



UDC 338.432:338.5

DOI: 10.48077/scihor.24(7).2021.68-80

Assessment of the Impact of the Armed Conflict in Ukraine on the Development of the Agricultural Sector and Price Setting

Oleh Semenenko^{1,2*}, Anatolii Minochkin³, Serhii Vasylenko²,
Valerii Klepikov², Oleksandr Pravdyvets⁴

¹National Aviation University
03058, 1 Liubomyr Huzar Ave., Kyiv, Ukraine

²Central Research Institute of the Armed Forces of Ukraine
03049, 28b Povitroflotskyi Ave., Kyiv, Ukraine

³Military Institute of Telecommunications and Information Technologies named after Heroes of Kruty
01011, 45/1 Moskovska Str., Kyiv, Ukraine

⁴Ministry of Defense of Ukraine
03168, 6 Povitroflotskyi Ave., Kyiv, Ukraine

Article's History:

Received: 29.08.2021

Revised: 27.09.2021

Accepted: 29.10.2021

Suggested Citation:

Semenenko, O., Minochkin, A., Vasylenko, S., Klepikov, V., & Pravdyvets, O. (2021). Assessment of the impact of the armed conflict in Ukraine on the development of the agricultural sector and price setting. *Scientific Horizons*, 24(7), 68-80.

Abstract. This paper analyses the impact of the armed conflict in Ukraine on the development of the agricultural sector and changes in average prices of agricultural products, and also identifies a possible relationship between changes in prices for agricultural products and financial expenditures for defence needs. The paper also investigates the possible relationship between changes in military spending, gross harvest of cereals and legumes, harvested and threshed area, their yield levels. The study considers how the presence and duration of armed conflict in the country affects: macroeconomic indicators, intensity of hostilities and their localisation in areas of economic activity, gross domestic product (GDP), government expenditures, export-import indicators; household expenditures and domestic investment, consumer and household expenditures. All this, indirectly, has an impact on fluctuations in average prices of products of different sectors of agriculture sold by enterprises. The study takes into account the importance of the agricultural sector of Ukraine, which is a significant part of the country GDP. The dependence of military spending on the size of GDP is the reason for analysing the relationship between the impact of the existing armed conflict on changes in the state of agriculture in Ukraine. One of the results of such actions was also the spending of more money on the purchase of agricultural products to support the defence needs of the state, etc. Therefore, to understand the magnitude of the impact of gross harvest factors, crop yields, and agricultural land volumes on the pricing of agricultural output using the method of statistical equation dependencies, the findings of the relevant analysis can be used as a basis for developing approaches, methods, and techniques to improve crop yields, or – initiate economic development of the country by increasing agricultural crop yields

Keywords: financial costs, macroeconomic indicators, gross domestic product, domestic investment, agricultural sector



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*Corresponding author

INTRODUCTION

Analysis of the current geopolitical situation in recent decades indicates a dynamic transformation of the system of international relations, which, in turn, is caused by increasing struggle for resources and markets, and attempts by some countries to strengthen their influence on world politics by force. Some countries consider using the armed forces not only to ensure their own security and protect national interests, but also to influence other countries to assert their political status and warn other countries about the possibility of using force against any country. The global spread of armed conflicts encourages countries to allocate significant human and financial resources to ensure and maintain the necessary level of their own security in the military-political situation in the world. Nowadays, in every state, in any society, agriculture is a vital sector of the national economy, as it affects the interests not only of each person but also the nation as a whole, because food production is the first prerequisite for quality life. It is also a raw material base for other industries, including light and food industry. Agricultural economics is an integral part of the system of economic sciences, which consider various aspects of social relations of people in the field of production and distribution of material goods. One of the important areas of economics is military-economic theory, or military economics, which can decisively affect the development of both state industry and the agricultural part of the national economy. Economic theory studies the laws of social production and consumption of products, goods and services at different stages of human society, including an integral part of it is the study and research of the agro-industrial complex of the state.

Nowadays, the agro-industrial complex (AIC) is a set of branches of the national economy for Ukraine, which are interconnected by economic relations regarding the production, distribution, exchange, and consumption of agricultural products. It includes industries that ensure the production of agricultural products, their processing, storage and sale, manufacturing of means of production in the agro-industrial complex and its maintenance. About 80 branches of the national economy take part in the agro-industrial complex at different stages of production and circulation. AIC is one of the main components of the national economy. It accounts for about 1/3 of GDP, fixed assets and the number of employees. Today, the development of agriculture in the country is aimed at increasing the efficiency of agricultural labour, i.e., to produce more agricultural products with less work [1]. The agro-industrial complex has its own peculiarities of development: dependence on natural conditions; seasonal nature of production and cash receipts; slowed down in comparison with industry cycle and turnover of fixed and working capital; use as means of production – land, productive animals, and cultivated plants; combinatorial variety of combinations of forms of production, management, and ownership; features

of production technologies associated with living organisms – plants, animals, microorganisms; territorial dispersion of production and remoteness of structural units from the centre, the differences of social nature between urban and rural areas; survivability of economic traditions and customs of the rural population; the impact of personal households on the economic situation of workers, etc.

The level of development of the agro-industrial complex largely determines the level of economic and food security of the country, as the specificity of its role is conditioned by food production as the basis of human life and reproduction of labour, production of raw materials for many non-productive consumer goods and industrial products. The level of economic and food security is one of the main characteristics of the level of military and economic security and national security of Ukraine as a whole. Today, it is not possible to find a country with a low rate of agricultural development among the world's leading countries, because the most important task of agriculture is to provide the population with food and industry with the necessary raw materials. In the conditions of development of market economy this problem can be solved only by increase of economic efficiency of agricultural production. It is the level of agricultural efficiency that determines the degree to which the population is provided with foodstuffs. Therefore, one of the primary tasks of science is to develop economic bases for the development of the industry in market conditions and effective management methods, but considering the factors influencing the development of the agricultural sector and the national economy as a whole.

In the context of Ukraine, one of the most influential factors in the development of agriculture is the state of armed conflict. A study of the development of certain countries (USSR, Germany, Japan, Yugoslavia, Iraq, Israel, Georgia) that have had or have an armed conflict in their territory shows that any armed conflict affects the country's economic growth, as a result of hostilities its resources and infrastructure are destroyed, and the outflow of human resources is observed [2-4]. That is, the state suffers losses caused by damage incurred during armed conflicts, and these losses are reflected in the economic growth of the country, and in the development of its agricultural sector in the first place. The speed of recovery of the national economy after the armed conflict will also directly depend on the damage inflicted. The annexation of Crimea and hostilities in eastern Ukraine in some regions of Donetska and Luhanska oblasts have a negative impact on the economic development of the entire country. Sharp reduction in GDP of Ukraine is conditioned by closure, relocation or suspension of enterprises, loss of territory and significant amounts of agricultural land, infrastructure losses, job losses, significant decline in income and forced migration [5].

In this regard, *the purpose of the study* is to investigate the impact of the state of armed conflict in Ukraine on the development of agriculture and the national economy as a whole. But the definition of such impact is expected to be made by analysing the dynamics of prices for agricultural products during the armed conflict in Ukraine with the subsequent establishment of functional dependencies of projected price growth by regression and correlation analysis, and extrapolation of price dynamics based on available statistics.

