$, then there is positive autocorrelation of the residuals.

Let's check the stability and instability of the parameters of the multivariate regression equation using the CUSUM test. These tests are based on calculating the cumulative sums of recursive residuals and the cumulative sums of squares of recursive residuals and estimating the corresponding equations. The test results are analyzed according to 95 % confidence intervals. If the recursive estimates of the residuals go beyond the critical limits, then this indicates the instability of the model parameters. Graphically, the blue line located between the red lines and not intersecting them confirms the hypothesis H_0 that the parameters are stable, otherwise, if the blue line intersects the red lines, then the hypothesis H_1 about the instability of the parameters relative to the length of the time interval is accepted. It can be seen from the graphic image that the blue line is located between the red lines, which means that the parameters of the regression model are stable. The stability of the parameters of the model we have built increases its predictive ability.

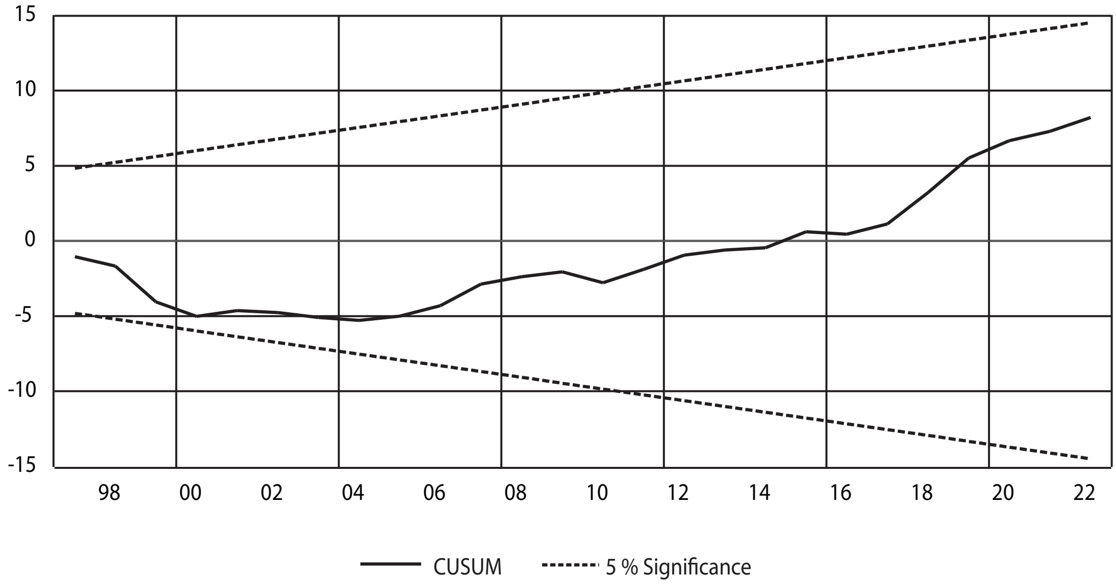

Fig. 2. CUSUM test

Source: Own elaboration

Using the procedures of the Eviews 12 software package, a correlation matrix is constructed and the dependence between the factors is determined.

Qualitative interpretation of the density of the relationship between the factors is carried out using the Chaddock scale. Since the correlation coefficient between the factors in this correlation matrix is $\left|r_{xy}\right| \geq 0,7$ according to the scale, the dependence between the factors is strong.

The stationarity of the time series was checked based on the Augmented Dickey-Fuller test of the Eviews 12 software package and the corresponding results are shown in the Table 4. The time series were stationary in the case of first-order differences, trend and free limits. If the Prob indicator in front of the value of the Augmented Dickey-Fuller test is less than 5 % (0.05), the hypothesis H_0 that the time series has a unit root (non-stationarity) is rejected.

That is, the alternative hypothesis about the stationarity of the time series is accepted. In order for the time series to be stationary, the value of the Dickey-Fuller test must also be less than the critical values (Test critical values) at the 1 %, 5 %, and 10 % significance levels.

According to the test results, all time series themselves are non-stationary when a constant is present either without a trend (intercept) or when a trend and constant are not included (none); nevertheless, the first-order differences are stationary in all cases.

The Granger causality test was used to determine the causality in the model. The results are presented in the Table 5: If the probability of fulfilling the hypothesis H_0 (Prob indicator) for any lag measure is greater than 5 %, then there is a causal relationship between these variables. Otherwise, there is no causal relationship between these variables.

