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THE IMPACT OF CRISIS EVENTS IN UKRAINE ON THE EXPORT OF AGRICULTURAL PRODUCTS TO EU COUNTRIES AND THE WORLD

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Abstract

The article examines the impact of crisis events in Ukraine on the export of agricultural products to EU countries and the world. *The purpose of the research* was the development, substantiation, and optimization of theoretical and methodological provisions as well as practical recommendations for estimating main indicators to forecast the future of the Ukrainian economy, in particular, determining through the use of economic and mathematical modeling, the influence of the level of the national trade turnover on the level of GDP and the correlation between the level of exports and the level of Ukraine's GDP. After almost thirty years of development, the Ukrainian economy faced a serious challenge and an unprecedented shock in its history due to hostilities and the escalation of the conflict in the East of the country. In particular, it was found that Russia's invasion of Ukraine, the sharp rise in commodity prices have created a threat to the food security around the world. In turn, before the full-scale war, one of the largest shares of Ukraine's export and import partnership agreements was occupied by EU countries. The conducted research using economic and mathematical modeling showed a direct correlation between commodity circulation of Ukraine and the GDP of the country. Thus, main results witness the Ukraine`s necessity to increase the level of exports and increase its trade turnover. The reconstruction of production facilities must be in accordance with European and global production norms, in compliance with environmental and other normative standards, so that Ukrainian products can compete on European and global markets.

Keywords: *agricultural policy, crisis events, agricultural products, correlation-regression analysis, commodity, import, export.*
JEL Codes: *B16, B27, C02.*

Introduction

The production and sale of Ukrainian agricultural products to the EU and the world partner countries is extremely important, as it ensures the inflow of financial funds to Ukraine and supplies other countries with the necessary agricultural products. It is important to understand that Ukraine is one of the main suppliers of grain, sunflower oil and other cereals to the countries of the world. Therefore, for this study, the determination of the trade impact on the level of the country's GDP played a significant role in order to determine the possibility of bringing the economy and the standard of living of the population closer to European standards.

When reasoning and analyzing the main indicators of economic efficiency, in particular trade with partner countries, it is necessary to consider the factors of increasing the efficiency of production and sale of agricultural products according to the main directions of development and improvement of production.

In the article of Agarwal S., Ang S.H., Varshneya S. (2022) the impact of 2008-2009 financial crisis on the United States of America and other World countries was reviewed. The authors attempted to identify predictive indicators of the approaching crisis and adapt their application for decision-making and effective management of the economic and financial consequences of COVID-19.

Balbaa M, Eshov M., and Ismailova N.(2022) mostly consider the history of the military conflict development between Ukraine and Russia and in the article make a forecast of the consequences of the crisis - the economic impact on production, consumption, distribution of energy resources and the inevitable increase in prices for agricultural products. The authors have analyzed in detail the trend of energy price growth, particularly oil, in the period 2012-2022 and concluded that the price of $100 per barrel (the highest mark in 14 years) can be raised to $140 per barrel. This, in turn, will inevitably lead to the complication of the work of agricultural enterprises and the development of rural areas. The authors considered the impacts of the Russian-Ukrainian war and the sanctions imposed on Russia on various sectors of the economy (energy, military, banking and financial, trade sector).

Bluszcz J. and Valente M. (2019) carried out modeling of the impact in quantitative expression of the short-term consequences of the war in Donbas on the GDP of Ukraine using a synthetic method of control. The causal effect of the conflict on GDP per capita was defined by the authors as the difference between the results of "Ukraine after the war" and the result of "Ukraine without war". The results of the synthetic control study showed that the underachieved GDP per capita due to the war was 15.1% on average in 2013-2017 in Ukraine.

The issues of the crisis events impact in Ukraine on the export of agricultural products to EU countries and the world have not been sufficiently studied. Little attention and research have been paid to the local and global impact of military conflicts and threats on the logistical organization of commodity flows, in particular the foreign economic export and import activities of the state and their impact on the gross domestic product. To date, there are many studies concerning the global impact of crises on countries, as well as the military conflict in Ukraine influencing the very economy of the region, and a provoked humanitarian crisis. However, it was detected there are practically no studies on the impact of crisis events in Ukraine on the logistics of agricultural products export to the EU and countries of the world.

Thus the main purpose of the research was the substantiation of theoretical and methodological provisions as well as practical recommendations for estimating main indicators of the Ukrainian economy, in particular, determining through the use of economic and mathematical modeling, the influence of the level of the national trade turnover on the level of GDP and the correlation between the level of exports and the level of Ukraine's GDP.