THE ROLE OF AGRICULTURE IN THE DEVELOPMENT OF THE NATIONAL ECONOMY

Agriculture plays an extremely important role for Ukraine as a catalyst for the development of the national economy, as it is an industry that ranks 3-5th annually in terms of contribution to GDP. This is facilitated by the significant scale of agricultural land use and fertile land. Thus, it can be argued that the development of agriculture plays a significant role in the development of the national economy, and thus it can be concluded that the development of agriculture also plays a significant role in shaping the military and economic potential of Ukraine. Nowadays, agricultural development of Ukraine is a platform for job creation and poverty reduction. This is a branch of material production, which is important in providing the population with food and industry with raw materials. The development of agriculture is a vital factor in the development of all sectors of the national economy. Today, most of the expenditures of the Ministry of Defence (MoD) are aimed at providing social guarantees for servicemen, both in cash and in kind. At the same time, the current structure of state budget expenditures does not allow fully meeting the needs of the Ministry of Defence of Ukraine and providing servicemen with their social guarantees. The war has a negative impact on economic development and key indicators of agriculture in the country. In particular, one of the criteria for the negative impact was a sharp decline in GDP, in particular, in the first year of the war, Ukraine's GDP per capita fell by 47.5% from USD 3,014.6 in 2014 to the value of USD 2,115 in 2015, which corresponds to the global trend of the consequences of military events.

Ukraine's GDP is affected by the consequences of the armed conflict: destruction of production facilities, infrastructure, transport, loss of land use capacity due to shelling, mining, outflow of human resources from the country, loss of civilian population, and more. All these consequences have a negative impact on GDP, which in turn has a negative impact on social protection, the state of the national economy and its components, the main of which is the agricultural sector. Therefore, a very important and urgent task of research today, when Ukraine is in its hybrid war for six years, is to investigate the problems of assessing the real impact of armed conflict in Ukraine on the agricultural sector and the national economy. One of the possible ways of such a study is to

analyse the dynamics of pricing of agricultural products before and during the armed conflict. Based on the results of the analysis, it is necessary to investigate the correlations between the effects of armed conflict on agricultural development and the national economy as a whole. The results of the analysis should determine the regression relationships between the level of agricultural development (the share of agriculture in GDP) and the volume of defence spending to assess the density of the relationship between the dynamics of defence spending and agricultural development in Ukraine.

A number of research papers are devoted to the study of the interdependence of the size of military expenditures of countries and individual sectors of the economy. Thus, T. Rahman and A. Siddiqui [1] considered this issue, touching upon the aspect of trade in goods of the military-industrial complex. N. Eftychia [2] approached the study from an extraordinary standpoint: the researcher considered the role of military expenditures in the debt crisis in Greece. R.F. Pustoviyt [3] analysed the factors influencing military spending on the country's economy. The impact of military spending on the economy is rather underinvestigated. The question of assessing the damage caused by the annexation of Crimea by Russia is reflected by Ukrainian researchers, in particular V.V. Anisimov [4], B.A. Karpinsky [5], O.P. Korniyuchuk [6], K.M. Kornienko [7], papers by analysts of consulting agencies [8]; studies by S.F. Garkavy [9], E.M. Libanova [10], O.V. Sobkevich [11], O.Yu. Snigova and T.Yu. Zagorelska [12] and investigation by non-governmental organisations [13; 14]. However, this issue needs further study for the following reasons: firstly, the insufficient study of the peculiarities of Ukraine's economy before the start of hostilities, in particular in terms of its structure, trade cooperation with other countries; secondly, the fragmentary nature of the study of military aggression in Donetska and Luhanska oblasts and the Crimea, in connection with which there was a need to summarise the results of research in this area; thirdly, the issues of assessing the consequences of annexation of parts of the territory and hostilities from the standpoint of already incurred losses (value of real estate, inventories, infrastructure) and lost opportunities, based on the share of affected regions in the economy, were incompletely covered. In addition, researchers do not have a consensus on approaches to assessing the relationship between defence spending and the development of both agriculture and industry, or other sectors of the national economy.

Therefore, one of the approaches to assessing the impact of the presence of armed conflict in Ukraine on the development of the agricultural sector is to assess the dynamics of agricultural prices in the country during and before the conflict. The price setting for agricultural products, the impact of the price mechanism on the development of the agricultural sector of Ukraine is the subject of research by many Ukrainian researchers [15-18].

They worked out the theoretical aspects of the price setting for agricultural products in the context of value theory, considered the principles and features of the mechanism of pricing in the agricultural sector [19; 20]. Most scholars analyse the impact of the economy as a whole and the defence sector separately, so there is a need to expand research in this area, namely: to determine the possible impact of the agricultural sector on meeting the financial needs of defence, which is one aspect of timely prevention of possible threats.

GENERAL INDICATORS OF GROWTH OF AGRICULTURAL PRODUCTION

A special place in any economic model is occupied by the price setting mechanism, which should balance the diverse interests of sellers (producers) and buyers (consumers) of goods, allocate resources, stimulate rational allocation of production, innovation, etc. The state and trends of development of both individual sectors of the economy and the national economy as a whole depend on the effectiveness of the implementation of the functions assigned to it by this mechanism. Price dynamics is an important indicator of the state of individual sectors of the economy, and the impact on price setting is one of the tools for optimising economic processes. This fully applies to pricing in the Ukrainian agricultural sector. Prices for agricultural products are the most dynamic characteristics of the agricultural market. They are sensitive to the influence of numerous economic, technological, weather, socio-political factors and in turn determine the vectors and rates of development of individual agricultural sectors, the level of food security of the country. Significant differentiation and fluctuations in the dynamics of prices for agricultural products indicate poor controllability of processes in the agri-food market, including the presence of influences not taken into account by specialists factors that decisively affect price setting. This creates the preconditions for the emergence of instability, which reduces the investment attractiveness of the agricultural sector, exacerbates the imbalances in the development of some of its components.

Ukraine ranks third in the list of largest suppliers of agricultural products to EU member states (EU), exporting more than EUR 7.3 billion [21]. More than 83% of the commodity structure of supplies to the EU is accounted for by exports of cereals and oil. Since October 1, 2017, the EU has introduced additional duty-free tariff quotas (autonomous trade preferences) for agricultural and food products temporary additional EU trade preferences for Ukraine (Regulation (EU) 2017/1566). In particular, the following duty-free quotas were increased: honey, barley, barley flour and granules, processed grain and flour, processed tomatoes, grape juice, oats, corn, corn flour and granules, soft wheat, wheat flour and granules. Most additional duty-free quotas apply from October 1, 2017, except for quotas for wheat, corn, and

barley, which are available from January 1, 2018, crops, fats, and oils, residues of the processing industry. However, the occupation of the Crimean Peninsula has led to the decision for the closure of the North Crimean Channel in 2014, which met 85% of the Autonomous Republic of Crimea's (ARC) water needs (850 million m³ per year).