According to the test results, at the 10 % significance level, there is a two-way causal relationship between the variables LN_GDP_AZE and LN_TRADE_TURNOVER_AZE for lag=1, and there is no causal relationship for lag=2, lag=3. There is no causal relationship between the variables LN_GDP_TUR and LN_TRADE_TURNOVER_AZE for lag=1, lag=2, and lag=3.

Table 3

Correlation matrix

	LN_TRADE_TURNOVER_A	LN_GDP_AZE	LN_GDP_TUR
LN_TRADE_TURNOVER_A	1.000000	0.893942	0.910605
LN_GDP_AZE	0.893942	1.000000	0.958611
LN_GDP_TUR	0.910605	0.958611	1.000000

Source: Own elaboration

Table 4

Dickey-Fuller test

Variable	T-statistic	Critical values: 1 %	Critical values: 5 %	Critical values: 10 %	Prob
First difference, intercept					
LN_TRADE_TURNOVER_AZE	-5.762532	-3.679322	-2.967767	-2.622989	0.0000
LN_GDP_AZE	-6.936984	-3.679322	-2.967767	-2.622989	0.0000
LN_GDP_TUR	-5.677218	-3.679322	-2.967767	-2.622989	0.0001
First difference, trend and constant					
LN_TRADE_TURNOVER_AZE	-5.627955	-4.309824	-3.574244	-3.221728	0.0004
LN_GDP_AZE	-6.959471	-4.309824	-3.574244	-3.221728	0.0000
LN_GDP_TUR	-5.648285	-4.309824	-3.574244	-3.221728	0.0004

Source: Own elaboration

Table 5

Results of the Granger test

Null Hypothesis	Lag=1		Lag=2		Lag=3	
	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
LN_GDP_AZE does not Granger Cause LN_TRADE_TURNOVER_AZE	4.44194	0.0445	0.53390	0.5931	0.68060	0.5737
LN_TRADE_TURNOVER_AZE does not Granger Cause LN_GDP_AZE	3.41373	0.0756	0.83811	0.4448	0.79912	0.5082
LN_GDP_TUR does not Granger Cause LN_TRADE_TURNOVER_AZE	0.80870	0.3765	0.53167	0.5944	0.07936	0.9705
LN_TRADE_TURNOVER_AZE does not Granger Cause LN_GDP_TUR	0.13179	0.7194	0.56209	0.5773	0.15345	0.9263
LN_GDP_TUR does not Granger Cause LN_GDP_AZE	4.48753	0.0435	0.21592	0.8073	0.92745	0.4448
LN_GDP_AZE does not Granger Cause LN_GDP_TUR	2.27793	0.1428	4.89463	0.0165	1.13451	0.3579

Source: Own elaboration

There is a one-way causal relationship between the variables LN_GDP_TUR and LN_GDP_AZE for lag=1, lag=2, and there is no causal relationship for lag=3.

The Eviews 12 software package has the following options for the Johansen Cointegration Test:

1) Neither the free term nor the trend is included in the VAR equation and the cointegration relation.
2) The free term is included in the cointegration relation, neither the free term nor the trend is included in the VAR equation.
3) The free term is included in both the cointegration relation and the VAR equation.
4) The free term and the trend are included in the cointegration relation, the trend is not included in the VAR equation.

The results of the Johansen cointegration test using the Eviews 12 software package are described in the Table 6:

In the hypothesis H_0: $r = 0$*, the value of the Trace statistic (51.70168) is higher than the critical value (42.91525), and at the same time, the probe indicator is less than 5 %. In this case,

Table 6

Results of the Johansen cointegration test

Sample: 1992 2022					
Included observations: 28					
Series: LN_TRADE_TURNOVER_A LN_GDP_AZE LN_GDP_TUR					
Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	0	1	1	1	1
Max-Eig	0	1	1	1	1
Information Criteria by Rank and Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Rank or	No Intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No Trend	No Trend	No Trend	Trend	Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	29.66777	29.66777	33.14361	33.14361	34.43867
1	35.61684	44.64848	46.87748	50.87384	51.45775
2	38.11957	47.19863	49.30460	56.63808	57.04859
3	39.25486	49.61651	49.61651	58.99445	58.99445
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	-0.833412	-0.833412	-0.867401	-0.867401	-0.745619
1	-0.829774	-1.403463	-1.419820	-1.633845*	-1.532696
2	-0.579970	-1.085616	-1.164615	-1.545577	-1.503471
3	-0.232490	-0.758322	-0.758322	-1.213889	-1.213889
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	0.023005	0.023005	0.131752	0.131752	0.396270
1	0.312116	-0.213995	-0.135195	-0.301641*	-0.105335
2	0.847392	0.436903	0.405484	0.119679	0.209364
3	1.480344	1.097248	1.097248	0.784417	0.784417