The research methodology is in dialectical approach to the study of the recession of economic processes, which involves the comprehensive identification of regularities, volatile condition and interrelationships and interdependencies between changing environment and the purpose to ensure the stable functioning of enterprises of the agricultural sector. The methodological principles of the article are based on the provisions of correlation between economic indicators and capital theory, modern concepts of investment and trade management, as well as scientific works of domestic and foreign scientists. We used the algorithm of a scientific study of the issue of the crisis events impact caused by military actions in the East of the country on the country's turnover, and the export of agricultural products of Ukraine in particular.

The following *research methods* were used in the work: the method of financial data synthesis regarding the export and import of Ukraine with EU countries; methods of economic-mathematical modeling based on correlation-regression analysis to study the impact of the trade level with EU countries, including agricultural products, on the macroeconomic indicator of Ukraine – GDP,

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method of comparison, statistical analysis, systemic and functional, which make up the theoretical and methodological basis of the researched process.

Theoretical part

Ukraine's economy remains raw material-oriented. The country continues to sell products with a low level of processing abroad. Basically, these are iron ore, agricultural products and metallurgical semi-finished products. It is worth noting that according to the data of the State Customs Service of Ukraine (Statistics and Registers, 2022) the volume of food products and agricultural products exceeds imports by an average of 3-4 times annually.

The negative foreign trade balance increased to $8.7 billion in 2022. Since 2008, Ukraine has had a negative trade balance (with the exception of 2014-2015) (table 1).

Table 1. Trade turnover of Ukraine in 2008-2022, $million*

Year	Trade turnover	Balance	Import	Export
2008	148668	-14735	81701	66967
2009	88608	-9308	48958	39650
2010	109113	-6397	57755	51358
2011	149420	-12754	81087	68333
2012	151933	-14473	83203	68730
2013	140221	-13631	76926	63295
2014	106613	1452	52580	54032
2015	74740	1601	36570	38171
2016	75234	-2505	38870	36364
2017	92797	-6277	49537	43260
2018	104204	-9547	56875	47329
2019	110476	-10353	60414	50061
2020	103429	-5040	54234	49195
2021	141377	-5201	73289	68088
2022	103676	-15331	44173	59503

**Concluded by authors according to the data of the State Customs Service of Ukraine (Statistics and Registers, 2022).*

Concerning analysis of the export structure of Ukraine, it should be noted that the most expensive export commodity in 2021 was iron ore. The second position in terms of export value was sunflower oil. Ukraine is the world's largest exporter of these products (50% of world trade). The next positions were corn and wheat. A significant share in export was occupied by food products and agricultural products - $28 billion, metals and metal products - $16 billion. This group showed the largest increase in value. Its volume increased by 81% compared to 2020 (Ekonomichna statystyka…, 2022).

Ukraine is the fourth largest supplier of food to the EU and a key source of cereals (52% of EU corn imports, 19% of common wheat), vegetable oils (23% of EU imports) and

oilseeds (22% of EU imports, especially rapeseed 72% of EU imports) (Communication from…, 2022).

However, it is worth noting that during the 11 months of 2022, the export of food and agricultural products decreased slightly compared to other groups of foreign trade goods - a decrease of 14% compared to 2021 was observed. Imports of this goods decreased by 22% in 2022 compared to 2021. Russia's invasion of Ukraine, the sharp rise in commodity prices and the Covid-19 pandemic have created a threat to food security around the world. There has been a cascading effect of the war in Ukraine for countries that have already faced conflicts and crises.

Countries that are heavily dependent on grain imports from Ukraine and other partners (mostly these are North African and Middle Eastern countries) have a higher risk of food insecurity due to disruptions in the supply chain. One of the main producers of basic food products is Ukraine, which provides a fairly large share of wheat supplies to Armenia, Georgia, Azerbaijan, Eritrea, Mongolia and Somalia. East Africa imports 72% of cereals from Russia and 18% from Ukraine.

Ukraine is a member of the World Food Program (it is the main supplier of wheat) and thus provides food aid to 115.5 million people in more than 120 countries. Since war disrupts production and export processes, these basic products become less available.