At the same time, 72% of this water was used for the needs of the agricultural sector of the economy [22]. Russia's occupation of Crimea has collapsed due to forced closure of the channel between mainland Ukraine and the peninsula to create water shortages in the occupied territories, but this in turn has led to violations of agricultural irrigation technology in the ARC, where 18% of sown areas require this agro-technological measure. In the period 2015-2019, due to the lack of irrigation water, the area of irrigated land decreased by 10-12 times. If Crimea is returned to Ukraine, it will have multi-billion negative consequences, namely in the northern part of the peninsula 14 thousand hectares of orchards and vineyards will suffer irreversible losses, and this will lead to irreversible loss of soil fertility in the ARC. The rice farm on the peninsula will be practically destroyed (the capacity of the industry was 19 thousand hectares of agricultural land). Due to the lack of water in 2015-2018, 350-400 thousand tonnes of rice were lost annually (about 50% of the harvest) [23]. The occupation of the Autonomous Republic of Crimea has led to the fact that Ukraine meets the needs of the domestic market for rice with only 30% of its own production capacity, which affected its price on the domestic market of Ukraine. The main rice-growing regions were Khersonska (Skadovsk, Kalanchak, Holoprystan and Tsyurupynsky raions) and Odeska (Kiliya and Izmail raions) oblasts. 50% (30 thousand hectares) of irrigation systems remained on the territory of the occupied ARC [24], the loss of which in 2015 had a significant impact on the development of Ukraine's agricultural sector and its national economy as a whole.

The armed conflict in Donetska and Luhanska oblasts leads to an imbalance of inter-economic relations in the agro-industrial complex (AIC) and reduces the level of its investment attractiveness. The hostilities in the Donbass naturally caused the main producers of mineral fertilisers to stop their production activities. Thus, in the area of the anti-terrorist operation (ATO) the production facilities of the PAT Severodonetske Obyednannya Azot and PAT Konzern Styrol are located. At the same time, the production and economic activity of PAT Azot in Cherkasy and PAT Rivneazot is unstable. This has exacerbated the shortage of mineral fertilisers in the national market. About 35% of the territory of Donbass is occupied and not under the control of the Ukrainian authorities [24]. As a result of the armed conflict, Ukraine is sowing only 50% of the projected areas of spring crops in Donetska and Luhanska oblasts. In the Donetska oblast, 22.3 thousand hectares of agricultural land need demining and elimination of the consequences

of hostilities. In turn, there are 10.6 thousand such areas in the Luhanska oblast. Of these, 7 and 9.1 thousand hectares were demined, respectively. The total area of mined and contaminated areas is 34 thousand hectares. At the same time, fortifications are being built on agricultural lands in the occupied territories.

In general, the volume of agricultural lands in Donetska and Luhanska oblasts is 26.5 million hectares, which is 8.8% of the structure of sown areas of Ukraine, including 485 and 198 thousand hectares in the ATO zone or 1.8 and 0.7%, respectively. All agricultural products produced along the line of demarcation cannot physically enter the domestic food market of Ukraine. In the occupied territories of Donbass, farming was destroyed as a class of socio-economic relations. According to available information, more than 30,000 hectares of arable land from Novoazovsk to Artemivsk raions of Donetska oblast have been mined or are in the combat zone. Only about 6,000 hectares were demined [19]. Ukraine has huge potential for the development of the agricultural sector of the national economy. This is evidenced by a number of important macroeconomic parameters. The most important among them is the share of agriculture in GDP, which was 10% in 2013, in 2016 – 14%, in 2019 – 11%, and in 2020 – 13% [25]. In highly developed countries, in particular in Germany and France, agriculture accounts for only 1-2% of GDP. Today, the armed conflict on the territory of Ukraine has a negative impact on its economic development and the main indicators of economic activity in the country, but it is unforeseen that the Ukrainian national economy still manages to adapt quickly to existing challenges. Tables 1

and 2 provide statistics on GDP dynamics, defence budgets of Ukraine, and key indicators of agricultural development in Ukraine to assess the density of the relationship between these indicators using regression and correlation analysis methods.

The analysis of the above statistical data shows that one of the criteria for the negative impact was a sharp decline in GDP, in particular, in the first year of the war, Ukraine's GDP per capita fell by 47.5% from USD 3,014.6 in 2014 to the value of USD 2,115 in 2015, which corresponds to the global experience of the consequences of military events. For the first time since 2014, Ukrainian scholars have faced problems with the interdependence of increasing military spending caused by the armed conflict with Russia on its own territory and the development of key sectors of the national economy. The need to increase defence spending and reshape some of the national economy in the interests of the military organisation of the state created the preconditions for studying the impact of armed conflict in Ukraine on major sectors of the national economy to determine a rational relationship between defence spending and economic development spending. One of the criteria that characterises the desire of the state to provide the necessary conditions for effective development of its armed forces to maintain their combat capability in accordance with existing threats is the amount of defence spending and their distribution in generally accepted areas, such as personnel maintenance, training and combat training, development armaments and military equipment, infrastructure [26].

Table 1. Statistics on the main indicators of the dynamics of agricultural development and spending on the Ministry of Defence (MoD) in Ukraine in the period before and during the armed conflict (2010-2020)

Indicators	Years										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
GDP ¹ (in actual prices) UAH billion	1,079.346	1,299.991	1,404.669	1,465.198	1,586.915	1,988.544	2,385.367	2,981.227	3,560.302	3,977.198	4,191.9
GDP ¹ (in actual prices) USD billion	136.013	163.160	175.781	183.310	133.503	91.031	93.356	112.091	130.891	153.883	155.486
Expenditures of the MoD, UAH billion	10.5	12.7	14.81	15.32	26.5	49.1	58.1	68.9	94.3	103.3	116.6
Expenditures of the MoD, USD billion	1.323	1.594	1.853	1.917	2.229	2.248	2.274	2.591	3.467	3.997	4.325
Official exchange rate of UAH against 100 USD	793.56	796.76	799.1	799.3	1,188.67	2,184.47	2,555.13	2,659.66	2,720.05	2,584.56	2,696
Population (estimated on January 1)											
Current population, million	43.6	43.4	43.3	43.2	43.1	42.9	42.8	42.6	42.4	41.9	41.6