Source: Own elaboration

Table 7

Results of the Trace test

Hypothesis	Alternative hypothesis	Trace Statistic	Critical Value 5 %	Probability
H_0: $r = 0$*	H_A: $r > 0$	51.70168	42.91525	0.0053
H_0: $r = 1$	H_A: $r > 1$	16.24124	25.87211	0.4733
H_0: $r = 2$	H_A: $r > 2$	4.712755	12.51798	0.6380

Source: Own elaboration

Table 8

Results of the Max-Eigenvalue test

Hypothesis	Alternative hypothesis	Trace Statistic	Critical Value 5 %	Probability
H_0: $r = 0$*	H_A: $r > 0$	35.46044	25.82321	0.0020
H_0: $r = 1$	H_A: $r > 1$	11.52848	19.38704	0.4603
H_0: $r = 2$	H_A: $r > 2$	4.712755	12.51798	0.6380

Source: Own elaboration

the hypothesis H_0: r = 0* about the absence of cointegration is rejected, that is, the hypothesis H_0: r = 1 is accepted. This means that there is a cointegration relationship between these time series.

Similarly, in the hypothesis H_0: r = 0*, the value of the Maximum Eigenvalue test (35.46044) is higher than the critical value (25.82321), and at the same time, the probe indicator is less than 5 %. In this case, the hypothesis H_0: r = 0* about the absence of cointegration is rejected, that is, the hypothesis H_0: r = 1 is accepted.

This means that there is a cointegration relationship between these time series.

The equation of the error correction model is implemented using the procedures of the Eviews 12 program:

Although the coefficient of determination is relatively low compared to the other options, we prefer this specification because the statistically significant (t-statistic -2.41068) negative correction coefficient for the trade turnover indicator between Turkey and Azerbaijan is higher. The corresponding correction coefficients for other factors are statistically insignificant. Within this specification, it takes about 2 years for the trend to return from the equilibrium state to the equilibrium trajectory due to the impact of shocks in the previous year. The corresponding ECM model is as follows:

$$\begin{gathered}\text{D(LN\_TRADE\_TURNOVER\_A)} = -0.51167434861^*(\text{LN\_TRADE\_TURNOVER\_A(-1)} + \\ +0.542181569277^*\text{LN\_GDP\_AZE(-1)} - 1.56884225936^*\text{LN\_GDP\_TUR(-1)} - \\ -0.118832214272^*\text{@TREND(92)} + 7.10794254932) + \\ +0.267403778535^*\text{D(LN\_TRADE\_TURNOVER\_A(-1))} + 0.184696944075^*\text{D(LN\_GDP\_AZE(-1))} - \\ -0.603459999915^*\text{D(LN\_GDP\_TUR(-1))} + 0.0939184023299\end{gathered} \quad (4)$$

$$\begin{gathered}\text{D(LN\_GDP\_AZE)} = -0.0892537060445^*(\text{LN\_TRADE\_TURNOVER\_A(-1)} + \\ +0.542181569277^*\text{LN\_GDP\_AZE(-1)} - 1.56884225936^*\text{LN\_GDP\_TUR(-1)} - \\ -0.118832214272^*\text{@TREND(92)} + 7.10794254932) + \\ +0.171990322961^*\text{D(LN\_TRADE\_TURNOVER\_A(-1))} + \\ +0.0173505775631^*\text{D(LN\_GDP\_AZE(-1))} - 0.0895084923181^*\text{D(LN\_GDP\_TUR(-1))} + 0.109239180414\end{gathered} \quad (5)$$

$$\begin{gathered}\text{D(LN\_GDP\_TUR)} = 0.0917843121941^*(\text{LN\_TRADE\_TURNOVER\_A(-1)} + \\ +0.542181569277^*\text{LN\_GDP\_AZE(-1)} - 1.56884225936^*\text{LN\_GDP\_TUR(-1)} - \\ -0.118832214272^*\text{@TREND(92)} + 7.10794254932) + \\ +0.023440557326^*\text{D(LN\_TRADE\_TURNOVER\_A(-1))} - 0.187636055698^*\text{D(LN\_GDP\_AZE(-1))} + \\ +0.0580566664627^*\text{D(LN\_GDP\_TUR(-1))} + 0.0664770432074\end{gathered} \quad (6)$$

This model contains both long-term and short-term changes. The statistically significant trend cointegration relationship reflecting the long-term dependence is as follows:

$$\begin{gathered} Coint_t = \text{LN\_TRADE\_TURNOVER\_AZE}_t + \\ +0.542181569277^*\text{LN\_GDP\_AZE}_t - \\ -0.11883214272\ @Trend_t + 7.10794254932. \end{gathered} \quad (7)$$

(4)-(6) The correction vector in the model is α(-0.51167434861),(-0.0892537060445),(0.0917843121941). The first component of the vector has the right sign. This means that for the factor D(LN_TRADE_TURNOVER_A) the short-term trends from the long-term equilibrium state approximately stabilize in the next 2 years, while for the first-order difference operator LN_GDP_AZE, as a result of these trends, stabilization will be provided, approximately, by 11 years. The difference operator of the logarithms of the third factor, GDP_TUR, does not return to the equilibrium state after short-term trends. The dispersion of the dynamics of trends over time increases.

