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**AGRO PRODUCTS EXPORTS OF UKRAINE
WITHIN ITS TRADE AGREEMENTS
WITH THE COMMONWEALTH OF INDEPENDENT STATES**

Key words: Commonwealth of Independent States (CIS), Ukraine,
agricultural products exports, trade agreements, correlation

ABSTRACT. The aim of the research is to work out the recommendations on the geography of the agricultural products trade of Ukraine under the circumstances of the on-going war through the analysis of the trends and dynamics of the agro exports from Ukraine to the CIS, the agricultural products exports from Ukraine to the CIS countries possible correlation with each other, its direction and level. The data are the values of the agricultural products exports from Ukraine to the CIS countries from 2001 to 2023 included with the special identification of the years 2021-2023 as the year 2001 is the earliest one with the available data, 2021 is the pre-war year and 2023 – the year with the latest data available and the second year of the war. Such methods of scientific research as empirical, comparative and statistical analyses, including data mining, cleaning and processing, methods of correlation measuring like Pearson, Spearman and Kendal correlation tests, the method of exclusion, as well as textual and tabular methods for better data presentation and comparison were used while conducting the research presented in the given article. The conducted research indicated, that the agro exports of Ukraine to the following country – pairs appeared to be positively correlated: 1) Armenia – with Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic and Tajikistan, 2) Azerbaijan – with Belarus, Georgia, Kyrgyz Republic, Tajikistan and Uzbekistan, 3) Belarus – with Uzbekistan, 4) Georgia – with Kazakhstan, Kyrgyz Republic, Tajikistan and Uzbekistan, 5) Kazakhstan – with Kyrgyz Republic, Tajikistan and Turkmenistan, 6) Kyrgyz Republic – with Tajikistan, and 7) Tajikistan – with Turkmenistan.

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INTRODUCTION

The geographical location of Ukraine on the crossroads to and from Europe, on the one hand, makes the country an important logistics regional and global subject, giving the competitive advantages connected with it. But, on the other hand, the said fact puts the country in-between the powerful global players, like Commonwealth of Independent States (CIS) and the European Union (UE) or the CIS and the NATO, making it a buffer zone and a place for the possible and, unfortunately, on-going conflicts. Throughout the entire history of the country's existence, it was either urged to be a part of some union or was tried to be controlled, entirely or partially, by some global players. After the collapse of the USSR, its hegemon couldn't allow its vassals (at least they were treated in such a way) to leave the union just like that. So, the idea of the CIS came onto the surface with all the former Soviet Republics, except the Baltic states, to be among its members. Being different in territory, economic structure and development level, eleven former Soviet republics – Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Turkmenistan, Tajikistan, Ukraine, and Uzbekistan (Georgia joined the CIS two years later, in December 1993) signed an agreement of membership in the CIS in December 1991 [Kim et al. 2018]. Among the scientists researching different spheres of the CIS in- and outland functioning, in particular different levels of economic relations, one should mention, Tamás Mizik et al. [2020], Shakhobjo Khabibov et al. [2020], Avtandil Silagadze and Tamar Atanelishvili [2020], Ekaterina Husu [2024], and others. If we narrow our search to the scientists, working on the issues of Ukraine's relations with the CIS countries, the scientific publications of the following researchers are interesting to be looked into: Iryna Miahkykh and Mariana Shkoda [2020], Wojciech Skuza [2023], Anton Poliszczuk [2021], Natalia Kalyuzhna [2020], Volodymyr Olefir [2021], Maryna Rabinovych [2022], Natalia Boyko et al. [2022], Elena Kaš'áková and Vladyslav Bato [2022], Joanna Żyra and Roman Kopych [2023], Yanina Belinska and Oleksandra Shevchuk [2023], and others. So, the literature sources search indicated rather many scientific works, in which either different aspects of the CIS functioning or Ukraine's relations with the said countries union were investigated, but none of them explored the issue being the topic of the research presented in the given paper. Therefore, the research and its results would be a perfect fit for the scientific gap discovered. Thereby, the scientific questions, which were tried to be answered in the course of the research conduction, are what the trends and dynamics of the agro exports from Ukraine to the CIS were in the time frame of 2001 to 2023, with a special attention being paid at the changes and differences on the year and country's basis, whether the agricultural products exports from Ukraine to the CIS correlate with each other, if they do, whether the said correlation is positive or negative and how strong the mentioned correlation is. So, the subject of the research is the agricultural products

exports of Ukraine to the CIS member-states with the stress being made on their dynamics during the analysed time frame, differences in the definite years as well as their correlation with each other. Consequently, the aim of the research is to work out the recommendations on the geography of the agricultural products trade of Ukraine under the circumstances of the on-going war through the analysis of the trends and dynamics of the agro exports from Ukraine to the CIS during 2001 to 2023, the agricultural products exports from Ukraine to the CIS countries possible correlation with each other, its direction and level.