Table 1, Continued

Indicators	Years										
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Population (estimated on January 1)											
Rural population, million	13.7	13.6	13.5	13.4	13.3	13.2	13.2	13.1	13	12.9	12.8
% of rural population to the total population	31.4	31.3	31.2	13.1	31	30.9	30.8	30.8	30.7	30.8	30.8
Export of cereals											
USD billion				6.4	6.5	6.1	6.1	6.5	7.24	9.63	9.4
Physical volumes, million tonnes				27	32.6	37.4	40.2	41.8	39.4	50.4	57.2
Sown areas of agricultural crops (thousand hectares)	26.085	26.846	27.022	27.573	27.239	26.902	27.026	27.585	27.699	28.001	
Crop production (thousand tonnes)											
Cereals and legumes	37.867	54.816	45.308	62.285	63.859	60.126	66.088	61.917	70.057	75.143	64.933
Sugar beet	13.749	18.740	18.439	10.789	15.734	10.331	14.011	14.882	13.968	10.204	9.150
Sunflower	6.735	8.614	8.313	10.789	10.134	11.181	13.627	12.236	14.165	15.254	13.110
Potato	18.338	23.781	22.906	21.852	23.693	20.839	21.750	22.208	22.504	20.269	20.838
Number of farm animals (at the end of the year; thousand units)											
Cattle	4.351	4.290	4.506	4.398	3.884	3.750	3.682	3.531	3.333	3.092	2.874
Pigs	7.775	7.204	7.418	7.765	7.351	7.079	6.669	6.110	6.025	5.727	5.876
Bird of all species (million units)	191.5	189	206.9	220.6	213.3	204	201.7	204.8	211.7	220.5	200.6
Production of animal goods											
Meat in slaughter weight (thousand tonnes)	1.914	1.996	2.063	2.260	2.360	2.323	2.324	2.318	2.355	2.492	2.478
Milk, million tonnes	10.9	10.7	11.1	11.2	11.1	10.6	10.4	10.3	10.1	9.7	9.3
Eggs, million pcs	16.242	17.897	18.364	19.094	19.587	16.783	15.100	15.506	16.132	16.678	16.167
Price indices of agricultural products sold by agricultural enterprises (up to 2020; %)											
Agricultural products	127	113.7	107.2	97.3	124.3	154.5	109	111.5	108.2	101.4	89.9
Crop products	139.5	118.2	106.9	91.7	129.2	167.2	116.3	107.3	110.2	101.8	87.9
Livestock products	114.4	109.2	107.6	102.8	119.1	141.3	101.7	130.7	101.2	100.2	97.5

Note: ¹ – is gross domestic product

Table 2 provides statistics for the establishment of relationships between prices for agricultural products and defence spending to assess the impact of armed conflict in Ukraine on the pricing process for the main types of agricultural products, namely cereals and

legumes. The analysis of the obtained statistical data in Table 1 reveals the growth of the main indicators that characterise the impact of the factor of armed conflict in Ukraine, both on GDP and on the growth rates of agricultural production (Fig. 1).

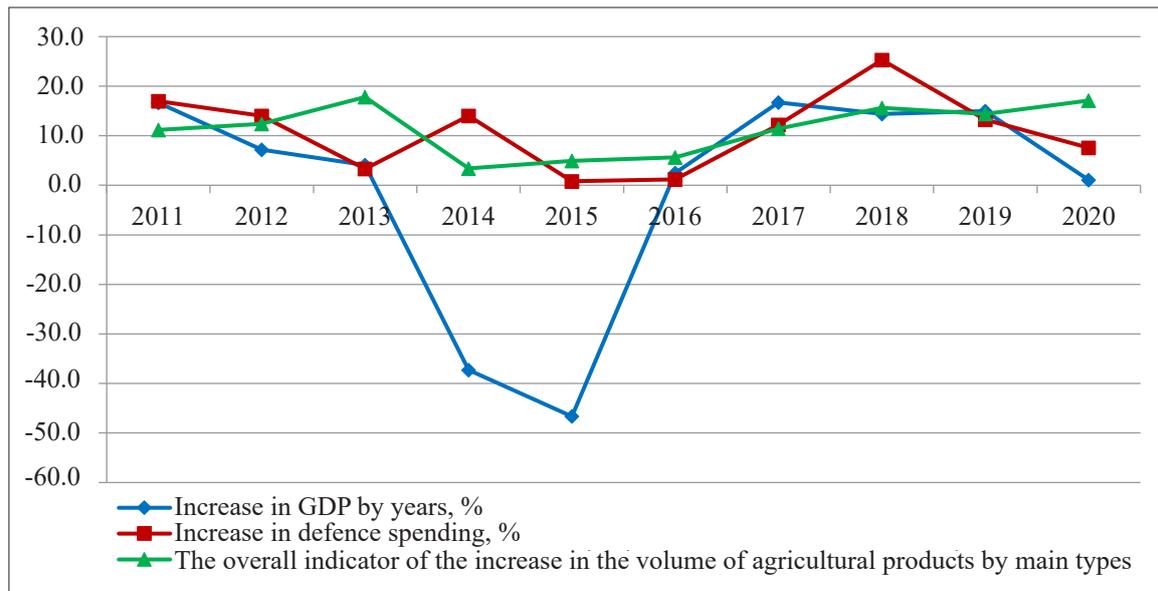


Figure 1. Dynamics of GDP growth, defence spending, and agricultural output for the period 2011-2020

Table 2. Dynamics of gross harvest of cereals and legumes, harvested and threshed area, levels of their yield, and expenditures on defence needs of Ukraine for 2010-2020

Years	Expenditures for the needs of the MoD (UAH million / %)		Gross harvest of cereals and legumes (including corn) (thousand centners / %)		Harvested and threshed area of cereals and legumes (including corn) (thousand hectares / year)		Average prices of agricultural products sold by enterprises (UAH per tonne / %)		Crop yield (centners from 1 hectare / %)	
2010	10,553.2	-	389,077.5	-	14,217.3	-	1,120.9	-	27.4	-
2011	12,295.1	16.51	505,433.5	29.91	14,156	-0.43	1,374.2	22.60	35.7	30.29
2012	14,814.3	20.49	408,806.1	-19.12	13,581.6	-4.06	1,547.1	12.58	30.1	-15.69
2013	15,174.0	2.43	510,706.3	24.93	13,717.7	1.00	1,299.8	-15.98	37.2	23.59
2014	27,346.0	80.22	572,347.8	12.07	13,583.9	-0.98	1,801.4	38.59	42.1	13.17
2015	27,346.0	0.00	560,592.5	-2.05	13,254.1	-2.43	2,912.1	61.66	40.6	-3.56
2016	58,099.1	112.46	561,067.2	0.08	12,802.1	-3.41	3,414.0	17.23	43.8	7.88
2017	68,537.4	17.97	527,574.3	-5.97	12,977.4	1.37	3,771.6	10.47	44.2	0.91
2018	94,959.4	38.55	604,121.3	14.51	13,578	4.63	4,315.0	14.41	44.5	0.68
2019	105,542.8	11.15	691,361.9	14.44	14,340.4	5.61	3,867.5	-10.37	48.2	8.31
2020	121,681.2	15.29	633,445.4	-8.38	14,759.1	2.92	4,794.1	23.96	42.9	-11.00

Source: [26]

Calculations of the total growth rate of agricultural production were performed on the main indicators, which are shown in Table 1 as the arithmetic mean of the growth of all major types of such products. The obtained data allowed forming a graphical dynamics of changes in these indicators over the years to study their correlation with each other. Notably, during the study period the arithmetic mean GDP growth rate was -0.6%, and the average growth rate of defence spending (+10.9) and agricultural output (+11.4) were positive

and correlated in some way (Fig. 2). This can be explained by the anomaly of the country's economic development, i.e., the general economic policy of Ukraine stubbornly does not notice something very significant. Ukraine's national economy has experienced shocks at least twice: in 2008 due to the global financial crisis and in 2014 due to internal disorganisation and external aggression, but managed to disregard the first shock caused by the collapse of Soviet economic ties and adapt to development economy even in conditions of protracted armed conflict.