However, during the first 5 months of the war, Ukraine could not export grain via the main sea routes through the Black Sea. More than 10% of the country's arable land was not available for the sowing campaign, which significantly affected both the country's export potential and the state budget. And if farmers relatively quickly got used to difficult conditions and found options for storage, transportation of necessary resources and provided other important things so that sowing could take place, it was more difficult for less flexible agricultural holdings to adapt to new realities (Cherez boiovi dii…, 2022).

It is worth noting that due to the policy of promoting its agriculture development, the EU countries did not face the problem of food security. The European Commission constantly monitors the situation and coordinates decision-making in response to crises that affect or threaten to affect food supply and food security in the EU.

After the “COVID” 2020, the world's economy went up. In 2020, a decrease in consumption led to a halt in production and less consumption of raw materials. Consequently, when the world economy began to recover, the producers of commodities (traded goods) could not keep up with demand. Prices for raw materials in the world began to rise. This explains the growth of the nominal gross domestic product of Ukraine in 2021 by more than 3% (table 2).

Table 2. Gross domestic product of Ukraine in 2011-2022, $ million*

Year										
2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Gross domestic product										
163160	175781	183310	131805	90615	93270	112154	130832	153781	155582	200090

**Concluded by authors on the basis of (World Bank national accounts data, 2022; International Monetary Fund, 2022).*

The situation with the agricultural products export from Ukraine was resolved by concluding agreements with Russia regarding some Ukrainian Black Sea ports resumption and the creation of so-called “solidarity routes”. Transportation of grain and oil crops was carried out by trains, trucks and inland waterways.

In 2021 the total turnover in Ukraine amounted to $141347 million, while the country imported goods and services in the amount of $68,088 million, and exported -

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$73,289 million. In 2021, the largest share of Ukraine's trade turnover was occupied by EU countries - 53%, the share with Eastern partners was 14%, and 32% were agreements with other partners.

In 2022 Ukraine's turnover decreased to $103,676 million while the country imported goods and services in the amount of $59503 million and exported in the amount of $44173 million (Fig. 1) (Statistics and Registers, 2022).

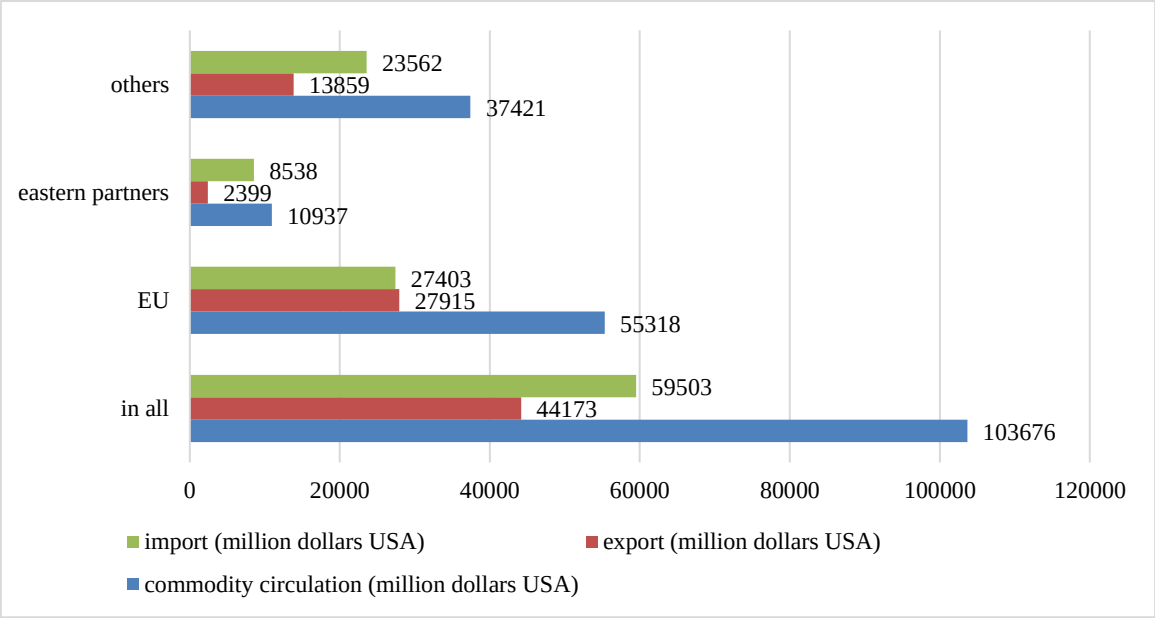


Figure 1. Dynamics of trade, export and import of Ukraine with main partners in 2022

Export to EU countries amounted to 39%, CIS countries - 11%, other countries - 50% in 2021. However the situation has changed significantly in 2022. The largest share in the Ukrainian export structure in 2022 was made up by EU countries - 63%, other countries - 32%, and eastern countries - 5% (Fig. 2) (Statistics and Registers, 2022). The structure of import between these two ears differs slightly.