MATERIAL AND METHODS

The data, analysed in the article, are the values of the agricultural products exports from Ukraine to the CIS countries in millions of US dollars from 2001 to 2023 included (on the yearly basis) with the identification of the years 2021-2023. The data under research were taken from the World Integrated Trade Solution (WITS) Comtrade data base. For the purpose of space saving as well as for making data tables readable enough, the said data for the years 2001, 2021 and 2023 only were presented in the paper. The mentioned data were chosen as they are of the certain interest concerning their data analysis, meaning – the year 2001 is the earliest one with the available data, 2021 is the year just before the war and 2023 – the year with the latest data available as well as the one of the second year of the war, in which certain changes caused by the war could be noticed and analysed. Such methods of scientific research as empirical, comparative and statistical analyses, including data mining, cleaning and processing, methods of correlation measuring like Pearson, Spearman and Kendal correlation tests, the method of exclusion, as well as textual and tabular methods for better data presentation and comparison were used while conducting the research presented in the given article. All the calculations on the correlation coefficients, which results are presented in the article, were made with the help of the R statistical software [R Core Team 2022]. As the most common way of measuring a linear correlation the Pearson correlation coefficient (r) [Turney 2022] was calculated with the help of R statistical software, which, in turn, was made according to the formula (1) [Srivastav and Vaidya 2024]:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} \quad (1)$$

where: r – Pearson correlation coefficient, n – number of the stock pairs.

Taking into account the number of observations being analysed as well as the possible non-normality of their distribution, and, therefore, trying to make the presented research results the most robust possible, the Spearman correlation coefficient, which measures the strength and direction of association between two ranked variables [Gupta 2024], was also calculated in the article. A simpler formula for the Spearman rank correlation coefficient calculation is presented in the formula (2) [Cheusheva 2022]:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)} \quad (2)$$

where: ρ – Spearman rank correlation coefficient, d_i – difference between a pair of ranks, n – number of observations.

Because of the small number of observations under analysis, besides Spearman, Kendall's rank correlation non-parametric test was calculated with the help of the R software according to the formula (3) [Finnstats 2021]:

$$\tau = \frac{\text{number of concordant pairs} - \text{number of discordant pairs}}{n(n-1)/2} \quad (3)$$

where: τ – Kendall's rank correlation coefficient, n – number of observations.

RESULTS AND DISCUSSION

The Commonwealth of Independent States (CIS) is a free association of sovereign states that was formed in 1991 by Russia and eleven other former Soviet Union republics [Britannica Encyclopaedia 2024]. CIS countries engage in political, economic, trade, and cultural cooperation as well as they share a free trade area and a visa-free regime. Nine countries (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Uzbekistan) are official members of the CIS with Georgia, Turkmenistan, and Ukraine being not official members but having had previously participated in CIS activities [Statista 2024]. Despite the date of the CIS foundation, the creation of the free trade area within the CIS dates back to 1994, though the necessary agreements were finally signed in October 2011 by eight of the eleven CIS prime ministers, that is Armenia, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, and Ukraine at a meeting in St. Petersburg, with the aim of eliminating export and import duties on a number of goods, focusing, at the same time, on the basic principles of currency regulation and currency

Table 1. Agro products exports of Ukraine to the CIS member-states

Partner name	Agro products exports [mln USD]				Difference			
	2001	2021	2022	2023	2023 to 2001		2023 to 2021	
					mln USD	%	mln USD	%
Armenia	12.77	73.67	38.32	40.27	27.50	▲215.5	-33.40	▼45.3
Azerbaijan	7.73	170.70	97.55	105.67	97.94	▲1,267.5	-65.03	▼38.1
Belarus	63.71	524.88	70.40	0.00	-63.71	▼100.0	-524.88	▼100.0
Georgia	12.54	221.11	113.50	111.99	99.45	▲793.3	-109.12	▼49.4
Kazakhstan	20.72	159.13	108.26	109.20	88.48	▲427.1	-49.93	▼31.4
Kyrgyz Republic	1.24	30.61	22.04	13.83	12.59	▲1,019.4	-16.78	▼54.8
Moldova	33.54	263.95	390.81	314.30	280.76	▲837.1	50.35	▲19.1
Russian Federation	673.76	50.21	2.80	0.00	-673.76	▼100.0	-50.21	▼100.0
Tajikistan	0.26	10.27	5.10	5.79	5.53	▲2,107.5	-4.47	▼43.6
Turkmenistan	5.80	21.19	8.65	10.36	4.56	▲78.5	-10.83	▼51.1
Uzbekistan	1.51	60.71	37.65	31.01	29.50	▲1,948.7	-29.70	▼48.9

Source: own elaboration based on the data [WITS 2024]

controls in the CIS [CCIS-Expertise 2004]. In 2016, Russia and Ukraine bilaterally terminated CIS 2011 and currently do not have a bilateral preferential regime [ITC 2024]. Both also slapped restrictions on each other's imports: Russia included Ukraine in its ban on certain European goods that had been in place since August 2014 (the "cheese ban" countersanctions). Ukraine, in its turn, banned imports of some Russian goods [Bhutia 2019], which results can be also noticed in Table 1.