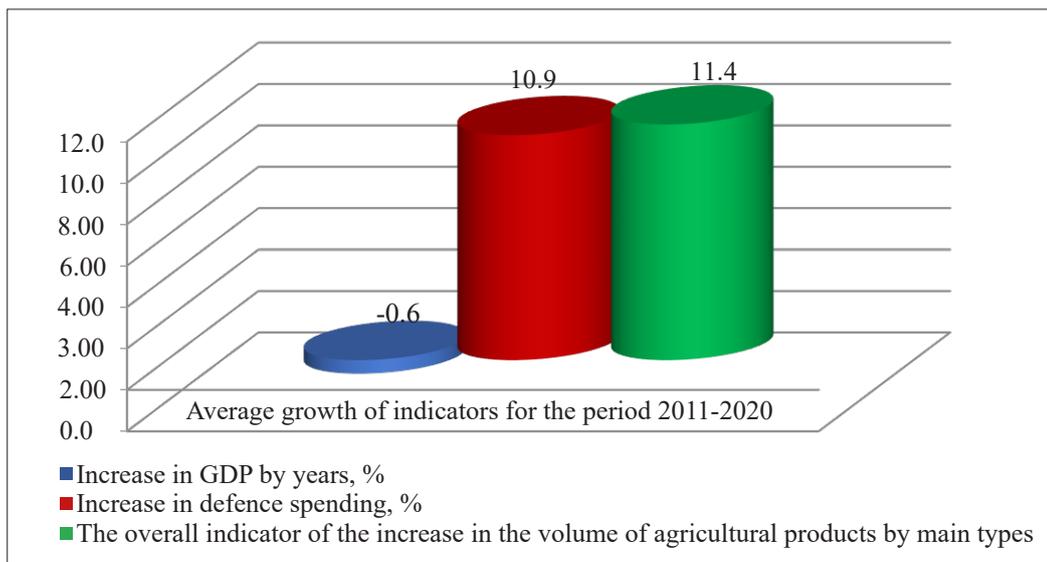


Figure 2. Dynamics of GDP growth, defence spending and agricultural output for the period 2011-2020

For example, in 2008 the decline of Ukraine’s economy was very deep, over 15.1%, i.e., the largest in the world, and in 2014-2015 over 15.8% in two years. However, the development of Ukraine’s economy continues and this is clear evidence of growth in agricultural production (Figs. 1 and 2), i.e., agriculture was able to adapt to the influence of the factor of armed conflict on the territory of Ukraine. Most world economists believe that the structural degradation of Ukraine’s economy has led to the loss of its recovery properties and identified a general downward trend, but studies show that in 2019-2021 Ukraine has regained its position on economic growth, and agricultural development even in 2015-2018. In 2018 and 2019, the growth trend in the main areas of agricultural development was over 25-40%, which characterises the full adaptation of this

industry to the operation in conditions of the ongoing armed conflict. If the statistical data in Tables 1 and 2 are used to form a correlation field between indicators of growth of defence expenditures and growth (rate) of development of the agricultural sector by main types of products, at the initial stage it becomes clear that these indicators have a low level of correlation, since the coefficient of determination by the best regression equation is only $R^2 = 0.1652$, that is 16.5% coherence (Fig. 3). But with a slight (2-3 years (points)) smoothing of the regression model on the same equation, it turns out quite a significant dependence of these indicators, the coefficient of determination of the same regression equation will be $R^2 = 0.8997$, i.e., almost a correlated relationship of indicators, which is considered quite strong at about 90%.

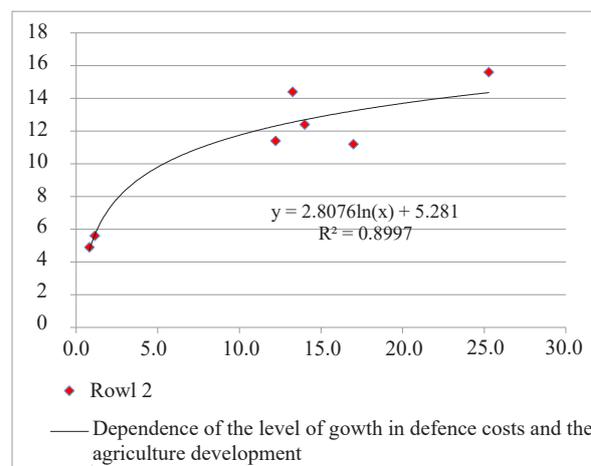
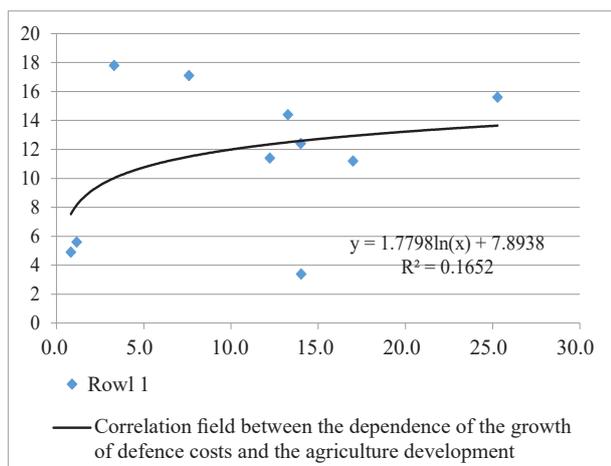


Figure 3. Correlation fields and regression relationships between indicators of growth of defence expenditures and growth (rate) of development of agriculture of Ukraine in the period 2010-2020

This indicates that when formulating development programmes for both the armed forces of Ukraine and

the agricultural sector in the medium and long term, it is necessary to take into account the impact of these

factors when forecasting the expected end results of their implementation. Figure 4 shows the dynamics of Ukraine's GDP by share of its main components to compare existing indicators of their development during the period of armed conflict and indicators before it (as of

2010). The structural degradation of Ukraine's economy conditioned by the existing armed conflict is primarily characterised by a decline in the share of manufacturing, professional and scientific-technical areas, but surprises by the growing share of agriculture in the country's GDP.