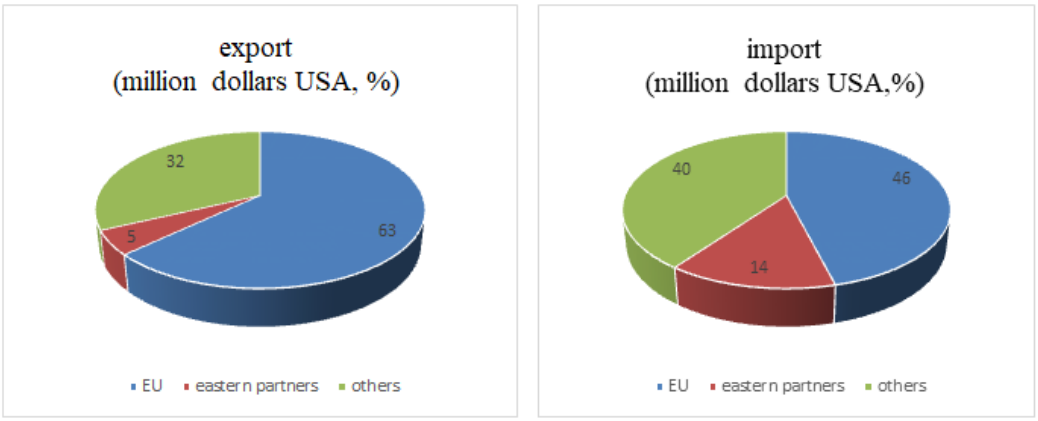
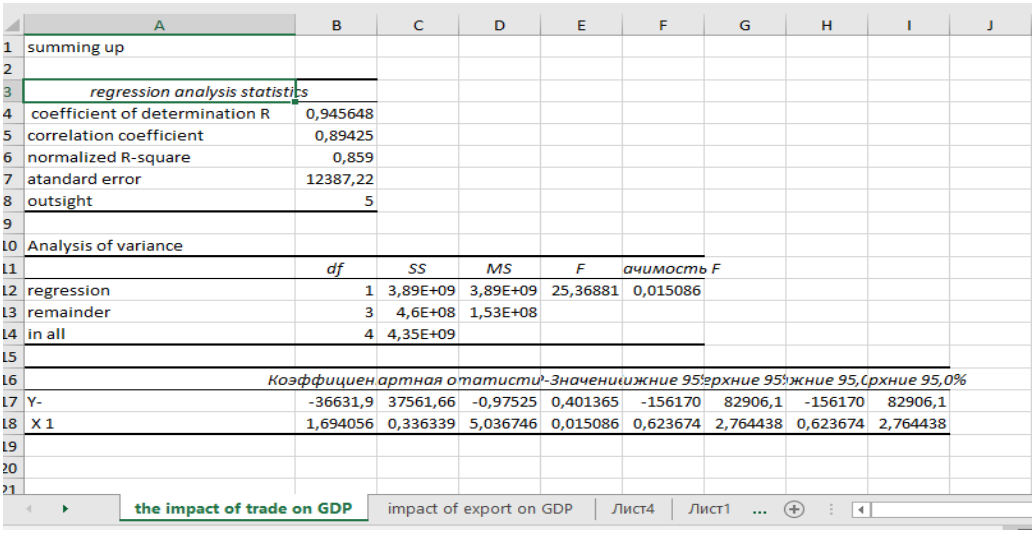


Figure 2. The structure of import and export of Ukraine in 2022

In order to identify the impact of Ukraine's trade volume (Table 1) on the level of GDP (Table 2) for the period 2017-2021, we performed economic and mathematical modeling based on regression analysis. Figure 3 shows the results of the calculations.