Having observed the dynamics of the agricultural products exports from Ukraine to the CIS member-states, it can be suggested, that the said dynamics reflect not only the exports values themselves, but the changes in the political relations between the analysed countries as well. In 2021 the value for the agro exports from Ukraine to all the analysed countries increased, if compared to 2001, with the exception of the Russian Federation, in the case of which a decrease of 92.2% was noted. The biggest increase of the said exports was noticed to Uzbekistan, Tajikistan, Kyrgyz Republic and Azerbaijan, which

is an indicator for the intensification of Ukraine's either economic or political relations with the mentioned countries and, therefore, could suggest the diversification of Ukraine's agricultural products exports into the Central Asia direction. A completely different situation can be observed in 2022, the first year of the war, if compared to the last pre-war year, that is 2021 – Ukraine's agro products exports to all the presented countries decreased, with the biggest decrease being noted in the cases of the Russian Federation and Belarus, except for Moldova, where an increase for the said exports value of approximately 48% was noted. The explanation of the mentioned increase can be the interruptions in the functioning of the Black Sea grain initiative route, due to which rather big amounts of grain had to be transported via the on-land exports routes, among the others, through Moldova. The second year of the war didn't bring any changes, that is the situation with the agricultural products exports values from Ukraine to the CIS countries continued decreasing to all the said countries, with the biggest decrease being noticed in the cases of the Russian Federation and Belarus, except for Moldova, to which Ukraine exported around 19% more agro products, if compared to the year 2021. If we take the same year, that is 2023, but compare the mentioned exports values to those of 2022, that is – if we compare the exports value of Ukraine from the second war year to that of the first one, the comparison results would be a little bit different – Ukraine increased its agro exports to five CIS countries (Armenia, Azerbaijan, Kazakhstan, Tajikistan and Turkmenistan) and decreased to the rest ones. The explanation of the above described situation can be considered a little bit double-wise, that is on the one hand the war was still going on in 2023 and the distances from Ukraine to the Central Asian and Caucasian countries didn't become shorter, so such a diversified change of the Ukrainian agro exports to the chosen CIS countries could be explained, among the others, by the political position of the said countries' governments towards support for Ukraine either political or economic ones. Therefore, it would be extremely interesting and useful for the subjects involved into the international trade in general and the one of the agricultural products in particular to see if the agro exports of one and the same country to the definite countries of a country union are correlated with each other, especially taking into account the unstableness of the nowadays geopolitical and geo-economic situation. In order to do that, the Pearson correlation coefficients for the said exports were calculated and presented in Table 2 together with their corresponding p-values.

Judging by the Pearson correlation coefficient values, it can be stated, that the agro exports of Ukraine to none of the CIS countries has a negative correlation. Taking into account either the Pearson correlation coefficient values or their corresponding p-values, it can be concluded, that the agricultural products exports of Ukraine to the following CIS countries are correlated with each other, as their Pearson correlation coefficients are statistically significant, having the following results: strong, close to perfect, positive correlation – to Armenia – with the one to Azerbaijan and Georgia, to Azerbaijan – with

Table 2. Results of the Pearson correlation test on Ukraine's agro exports to the CIS member-states

Countries	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyz Republic	Moldova	Russian Federation	Tajikistan	Turkmenistan	Uzbekistan
Pearson correlation coefficient	1	0.9196263	0.883766	0.956243	0.82772199	0.8214144	0.351053	0.1118714	0.8314239	0.672892166	0.86244435
	0.919626	1	0.80322	0.942436	0.68371396	0.740044	0.577513	-0.2766208	0.8137103	0.446606841	0.95338932
	0.883766	0.8032202	1	0.841559	0.63157492	0.6849758	0.044099	0.0343686	0.7439419	0.545268288	0.75387064
	0.956243	0.9424359	0.841559	1	0.87161582	0.9040158	0.455552	-0.0178317	0.9287314	0.701142759	0.91548889
	0.827722	0.683714	0.631575	0.871616	1	0.963336	0.284941	0.3876935	0.9043708	0.941595634	0.65272321
	0.821414	0.740044	0.684976	0.904016	0.96333597	1	0.333716	0.2120028	0.9539195	0.89127556	0.70083285
	0.351053	0.5775125	0.044099	0.455552	0.28494119	0.333716	1	-0.4886344	0.3061989	-0.022670512	0.66409926
	0.111871	-0.2766208	0.034369	-0.01783	0.38769354	0.2120028	-0.48863	1	0.0365222	0.595994263	-0.2903355
	0.831424	0.8137103	0.743942	0.928731	0.90437081	0.9539195	0.306199	0.0365222	1	0.812646534	0.74900148
	0.672892	0.4466068	0.545268	0.701143	0.94159563	0.8912756	-0.02267	0.5959943	0.8126465	1	0.38727755
	0.862444	0.9533893	0.753871	0.915489	0.65272321	0.7008329	0.664099	-0.2903355	0.7490015	0.387277551	1
Countries	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyz Republic	Moldova	Russian Federation	Tajikistan	Turkmenistan	Uzbekistan
	0.001221	0.001221	0.003592	0.000203	0.01118815	0.0124	0.393855	0.791984682	0.010513	0.067438662	0.00585409
	0.001221	1	0.016349	0.000457	0.06152378	0.0358	0.133839	0.507187122	0.013988	0.267298303	0.00024439
	0.003592	0.0163487	1	0.008799	0.09302183	0.060855	0.917421	0.93560958	0.034324	0.162194046	0.03073375
	0.000203	0.0004565	0.008799	1	0.00479392	0.002055	0.256657	0.966572604	0.000857	0.052668188	0.00141495
	0.011188	0.0615238	0.093022	0.004794	0.00011985	0.00012	0.493949	0.342631041	0.002033	0.000476492	0.0793279
	0.0124	0.0358004	0.060855	0.002055	0.00011985	0.00012	0.419186	0.61424474	0.000236	0.002956772	0.05281851
	0.393855	0.1338394	0.917421	0.256657	0.49394938	0.419186	1	0.219199576	0.460753	0.957507352	0.07248258
	0.791985	0.5071871	0.93561	0.966573	0.34263104	0.614245	0.2192	1	0.931582	0.118939519	0.48543953
	0.010513	0.0139884	0.034324	0.000857	0.0020325	0.000236	0.460753	0.931581716	1	0.014217257	0.03246408
	0.067439	0.2672983	0.162194	0.052668	0.00047649	0.002957	0.957507	0.118939519	0.014217	1	0.34319439
	0.005854	0.0002444	0.030734	0.001415	0.0793279	0.052819	0.072483	0.485439534	0.032464	0.343194387	1
P-values											