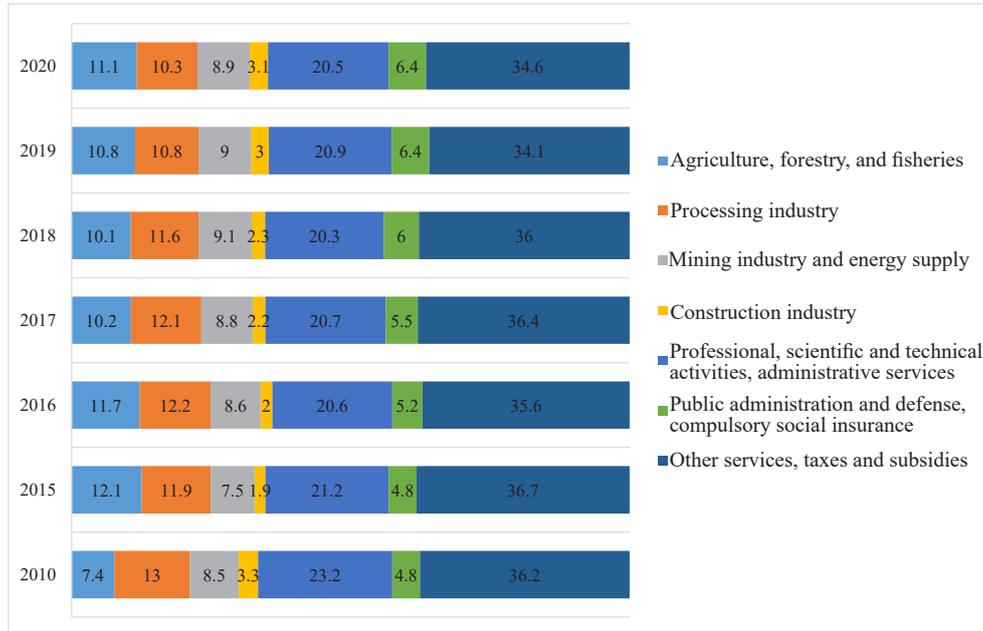


Figure 4. Dynamics of Ukraine's GDP distribution by shares of its main components for the period 2015-2020 and as of 2010

THE IMPACT OF ARMED CONFLICT ON PRICES FOR AGRICULTURAL PRODUCTS

One of the results of the impact of the military conflict is that in 2014-2020 there was a significant correlation between the growth rates of the studied indicators. The results of changes in the dynamics of average prices

of agricultural products sold by enterprises and the volume of military expenditures are shown in Figure 5. Their relationship (2015) after the start of the anti-terrorist operation (ATO) in eastern Ukraine, then, during 2016-2020, is quite clear correlation trend.

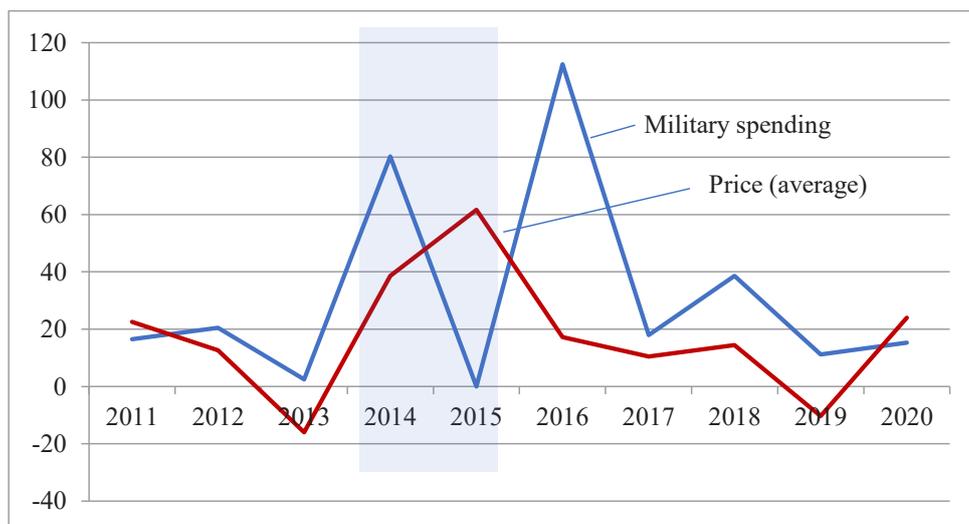


Figure 5. Dynamics of changes in defence spending and average prices of agricultural products sold by enterprises (compared to the previous year)

The method of statistical equations of dependences was used to highlight the consequences of the armed conflict on the state of some agricultural sectors, namely to determine the possible relationship between changes in prices for agricultural products sold by enterprises, volumes of cereals and legumes, their yields, and financial spending for defence needs [27]. Which has gained wide international recognition because of a significant advantage – it solves the inverse economic and statistical problem and is used along with mathematical methods of correlation and regression analysis to study the relationships in large and small sets, including correlation or functional dependence.

The main equations of the method are linear, parabolic, hyperbolic, and logical functions, among which the researcher chooses the best to study according to the available parameters and criteria. The basis of the method of statistical equations of dependences is the calculation of comparison coefficients. Properly selected

statistical methods provides an objective quantitative assessment of the relationship between economic phenomena. The principle of choosing the right methods and ways to assess the impact of factors on the results of socio-economic development requires significant efforts to prepare conclusions and proposals, to clarify how broad they are and the goals to achieve them. Here it is necessary to avoid choosing the wrong purpose of the applied use of the obtained calculations, because obtaining, according to all criteria, an accurate answer to the wrong function will be less useful than an incomplete answer due to the correct choice of regression or dependence equation. Therefore, more and more scientists from all over the world are dealing with the problem of choosing the best method for such a study of statistical analysis of the relationship between social and technical phenomena and processes. The results of using the method of statistical equations of dependences are shown in Tables 3 and 4.

Table 3. The results of determining the possible relationship between changes in financial expenditures for defence needs and possible factors of influence

Factors	Parameters of one-factor dependence equations	Connection stability coefficient	Connection characteristic
Gross harvest of cereals and legumes (including corn)	$Y_{x1} = 121,681.2(1 - 2.70899 * d_{1-x/xmin})$	0.672	Direct connection (reduction of factor and result characteristic)
Harvested and threshed area of cereals and legumes (including corn)	$Y_{x2} = 121,681.2(1 - 8.33462 * d_{1-x/xmin})$	0.447	Direct connection (reduction of factor and result characteristic)
Average prices of agricultural products sold by enterprises	$Y_{x3} = 121,681.2(1 - 1.36852 * d_{1-x/xmin})$	0.815	Direct connection (reduction of factor and result characteristic)
Yields of cereals and legumes (including corn)	$Y_{x4} = 121,681.2(1 - 3.31359 * d_{1-x/xmin})$	0.601	Direct connection (reduction of factor and result characteristic)

Table 4. The results of determining the possible relationship between changes in average prices of agricultural products sold by enterprises and possible factors of influence

Factors	Parameters of one-factor dependence equations	Connection stability coefficient	Connection characteristic
Gross harvest of cereals and legumes (including corn)	$Y_{x1} = 4,794.1(1 - 1.97949 * d_{1-x/xmin})$	0.672	Direct connection (reduction of factor and result characteristic)
Harvested and threshed area of cereals and legumes (including corn)	$Y_{x2} = 4,794.1(1 - 6.09023 * d_{1-x/xmin})$	0.294	Direct connection (reduction of factor and result characteristic)
Yields of cereals and legumes (including corn)	$Y_{x3} = 4,794.1(1 - 2.42129 * d_{1-x/xmin})$	0.833	Direct connection (reduction of factor and result characteristic)

When comparing the dynamics of financial expenditures for defence needs and possible factors of influence, the most stable and direct relationship (reduction of factor and performance) is identified between

“changes in average prices of agricultural products sold by enterprises and changes in military expenditures” – “0.815”. According to the results obtained using the method of statistical equations of the relationship

between changes in average prices of agricultural products sold by enterprises and possible factors of influence, the most stable and direct relationship was observed with cereals and legume yields (Table 4). Thus, the comparison of three possible ways of influence of cereals and legumes on the pricing of agricultural enterprises (gross harvest, area and yield) shows the importance of crop yields.