	A	B	C	D	E	F	G	H	I	J
1	summing up									
2										
3	*regression analysis statistics*									
4	coefficient of determination R	0,945648								
5	correlation coefficient	0,89425								
6	normalized R-square	0,859								
7	atandard error	12387,22								
8	outsight	5								
9										
10	Analysis of variance									
11		*df*	*SS*	*MS*	*F*	*ачимость F*				
12	regression	1	3,89E+09	3,89E+09	25,36881	0,015086				
13	remainder	3	4,6E+08	1,53E+08						
14	in all	4	4,35E+09							
15										
16		*Коэффициен*	*артная о*	*татисти*	*-Значени*	*ижние 95%*	*ерхние 95%*	*жние 95,0*	*рхние 95,0%*	
17	Y-	-36631,9	37561,66	-0,97525	0,401365	-156170	82906,1	-156170	82906,1	
18	X 1	1,694056	0,336339	5,036746	0,015086	0,623674	2,764438	0,623674	2,764438	
19										
20										
21										

the impact of trade on GDP | impact of export on GDP | Лист4 | Лист1 | ...

Figure 3. Correlation-regression analysis of the impact of Ukraine's trade turnover on GDP

The analysis of the modeling results leads to the conclusion that the level of turnover has a sufficient influence on the GDP of the national economy (the correlation coefficient is 0.89), which indicates a close correlation. The coefficient of determination R is 0.95, which indicates the adequacy of the constructed model. The regression equation of the model of the effect of turnover on the GDP of the economy of Ukraine has the form:

$$y = -36631.9 + 1{,}69x \qquad (1)$$

The coefficient of elasticity is calculated according to the formula:

$$k_e = \frac{a_1 \ddot{x}}{a_0 + a_1 \bar{x}} \qquad (2)$$

Results of the calculations will be:

$$k_e = \frac{1.69 * 110456{,}6}{-36631{,}9 + (1.69 * 11046{,}6)} = 1.24 \qquad (3)$$

Therefore, the elasticity coefficient is 1.24, which means that if the turnover of Ukraine increases by 10%, the GDP of the national economy will increase by 12.4%. That is, according to the simulation, we can argue that it is necessary to work on increasing Ukraine's partnership agreements with European and world partners. It is necessary to direct the development strategy increasing the share of turnover with innovative technologies, high-tech developments of goods and services. This, in turn, will lead to the improvement of macroeconomic indicators of the Ukrainian economy.

The results of modeling the impact of exports on the dynamics of Ukraine's GDP are presented in the figure 4. Analysis of the correlation effect will allow to implement the correct strategy for the development of the national economy in the near future.

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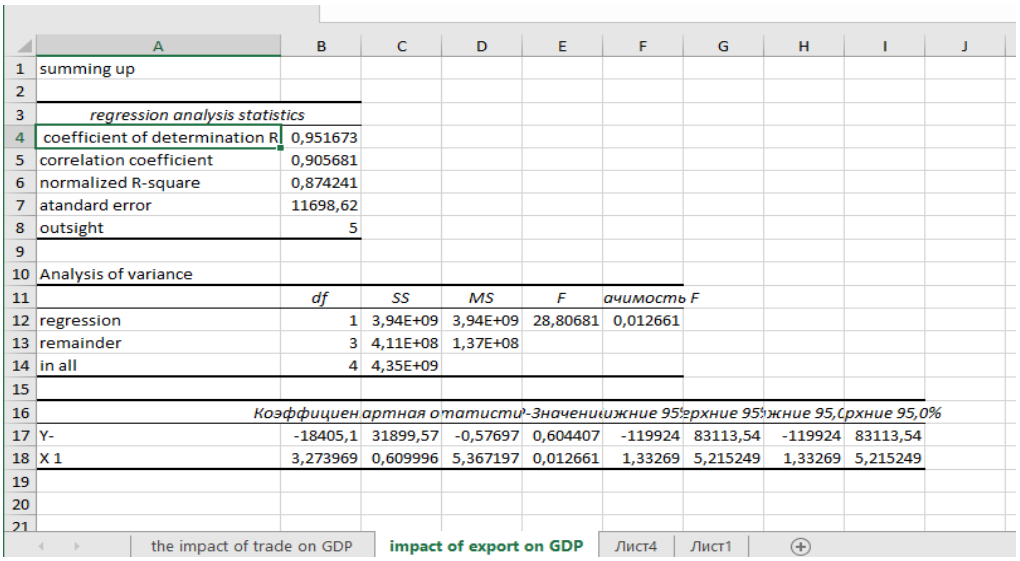