Source: own elaboration made with the help of [R Core Team 2023] and based on data [WITS 2024]

the one to Georgia and Uzbekistan, to Georgia – with the one to Kyrgyz Republic, Tajikistan, Uzbekistan, to Kazakhstan – with the one to Kyrgyz Republic, Tajikistan, Turkmenistan, and to Kyrgyz Republic – with the one to Tajikistan, as well as strong positive correlation – to Armenia – with the one to Belarus, Kazakhstan, Kyrgyz Republic, Tajikistan, to Azerbaijan – with the one to Belarus, Kyrgyz Republic, Tajikistan, to Belarus – with the one to Georgia, Tajikistan, and Uzbekistan, to Georgia – with the one to Kazakhstan, to Tajikistan – with the one to Turkmenistan, and Uzbekistan. As, according to some researchers, Pearson correlation coefficient is sensitive to outliers [Rousselet and Pernet 2012], as well as it can be affected by the magnitude of the slope around which points are clustered, curvature, the magnitude of the residuals, restriction of range, and heteroscedasticity [Rousselet and Pernet 2012], the Spearman correlation coefficient was decided to be calculated in order to make the research results the most robust possible. In addition, Spearman correlation coefficient uses data rank to measure monotonicity between ordinal or continuous variables [DataScientest 2024], which makes it less sensitive to the non-normality of the data under analysis distribution. The results of the Spearman correlation test together with the corresponding p-values are displayed in the table given below (Table 3).

Taking into account both the Spearman correlation coefficient values and their corresponding p-values, the following conclusions are to be suggested, judging by the significance of the mentioned test results: the agricultural products exports from Ukraine to the following CIS countries have such correlation levels as: strong, close to perfect, positive correlation – to Georgia – with the one to Kazakhstan, Kyrgyz Republic, to Kazakhstan – with the one to Kyrgyz Republic, and Tajikistan, to Kyrgyz Republic – with the one to Tajikistan, as well as strong positive correlation – to Armenia – with the one to Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan, to Azerbaijan – with the one to Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan, and Uzbekistan, to Belarus – with the one to Georgia, and Uzbekistan, to Georgia – with the one to Tajikistan, Turkmenistan, and Uzbekistan, to Kazakhstan – with the one to Turkmenistan, and Uzbekistan, to Kyrgyz Republic – with the one to Turkmenistan, and Uzbekistan, to Tajikistan – with the one to Turkmenistan, and Uzbekistan. Another difference between the Pearson and Spearman correlation coefficients, but this time it's about their values presented in the tables given above, is that, there are negative values in the table with the Spearman correlation test results, opposite to that with the Pearson ones, but their corresponding p-values indicate them to be statistically insignificant to take them into consideration. Just to be sure of the research results, the Kendall correlation coefficient was also calculated for the Ukrainian agricultural exports to the CIS countries, though the said correlation test, just like the Spearman's one, measures the monotonic relationship, which, in turn, measures how likely it is for two variables to move in the same direction,

Table 3. Results of the Spearman correlation test on Ukraine's agro exports to the CIS member-states