An important component of the state should be a targeted policy on food production, the most important conditions for the establishment of which should be the development of mathematical models that can adequately assess the real and potential development of the agro-industrial complex as a whole and within

its regions, analysis of dynamics, identification of positive and negative aspects in this area. For the current level of research on the food complex of agriculture and in particular agriculture, a significant approach is one in which the dynamics of milk production [28] is analysed using mathematical methods and models that allow for deeper analysis and obtain the most structured and mathematically sound results at the moment of consideration of the process and its perspective. This approach can also be applied to the agricultural sector. Extrapolation of the dynamics of average prices for agricultural products sold by enterprises in 2022-2024 indicates its future increase by an average of 8% (Fig. 6).

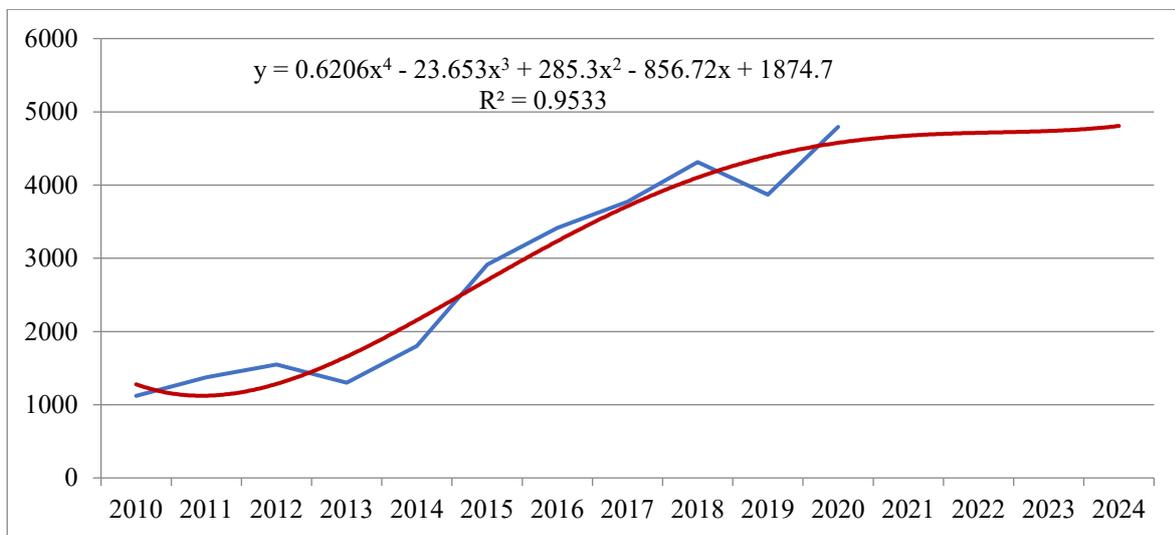


Figure 6. Extrapolation values of average prices of agricultural products sold by enterprises for 2022-2024

Military spending is important for the national security of the country, so its full and timely provision is part of the priority areas of public policy at present. There are conflicting views on the interdependence of military spending and economic development of sectors of the national economy. In general, due to the loss of government control over part of the territory and ongoing hostilities in society, transformation processes have begun, aimed at mobilising resources as quickly as possible to prevent further escalation of the conflict. Ukraine's economy, which was not ready for military aggression, was forced to take the first steps to move to a new state – the wartime economy. The final assessment of the consequences of this is possible only after the end of hostilities, and current calculations only make it possible to predict with some probability the further development of the situation. A thorough examination of the economy's losses from the conflict should be the starting point for its post-war recovery. The results of relevant analyses can be used in the development of approaches, methods, techniques for "increasing crop yields to reduce average prices for products", or – "initiating military and economic development of the country by increasing crop yields", etc.

CONCLUSIONS

The example of Ukraine shows that with the increase in military spending there is a decline in GDP per capita, slow economic development, significant changes in the development of some industries in the national economy, etc. But this dependence is largely conditioned upon the military conflict, so the conclusions cannot be unequivocal. For example, Ukraine's agricultural sector suffered some upheavals at the beginning of the 2015-2016 armed conflict, but as of today it has practically adapted to operating in such conditions, as evidenced by growth rates in most key positions. There are losses of agricultural land, significant losses of the rice sector and several other positions, but innovative changes have had a positive impact on the development of the industry as a whole, even in the face of another state and partial loss of eastern export markets (Russia, Belarus). New areas of export of products have been formed, which are more demanding to quality but more profitable.

When comparing the dynamics of financial expenditures on defence needs and possible factors of influence, the most stable and direct relationship "change in average prices of agricultural products sold by enterprises and changes in military expenditures", the factor

that has the greatest impact on pricing was “crop yield”. Proper public administration of the agricultural sector in an agricultural country such as Ukraine is part of increasing the country’s GDP, which in turn can be used to increase funding for defence needs. This aspect can serve as a basis for further research in this area, namely the impact of armed conflict on the state of all agricultural sectors, taking into account the relationship between

changes in prices for agricultural products and financial expenditures for defence needs. The basis of further research in the direction defined in the paper is the establishment of a general mathematical model for forecasting the results of development programmes of the defence industry of Ukraine, taking into account trends in the agro-industrial complex of Ukraine in the medium and long term.