One of the means of studying the interaction of variables in dynamic vector models is the study of the impulse response functions of the variables themselves and other variables to impulses–shocks. In VAR and VEC models, the impulse responses of the main variables to shocks are used as an interpretation tool for the short, medium and long-term dependencies between the studied variables. "Shock" is an instantaneous change in the explanatory variable over the entire observation period equal to its standard deviation. The impulse response function characterizes the time for the dependent variable to return to the balanced trajectory when a unit shock to the independent variable occurs. The results of the tests for 10-year time periods are depicted in the Fig. 3. Here, in the time period t = 0, all variables are equal to 0, then the variables in turn increase by one unit of their standard deviation for the entire period. The responses of the variables to these shocks in the periods t = 1.2,..., 10 were estimated. The values of the impulse responses are depicted in the Table 9. Here, the standard error of the VECM model is 0.291919.

One of the important tools for studying the interaction of variables in dynamic vector models is the decomposition of the variance of the errors of the variables by variables, which provides information about the relative importance of the effects of each shock on the variables. The decomposition of the variance is an expression of the share of each of these variables in the variance of the forecast of the indicator under study.

Fig. 4 shows the effects of the shocks of the variables LN_TRADE_TURNOVER_AZE, LN_GDP_AZE, LN_GDP_TUR on the annual forecast of the variable LN_TRADE_TURNOVER_AZE. Its own effect on the change of L N_TRADE_TURNOVER_AZE was insignificant, about 0.36 % for 2 years, about 27.2 % for 6 years, and about 32.36 % for 10 years. The impact of the LN_GDP_AZE variable on the change in LN_TRADE_TURNOVER_AZE was approximately 99.92 % over 2 years, approximately 93.63 % over 6 years, and approximately 91.89 % over 10 years. The impact of the LN_GDP_TUR variable was approximately 99.7 % over 2 years, approxi-