Countries	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyz Republic	Moldova	Russian Federation	Tajikistan	Turkmenistan	Uzbekistan
Spearman correlation coefficient	1	0.7857143	0.857143	0.880952	0.85714286	0.8333333	0.119048	0.30952381	0.761905	0.880952381	0.833333333
	0.785714	1	0.809524	0.809524	0.78571429	0.761905	0.3333333	-0.2380952	0.785714	0.595238095	0.95238095
	0.857143	0.8095238	1	0.761905	0.64285714	0.690476	0	0.23809524	0.595238	0.666666667	0.88095238
	0.880952	0.8095238	0.761905	1	0.95238095	0.97619	0.380952	0.0952381	0.857143	0.80952381	0.88095238
	0.857143	0.7857143	0.642857	0.952381	1	0.97619	0.285714	0.11904762	0.952381	0.857142857	0.78571429
	0.8333333	0.7619048	0.690476	0.97619	0.97619048	1	0.309524	0.14285714	0.928571	0.833333333	0.80952381
	0.119048	0.3333333	0	0.380952	0.28571429	0.309524	1	-0.7142857	0.190476	-0.023809524	0.4047619
	0.309524	-0.2380952	0.238095	0.095238	0.11904762	0.142857	-0.71429	1	0.071429	0.452380952	-0.14285714
	0.761905	0.7857143	0.595238	0.857143	0.95238095	0.928571	0.190476	0.07142857	1	0.785714286	0.73809524
	0.880952	0.5952381	0.666667	0.809524	0.85714286	0.8333333	-0.02381	0.45238095	0.785714	1	0.5952381
	0.8333333	0.952381	0.880952	0.880952	0.78571429	0.809524	0.404762	-0.1428571	0.738095	0.595238095	1
P-values											
Armenia		0.0279	0.0107	0.00724	0.0107	0.0154	0.793	0.462	0.0368	0.00724	0.0154
Azerbaijan	0.0279		0.0218	0.0218	0.0279	0.0368	0.428	0.582	0.0279	0.132	0.00114
Belarus	0.0107	0.0218		0.0368	0.0962	0.0694	1	0.582	0.132	0.0831	0.00724
Georgia	0.00724	0.0218	0.0368		0.00114	0.000397	0.36	0.84	0.0107	0.0218	0.00724
Kazakhstan	0.0107	0.0279	0.0962	0.00114		0.000397	0.501	0.793	0.00114	0.0107	0.0279
Kyrgyz Republic	0.0154	0.0368	0.0694	0.000397	0.000397		0.462	0.752	0.00223	0.0154	0.0218
Moldova	0.793	0.428	1	0.36	0.501	0.462		0.0576	0.665	0.977	0.327
Russian Federation	0.462	0.582	0.582	0.84	0.793	0.752	0.0576		0.882	0.267	0.752
Tajikistan	0.0368	0.0279	0.132	0.0107	0.00114	0.00223	0.665	0.882		0.0279	0.0458
Turkmenistan	0.00724	0.132	0.0831	0.0218	0.0107	0.0154	0.977	0.267	0.0279		0.132
Uzbekistan	0.0154	0.00114	0.00724	0.00724	0.0279	0.0218	0.327	0.752	0.0458	0.132	

Source: own elaboration made with the help of [R Core Team 2023] and based on data [WITS 2024]

Table 4. Results of the Kendall correlation test on Ukraine's agro exports to the CIS member-states

Countries	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyz Republic	Moldova	Russian Federation	Tajikistan	Turkmenistan	Uzbekistan
Armenia	1	0.6428571	0.714286	0.714286	0.71428571	0.642857	0.142857	0.1428571	0.571429	0.785714286	0.64285714
Azerbaijan	0.642857	1	0.642857	0.642857	0.64285714	0.571429	0.214286	-0.2142857	0.642857	0.428571429	0.85714286
Belarus	0.714286	0.6428571	1	0.571429	0.42857143	0.5	0.142857	0.1428571	0.285714	0.5	0.78571429
Georgia	0.714286	0.6428571	0.571429	1	0.85714286	0.928571	0.285714	0.1428571	0.714286	0.642857143	0.78571429
Kazakhstan	0.714286	0.6428571	0.428571	0.857143	1	0.928571	0.142857	0.1428571	0.857143	0.785714286	0.64285714
Kyrgyz Republic	0.642857	0.5714286	0.5	0.928571	0.92857143	1	0.214286	0.2142857	0.785714	0.714285714	0.71428571
Moldova	0.142857	-0.2142857	0.142857	0.285714	0.14285714	0.214286	1	-0.5714286	0	-0.071428571	0.35714286
Russian Federation	0.142857	0.6428571	0.142857	0.142857	0.14285714	0.214286	-0.57143	1	0.142857	0.357142857	-0.0714286
Tajikistan	0.571429	0.6428571	0.285714	0.714286	0.85714286	0.785714	0	0.1428571	1	0.642857143	0.5
Turkmenistan	0.785714	0.4285714	0.5	0.642857	0.78571429	0.714286	-0.07143	0.3571429	0.642857	1	0.42857143
Uzbekistan	0.642857	0.8571429	0.785714	0.785714	0.64285714	0.714286	0.357143	-0.0714286	0.5	0.428571429	1
P-values	Armenia	Azerbaijan	Belarus	Georgia	Kazakhstan	Kyrgyz Republic	Moldova	Russian Federation	Tajikistan	Turkmenistan	Uzbekistan
Armenia		0.0312	0.0141	0.0141	0.0141	0.0312	0.72	0.72	0.061	0.00551	0.0312
Azerbaijan	0.0312		0.0312	0.0312	0.0312	0.061	0.548	0.548	0.0312	0.179	0.00174
Belarus	0.0141	0.0312		0.061	0.179	0.109	0.72	0.72	0.399	0.109	0.00551
Georgia	0.0141	0.0312	0.061		0.00174	0.000397	0.399	0.72	0.0141	0.0312	0.00551
Kazakhstan	0.0141	0.0312	0.179	0.00174		0.000397	0.72	0.72	0.00174	0.00551	0.0312
Kyrgyz Republic	0.0312	0.061	0.109	0.000397	0.000397		0.548	0.548	0.00551	0.0141	0.0141
Moldova	0.72	0.548	0.72	0.399	0.72	0.548		0.061	1	0.905	0.275
Russian Federation	0.72	0.548	0.72	0.72	0.72	0.548	0.061		0.72	0.275	0.905
Tajikistan	0.061	0.0312	0.399	0.0141	0.00174	0.00551	1	0.72		0.0312	0.109
Turkmenistan	0.00551	0.179	0.109	0.0312	0.00551	0.0141	0.905	0.275	0.0312		0.179
Uzbekistan	0.0312	0.00174	0.00551	0.00551	0.0312	0.0141	0.275	0.905	0.109	0.179	

Source: own elaboration made with the help of [R Core Team 2023] and based on data [WITS 2024]

but not necessarily at a constant rate [Zinda 2021]. The results of the Kendall correlation test as well as their corresponding p-values are presented in Table 4.