	A	B	C	D	E	F	G	H	I	J
1	summing up									
2										
3	*regression analysis statistics*									
4	coefficient of determination R	0,951673								
5	correlation coefficient	0,905681								
6	normalized R-square	0,874241								
7	atandard error	11698,62								
8	outsight	5								
9										
10	Analysis of variance									
11		*df*	*SS*	*MS*	*F*	*ачимость F*				
12	regression	1	3,94E+09	3,94E+09	28,80681	0,012661				
13	remainder	3	4,11E+08	1,37E+08						
14	in all	4	4,35E+09							
15										
16		*Коэффициен*	*артная о*	*татисти*	*-Значени*	*ижние 95%*	*ерхние 95%*	*жние 95,0*	*рхние 95,0%*	
17	Y-	-18405,1	31899,57	-0,57697	0,604407	-119924	83113,54	-119924	83113,54	
18	X 1	3,273969	0,609996	5,367197	0,012661	1,33269	5,215249	1,33269	5,215249	
19										
20										
21										

the impact of trade on GDP | impact of export on GDP | Лист4 | Лист1

Figure 4. Correlation-regression analysis of the impact of export on GDP

Analysis of the conducted simulation statistics leads to the conclusion that the level of export directly influences the level of Ukraine's GDP. The correlation coefficient is 0.91, which indicates a high density between the indicators. The coefficient of determination 0.95 indicates the adequacy of the model and the possibility of applying the research results. The regression equation will take the form:

$$y = 18405.1 + 3.27x \qquad (4)$$

According to formula 2 the calculation of the elasticity coefficient will be:

$$k_e = \frac{3.27*51586,6}{18405,1+168688,18} = 0,9 \qquad (5)$$

Therefore, the elasticity coefficient is 0.9, that is, if the export level increases by 10%, the dynamics of Ukraine's GDP will increase by 9%, which is a significant indicator.

That is, it is necessary to increase export to provide the growth of the national economy and improvement of macroeconomic indicators. Currently, a balanced policy of Ukraine with European and world partners, ensuring trade routes and supply chains of agricultural products to European and world markets by sea, land and air is important.

These estimation results allow developing a methodology that would comply the state authorities to form appropriate strategies, methods and means used to confront the crisis situation regarding the export of agricultural products to EU countries and the world in order to increase its economic condition and assure the provision of the products. In our opinion it is necessary to do this starting from the development of primary concepts and ending with the detailing of the operational reality of the daily work of an agricultural enterprise.

Conclusions

The article examines the impact of crisis events in Ukraine on the logistics of financial and economic flows of export products, including agricultural products to EU countries and the world. The authors analyzed the export structure of Ukraine for 2022 and found that the second position in the structure was sunflower oil. The next positions are corn and wheat. A significant share of exports was food and agricultural products - $28 billion. The military events in Ukraine in 2022 disrupted the supply chains of agricultural products, both to the EU countries and the countries of the world, which caused to some extent the crisis phenomena of the world economy and the rise in prices of critical consumer goods.

That is, to summarize, considering the statistics of Ukraine for the year 2022, the main trading partners were the EU countries.

The war in Ukraine displaced the supply chains of goods and services both in the countries of the European Community and in the countries of the world that are in dire need of grain and other raw materials that Ukraine produced and supplied in accordance with the signed agreements.

This involved conducting fundamental research from the analysis of the country's GDP and the impact on this economic indicator of turnover, narrowing the scope of searches to identifying the impact of specific exports on GDP. We proposed appropriate measures to prevent or reduce the impact of today's negative economic trends on further trade in agricultural products with the countries of the EU and the world with the prospect of further scientific development of methods to solve this problem. The conducted research used economic and mathematical modeling and showed a direct correlation between the turnover level of the Ukrainian economy and the GDP of the country, the correlation coefficient was 0.89, which indicated a close correlation. The coefficient of elasticity was 1.24. This indicates that with an increase in Ukraine's trade turnover by 10%, the GDP of the national economy will increase by 12.4%.

We established a direct correlation between the level of Ukrainian export and the level of GDP using regression analysis. The calculated elasticity coefficient was 0.9, that is, if the level of exports increases by 10%, the dynamics of Ukraine's GDP will increase by 9%.

The results of scientific research actualize the importance of deepening cooperation between Ukraine and the countries of the European Union and the World in terms of export-import agreements, expanding cooperation and interaction taking into account the needs of European partners in ensuring the supply chains of agricultural products and other goods according to the signed agreements and considering external risks and threats. The developed economic-mathematical models of the exports the EU countries influence on the macroeconomic indicator of Ukraine - GDP will allow forecasting and practical implementation of all partnership agreements with the European Union in the near future.

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