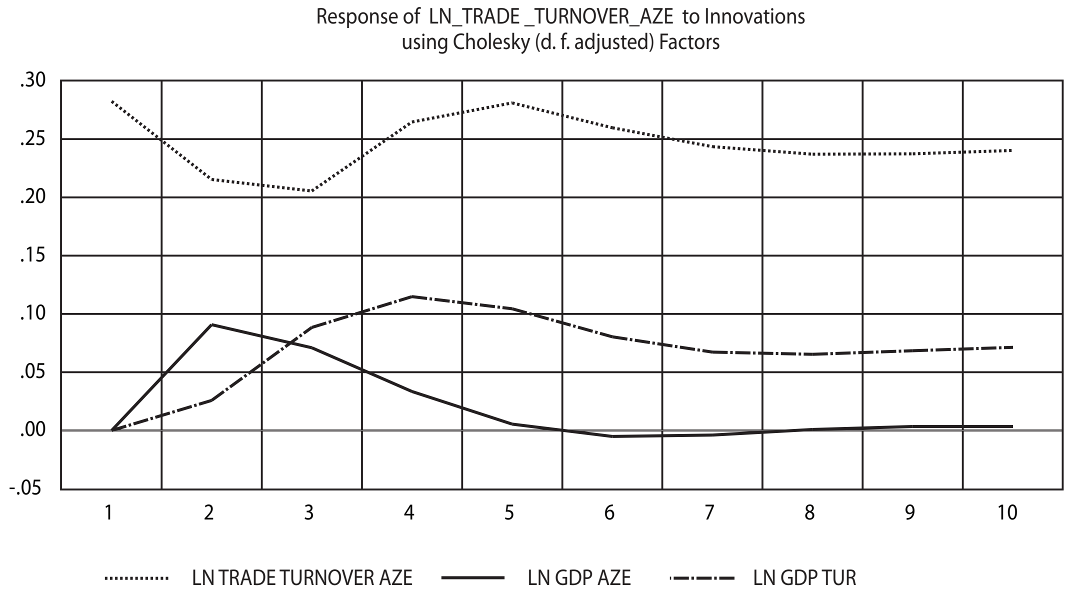

Fig. 3. Impulse response

Source: Own elaboration

Table 9

The calculated impulse responses

Response of LN_TRADE_TURNOVER_AZE			
Period	**LN_TRADE_TURNOVER_AZE**	**LN_GDP_AZE**	**LN_GDP_TUR**
1	0.291919	0.133643	0.120742
2	0.232281	0.159747	0.125576
3	0.155873	0.138631	0.130748
4	0.115161	0.122348	0.135598
5	0.114323	0.117417	0.135113
6	0.130871	0.120264	0.132871
7	0.143508	0.124465	0.131459
8	0.146084	0.126414	0.131321
9	0.142815	0.126135	0.131797
10	0.139333	0.125130	0.132207

Source: Own elaboration

Table 10

Decomposition of forecast error variances

Variance Decomposition of LN_TRADE_TURNOVER_AZE			
Period	**LN_TRADE_TURNOVER_AZE**	**LN_GDP_AZE**	**LN_GDP_TUR**
1	100.0000	0.000000	0.000000
2	99.63123	0.074616	0.294157
3	93.86256	0.745996	5.391448
4	83.98764	2.820106	13.19226
5	76.56164	5.000629	18.43773
6	72.79167	6.361525	20.84680
7	71.06614	7.042127	21.89173
8	69.94287	7.432210	22.62492
9	68.81124	7.763956	23.42480
10	67.63415	8.100072	24.26578

Source: Own elaboration

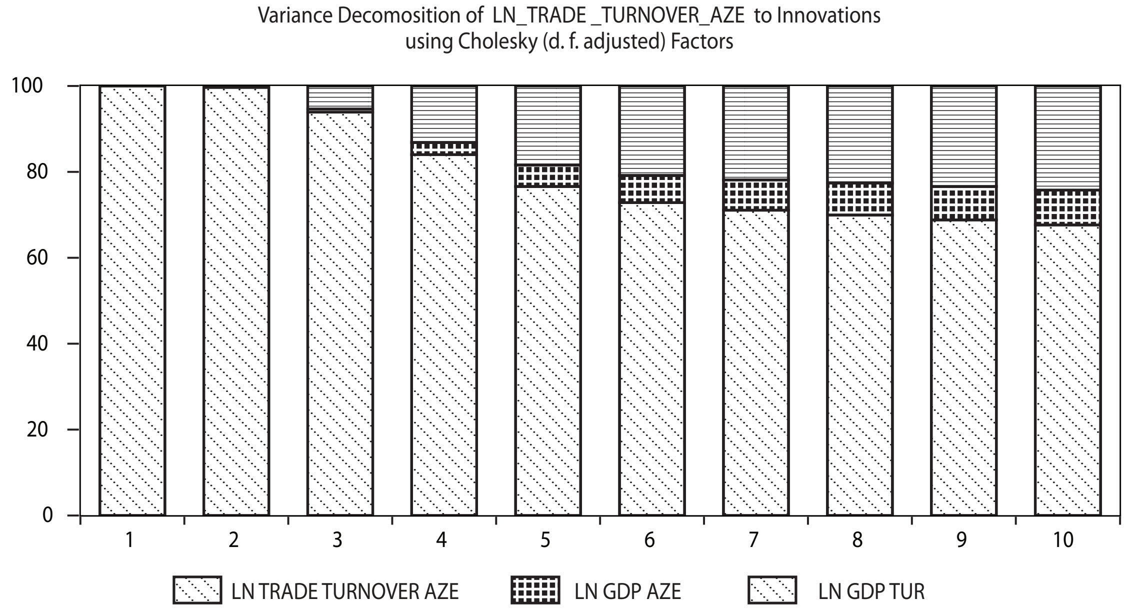

Fig. 4. Decomposition of variances

Source: Own elaboration

mately 79.15 % over 6 years, and approximately 75.73 % over 10 years.

Conclusions. The existence of a statistically significant cointegration dependence of the balanced long-term relationship between the analyzed indicators is substantiated. D(LN_TRADE_TURNOVER_A) the short-term trends from the long-term equilibrium state approximately stabilize in the next 2 years, while for the first-order difference operator LN_GDP_AZE, as a result of these trends, stabilization will be provided, approximately, by 11 years.

The difference operator of the logarithms of the third factor, GDP_TUR, does not return to the equilibrium state after short-term trends. The dispersion of the dynamics of trends over time increases. The results obtained with VECM can be shown as a recommendation for the dynamic analysis of the effective state regulation of export-import transactions between Turkey and Azerbaijan.

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