Both the Kendall correlation test results and their corresponding p-values indicate the agro exports of Ukraine to the following countries to be correlated on such levels as: strong, close to perfect, positive correlation – to Georgia – with the one to Kyrgyz Republic, to Kazakhstan – with the one to Kyrgyz Republic, as well as strong positive correlation – to Armenia – with the one to Belarus, Georgia, Kazakhstan, and Turkmenistan, to Azerbaijan – with the one to Uzbekistan, to Belarus – with the one to Uzbekistan, to Georgia – with the one to Kazakhstan, Tajikistan, and Uzbekistan, to Kazakhstan – with the one to Tajikistan, and Turkmenistan, to Kyrgyz Republic – with the one to Tajikistan, Turkmenistan and Uzbekistan, added by the medium positive correlation – to Armenia – with the one to Azerbaijan, Kyrgyz Republic, Tajikistan, and Uzbekistan, to Azerbaijan – with the one to Belarus, Georgia, Kazakhstan, and Tajikistan, to Georgia – with the one to Turkmenistan, to Kazakhstan – with the one to Uzbekistan, and to Tajikistan – with the one to Turkmenistan. After the application of the exclusion method, it can be concluded, that the agricultural products exports from Ukraine to the following countries are correlated: Armenia – Azerbaijan, Armenia – Belarus, Armenia – Georgia, Armenia – Kazakhstan, Armenia – Kyrgyz Republic, Armenia – Tajikistan, Azerbaijan – Belarus, Azerbaijan – Georgia, Azerbaijan – Kyrgyz Republic, Azerbaijan – Tajikistan, Azerbaijan – Uzbekistan, Belarus – Uzbekistan, Georgia – Kazakhstan, Georgia – Kyrgyz Republic, Georgia – Tajikistan, Georgia – Uzbekistan, Kazakhstan – Kyrgyz Republic, Kazakhstan – Tajikistan, Kazakhstan – Turkmenistan, Kyrgyz Republic – Tajikistan, and Tajikistan – Turkmenistan.

The presented research is suggested to be the beginning of a greater research, comprising either all the countries, with which Ukraine has FTAs signed or the analysed CIS countries, but in the longer run, as the further continuation of the war will surely impact Ukraine's agro exports to the analysed CIS countries either from the point of view of its amounts/values or its structure. Nevertheless, marking the beginning of a bigger one, the research presented in the paper, will have to face the certain limitations, the main of which are arising because of the war going on in Ukraine, with all the direct and indirect consequences a war can bring, as well as the changes in the political and, consequently, economic relations, which can again be caused directly or indirectly by the ongoing war.

CONCLUSIONS

Ukraine has concluded free trade agreements with the following CIS member – states: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Turkmenistan, Tajikistan, and Uzbekistan. These agreements grant, on a reciprocal basis, most favoured nation (MFN) status on trade with signatory countries, as in the case of the PCA, Ukraine benefits via these agreements from the tariff concessions made by its partner countries who are WTO members without binding its own tariffs [ITA 2023].

In the course of the research it can be concluded, that the diversification of the agro products trade into the direction of the CIS member-states, except Russia and Belarus, could be a good option for Ukraine to ensure its agricultural products exports and minimize such obstacles to its successful functioning as border blockings, imports tariff changes, etc. The diversification of the trade relations into the mentioned direction would give Ukraine's economy some kind of insurance against the interruptions of its agro products exports to the other countries. But, what should be also pointed out here, is, that the political relations of the said countries, either with Ukraine itself or with the other CIS member-states, should be taken into account while working out both the logistics and the economic/political relations with the mentioned countries. The following countries pairs should be given a special attention at while expanding the Ukrainian agro exports routes: Armenia – with Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Tajikistan; Azerbaijan – with Belarus, Georgia, Kyrgyz Republic, Tajikistan, Uzbekistan; Belarus – with Uzbekistan; Georgia – with Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan; Kazakhstan – with Kyrgyz Republic, Tajikistan, Turkmenistan; Kyrgyz Republic – with Tajikistan, and Tajikistan – with Turkmenistan. From the mentioned above, it flows out, that, taking into account the instability of the exports routes functioning through some either southern or west-southern parts of the Ukrainian border, including the constant interruptions in the functioning mode of the Black Sea Grain Corridor in the frame of the Black Sea Grain Initiative, the unannounced and unexpected blockings of the land borders with some countries, and, therefore, the longer distances and necessity for the logistics routes changes, which, in turn, incur additional costs, making the agro products prices rise, the importance of the Asian/Caucasian direction for the Ukrainian agro exports is becoming important for the economy of Ukraine, suggesting a new option for the agricultural exports uninterrupted functioning as well as giving Ukraine one more opportunity to improve its economic and political relations in the region.

So, the conducted research as well as its results will be interesting and useful for the public administrators, companies involved both in the international trade in general and agricultural products one in particular and not only in the analysed countries, but the whole Europe, at least, politicians and decision makers, academic community representatives

as well as statisticians and data analysts. The possible spheres of the research as it is as well as its results application include, but not abridged to, either the analysis of the global/regional markets or the one of a single country as a whole or its single segments (especially of the one analysed in the article) in particular, while searching for the new agro exports logistic routes, the new trade partners in general and those involved into agricultural trade in particular, the analysis of both economic and political inter-relations of the countries under analysis, a part of the overall analysis of the researched countries for those companies and their employees working in or with the subjects in the mentioned countries, the creation or enrichment of such educational subjects as “International Trade”, “International Economic/Political Relations” and others, etc. Hence, the novelty of the research presented in the paper lies in the attempt to find out whether the trade flow of one and the same country has any relations/interdependencies with the same flows to the definite countries, making the results the basis for the conclusions about either the economic or political relations between not only the analysed country and the defined ones, but between the latter countries as well.

BIBLIOGRAPHY

- Belinska Yanina, Oleksandra Shevchuk. 2023. Foreign trade between Ukraine and the EU. *Visegrad Journal on Bioeconomy and Sustainable Development* 12 (1): 23-26. DOI: 10.2478/vjbsd-2023-0005.
- Bhutia Sam. 2019. *How has conflict with Russia affected Ukraine's trade?* <https://eurasianet.org/how-has-conflict-with-russia-affected-ukraines-trade>, access: 22.03.2024.
- Boyko Natalia, Kjersti Nes, Aleks K. Schaefer. 2022. International trade and Ukraine's pursuit of self-determination. *The World Economy* 47 (4): 1325-1767. DOI: 10.1111/twec.13493.
- Britannica Encycloapedia. 2024. *Commonwealth of Independent States*, <https://www.britannica.com/topic/Commonwealth-of-Independent-States>, access: 29.03.2024.
- CCIS-Expertise. 2024. *Commonwealth of Independent States (CIS)*, <https://www.ccis-expertise.com/en/cis-export>, access: 24.03.2024.
- Cheusheva Svetlana. 2022. *How to do Spearman correlation in Excel*, <https://www.ablebits.com/office-addins-blog/spearman-rank-correlation-excel/>, access: 29.03.2024.
- DataScientest. 2024. *Pearson and Spearman correlations: A guide to understanding and applying correlation methods*, <https://datascientest.com/en/pearson-and-spearman-correlations-a-guide-to-understanding-and-applying-correlation-methods>, access: 15.03.2024.
- Finnstats. 2021. *Kendall's rank correlation in R-correlation test*, <https://www.r-bloggers.com/2021/06/kendalls-rank-correlation-in-r-correlation-test/>, access: 16.03.2024.

- Gupta Aryan. 2024. *Spearman's rank correlation*, <https://www.simplilearn.com/tutorials/statistics-tutorial/spearmans-rank-correlation>, access: 22.03.2024.
- Husu Ekaterina. 2024. *Changing trade situations: The role of CIS countries in finish supply chains in the context of the Russian Ukrainian military conflict*, https://www.theseus.fi/bitstream/handle/10024/863529/Husu_Ekaterina.pdf?sequence=2, access: 20.03.2024.
- ITC. 2024. *Commonwealth of Independent States (CIS). Market Access Map. Improving transparency in international trade and market access*, <https://www.macmap.org/en/resources/cis>, access: 22.03.2024.
- Kalyuzhna Natalia. 2020. International trade integration of Ukraine in the context of deepening interstate conflicts. *The Problems of Economy* 1 (43): 27-35. DOI: 10.32983/2222-0712-2020-1-27-35.
- Kašťáková Elena, Vladyslav Bato. 2022. The potential of the EU's foreign trade with Ukraine under the influence of geo-economic changes. *Studia Commercialia Bratislavensia* 15 (54): 237-247, https://scb.euba.sk/archiv_scb/scb0422_vfinal.pdf#page=14, access: 25.03.2024.
- Khabibov Shakhobjo, Latif Khalilov, Chae-Deu Yi. 2020. An analysis of trade interdependence among the CIS countries. *Journal of Korea Research Association of International Commerce* 20 (2): 31-57. DOI: 10.29331/JKRAIC.2020.4.20.2.31.
- Kim Kyung-Ryang, Golib Sanaev, Sherzod Babakholov. 2018. Economic and agricultural development after transition in CIS countries. *Journal of Agricultural, Life and Environmental Sciences* 30 (3): 200-225. DOI: 10.22698/jales.20180022.
- Miahkykh Iryna, Mariana Shkoda. 2020. International trade in goods and its key development trends in Ukraine. *Bulletin of the Kyiv National University of Technologies and Design. Economic Science Series* 149: 39-49. DOI: 10.30857/2413-0117.2020.4.4.
- Mizik Tamás, Péter B.K. Gál, Aron Torok. 2020. Does agricultural trade competitiveness matter? The case of the CIS countries. *Agris on-line Papers in Economics and Informatics* 12 (01): 61-72. DOI: 10.7160/aol.2020.120106.
- Olefir Volodymyr. 2021. *The impact of trade liberalization between Ukraine and EU on trade and investment*. [In] 5th International Scientific Conference EMAN 2021: "Economics & Management: How to cope with disrupted times", March 18, 2021. Association of Economists and Managers of the Balkans, Belgrade, Serbia. DOI: 10.31410/EMAN.2021.13.
- Poliszczuk Anton. 2021. Ukraine's foreign trade: Measuring dichotomies between East and West. *Studia Politologiczne* 59: 334-351. DOI: 10.33896/SPolit.2021.59.18.
- Rabinovych Maryna. 2022. EU-Ukraine "deep" trade agenda: The effectiveness and impact perspectives. *International Politics*. DOI: 10.1057/s41311-022-00384-x.
- R Core Team. 2022, 2023. *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria, <https://www.R-project.org/>, access: 30.03.2024.

- Rousselet Guillaume A., Cyril R. Pernet. 2012. Improving standards in brain-behavior correlation analyses. *Frontiers in Human Neuroscience* 6: 119. DOI: 10.3389/fnhum.2012.00119.
- Silagadze Avtandil, Tamar Atanelishvili. 2020. Georgia – CIS trade relations: The problems of the Russian market. *Academic Journal of Science* 10 (01): 53-58, <http://www.universitypublications.net/ajs/1001/pdf/E9X95.pdf>, access: 28.03.2024.
- Skuza Wojciech. 2023. *Ukraine's integration into the EU in trade context*. [In] Materials of XXXIV International Scientific and Practical Conference of Young Scientists and Students, April 24-25, 2023. Dnipro, Alfred Nobel University, https://duan.edu.ua/images/Announcements/UA/Departments/IER/2023/Theses_int_econom_April_23_2.pdf#page=202, access: 28.03.2024.
- Srivastav Ashish Kumar (ed.), Dheeraj Vaidya. 2024. *Pearson correlation coefficient*, <https://www.wallstreetmojo.com/pearson-correlation-coefficient/#h-pearson-correlation-coefficient-formula>, access: 29.03.2024.
- Statista. 2024. *Commonwealth of Independent States (CIS) – statistics & facts*, <https://www.statista.com/topics/10533/commonwealth-of-independent-states-cis/#topicOverview>, access: 27.03.2024.
- Turney Shaun. 2022. *Pearson correlation coefficient (r). Guide & examples*, <https://www.scribbr.com/statistics/pearson-correlation-coefficient/>, access: 27.03.2024.
- WITS (World Integrated Trade Solution). 2024. *Trade data*, <http://wits.worldbank.org/WITS/WITS/AdvanceQuery/RawTradeData/QueryDefinition.aspx?Page=RawTradeData>, access: 18.03.2024.
- Zinda Zac. 2021. *Data science stats review: Pearson's, Kendall's, and Spearman's correlation for feature selection*. phData, <https://www.phdata.io/blog/data-science-stats-review/>, access: 30.03.2024.
- Żyra Jonna, Roman Kopych. 2023. Trading partners and output growth in Ukraine. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu* 67 (4): 172-181. DOI: 10.15611/pn.2023.4.16.

EKSPORT PRODUKTÓW ROLNYCH UKRAINY W RAMACH UMÓW HANDLOWYCH ZE WSPÓLNOTĄ NIEPODLEGŁYCH PAŃSTW

Słowa kluczowe: Wspólnota Niepodległych Państw (WNP), Ukraina,
eksport produktów rolnych, umowy handlowe, korelacja

ABSTRAKT. Celem badań było opracowanie rekomendacji dotyczących geografii handlu produktami rolnymi Ukrainy oraz jej kierunków w warunkach trwającej wojny. Analizowano trendy i dynamikę eksportu produktów rolnych z Ukrainy do WNP, możliwe korelacje między nimi, a także ich kierunek i poziom. Do badań wykorzystano dane dotyczące wartości eksportu produktów rolnych z Ukrainy do krajów WNP w latach 2001-2023, ze szczególnym uwzględnieniem lat 2021-2023. Zakres badań podyktowany był tym, że najwcześniejsze dane były dostępne za 2001 rok, a najnowsze za 2023 rok, natomiast 2021 to rok przedwojenny, a 2022 – pierwszy rok trwania wojny. Dla prezentacji wyników i porównań zastosowano takie metody badań, jak analizy empiryczne, porównawcze i statystyczne, w tym eksplorację, czyszczenie i przetwarzanie danych, metody pomiaru korelacji, tj. testy korelacji Pearsona, Spearmana i Kendalla, metodę wykluczania, a także metody opisowe i tabelaryczne. Wykazano, że eksport produktów rolnych z Ukrainy okazał się dodatnio skorelowany (parami) z następującymi krajami: 1) do Armenii – z Azerbejdżanem, Białorusią, Gruzją, Kazachstanem, Republiką Kirgiską i Tadżykistanem, 2) do Azerbejdżanu – z Białorusią, Gruzją, Republiką Kirgiską, Tadżykistanem i Uzbekistanem, 3) na Białoruś – z Uzbekistanem, 4) do Gruzji – z Kazachstanem, Republiką Kirgiską, Tadżykistanem i Uzbekistanem, 5) do Kazachstanu – z Republiką Kirgiską, Tadżykistanem i Turkmenistanem, 6) do Republiki Kirgiskiej – z Tadżykistanem i 7) do Tadżykistanu – z Turkmenistanem.

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