REFERENCES

- [1] Rahman, T., & Siddiqui, D.A. (2019). *The effect of military spending on economic growth in the presence of arms trade: A global analysis*. doi: 10.2139/ssrn.3401331.
- [2] Dou Eftychia, N. (2016). The role of military expenditure and arms imports in the Greek debt crisis. *Economics of Peace and Security Journal*, 11(1), 18-27. doi: 10.15355/epsj.11.1.18.
- [3] Pustoviyt, R.F. (2016). Military expenditures and their impact on the national economy. *Finance of Ukraine*, 11, 79-93.
- [4] Anisimov, V.V. (2015). Commercial banks in the annexation of Crimea by the Russian Federation. *Financial Space*, 4, 19-26.
- [5] Karpinsky, B.A., Grigorenko, V.O., & Karpinskaya, O.B. (2014). Financial and resource losses of Ukraine from the actions of the annexer state (part I). *Scientific Bulletin of National Forestry University of Ukraine*, 24.5, 199-208.
- [6] Korniychuk, O.P. (2016). Procedure for calculating the losses of socio-economic potential of Ukraine caused by the occupation of Donbass and the annexation of Crimea. *Economics and Law. Series: Economics*, 2, 118-123.
- [7] Kornienko, K. (2015). Prospects port industry of Ukraine in conditions of annexation of Crimea. *Global and National Economic Problems*, 8, 181-183.
- [8] Assessment of peace restoration and development. Analysis of the impact of the crisis and needs in eastern Ukraine. Part II: Reports by components. (2018). Retrieved from https://www.ua.undp.org/content/ukraine/uk/home/library/poverty/Recovery_and_Peacebuilding_Assessment_ukr_vol2.html.
- [9] Garkavy, S.F. (2014). The escalation of the conflict in eastern Ukraine: Socio-economic consequences. *Financial Space*, 4, 40-46.
- [10] Libanova, E.M., Gorbulin, V.P., & Pirozhkov, S.I. (2015). *The policy of integration of Ukrainian society in the context of challenges and threats of events in Donbass (national report)*. Kyiv: National Academy of Sciences of Ukraine.
- [11] Sobkevich, O.V., Mikhailychenko, K.M., Shevchenko, A.V., Rusan, V.M., & Belashov, E.V. (2015). *Assessment of losses and mechanisms for rebuilding the real sector of the economy of eastern Ukraine*. Retrieved from http://www.niss.gov.ua/public/File/2015_analit/realniy_sector.pdf.
- [12] Snigova, O.Yu., & Zagorelska, T.Yu. (2015). Financial risks and threats in the context of the armed conflict in eastern Ukraine. *Global and National Economic Problems*, 5, 246-250.
- [13] Libanova, E.M. (Ed.). (2015). *Revival of Donbass: Assessment of socio-economic losses and priority areas of public policy*. Retrieved from http://nbuviap.gov.ua/index.php?option=com_content&view=article&id=2794:vidrodzhennya-donbasu-otsinka-sotsialno-ekonomichnikh-vtrat-i-prioritetni-napryami-derzhavnoji-politiki&catid=4&Itemid.
- [14] Yermolayev, A., Klimenko, I., Taran, S., & Yemets, V. (2015). *Economy of the occupied Donbass*. Kyiv: New Ukraine Institute for Strategic Studies.
- [15] Artus, M.M. (2011). *State policy and financial mechanism of pricing of agricultural products*. (Doctoral dissertation, Institute of Agrarian Economics, Kyiv, Ukraine).
- [16] Kyrylyuk, Ye.M. (2013). *Agrarian market in the conditions of transformation of economic systems*. Kyiv: Kyiv National University of Economics.
- [17] Shpychak, O.M. (2012). Theoretical and methodological aspects of pricing of agricultural products. *Economics of Agro-Industrial Complex*, 8, 3-10.
- [18] Shkvyya, N.O. (2014). Features of pricing in the market of agricultural products. *Collection of Scientific Works of the Tavriya State Agrotechnological University (Economic Sciences)*, 1(25), 272-275.
- [19] Parkhomets, M.K., & Gudak, V.V. (2014). *Organizational and economic mechanism for ensuring the profitability of agricultural enterprises: Theory, methodology, practice*. Ternopil: Ternopil National University of Economics.
- [20] Strapchuk, S.I., & Mykolenko, O.P. (2021). Factors of sustainable intensification in agriculture of Ukraine: Evidence from the enterprises of the Kharkivska oblast. *Scientific Bulletin of Mukachevo State University. Series "Economics"*, 8(3), 9-17
- [21] "On improving the efficiency of the agro-industrial complex of Ukraine in conditions of macroeconomic instability and European integration". Analytical note. (2016). Retrieved from <https://niss.gov.ua/doslidzhennya/ekonomika/schodo-pidvischennya-efektivnosti-funkcionuvannya-apk-ukraini-v-umovakh>.

- [22] Information and analytical portal of the agro-industrial complex of Ukraine. (2021). Retrieved from <https://agro.me.gov.ua/ua>.
- [23] This Commission department is responsible for EU policy on agriculture and rural development and deals with all aspects of the common agricultural policy (CAP). (2021). Retrieved from http://ec.europa.eu/dgs/agriculture/index_en.htm.
- [24] "Socio-economic development of the annexed Crimea and the city of Sevastopol and assessment of the losses of the Ukrainian economy from the annexation of Crimea". Analytical note. (2016). Retrieved from https://niss.gov.ua/sites/default/files/2015-12/Vtrata_Krimu-3a502.pdf.
- [25] The share of agriculture in Ukraine's GDP. (2015). Retrieved from <https://economics.segodnya.ua/ua/economics/enews/nas-zhdet-otkat-k-pokazatelyam-2015-goda-1463897.html>.
- [26] Budget planning and execution of the Ministry of Defence. (2013). Retrieved from <https://www.mil.gov.ua/diyalnist/byudzhet-ta-vikonannya-czilovix-program/>.
- [27] Kulinich, O.I. (2019). Method of statistical equations of dependences: Functionality and application criteria. In *Statistical methods and information technologies of the analysis of social and economic development: Collection of texts of reports on materials of the XIX International scientific and practical conference* (pp. 8-23). Khmelnytskyi: Leonid Yuzkov Khmelnytsky University of Management and Law.
- [28] Radko, V., & Svyynous, I. (2015). Methodological approaches to determine the effectiveness of the intensification of dairy farming. *Investments: Practice and Experience*, 23, 53-57.

Оцінювання впливу збройного конфлікту на території України на розвиток сільськогосподарської галузі та ціноутворення її продукції

Олег Михайлович Семененко^{1,2}, Анатолій Іванович Міночкін³, Сергій Петрович Василенко², Валерій Федорович Клепиков², Олександр Миколайович Правдивець⁴

¹Національний авіаційний університет
03058, просп. Любомира Гузара, 1, м. Київ, Україна

²Центральний науково-дослідний інститут Збройних Сил України
03049, просп. Повітрофлотський, 28б, м. Київ, Україна

³Військовий інститут телекомунікацій та інформатизації імені Героїв Крут
01011, вул. Московська, 45/1, м. Київ, Україна

⁴Міністерство оборони України
03168, просп. Повітрофлотський, 6, м. Київ, Україна

Анотація. У статті проведено аналіз впливу збройного конфлікту на території України на розвиток сільськогосподарської галузі та зміну середніх цін продукції, реалізованої підприємствами сільського господарства, а також визначено можливий взаємозв'язок між зміною ціни на продукцію сільського господарства, реалізовану підприємствами, та фінансових витрат на оборонні потреби. У статті також розглянуто можливий зв'язок між зміною обсягів воєнних витрат, валового збору зернових і зернобобових культур, зібраної та обмолоченої площі, рівнями їх урожайності. Авторами взято до уваги, що наявність і тривалість збройного конфлікту на території країни впливає на: макроекономічні показники, інтенсивність бойових дій і їхню локалізацію в районах економічної активності, ВВП, видатки уряду, експортно-імпортні показники; видатки домогосподарств та внутрішні інвестиції, на споживчі видатки та видатки домогосподарств. Усе це, опосередковано, має вплив на коливання середніх цін продукції різних секторів сільського господарства, реалізованої підприємствами. Під час проведення досліджень авторами врахована важливість аграрного сектору України, що є вагомою частиною ВВП держави. Залежність воєнних витрат від величини ВВП слугує причиною до аналізу взаємозв'язків між впливом наявного збройного конфлікту на зміну стану сільського господарства України. Одним із результатів таких дій також стало витрачання більшої грошової маси на закупку продукції сільськогосподарського спрямування для підтримання оборонних потреб держави тощо. Тому для розуміння величини впливу факторів валового збору, урожайності та обсягів сільськогосподарських угідь на ціноутворення продукції сільського господарства за допомогою методу статистичних рівнянь залежностей авторами отримані результати відповідного аналізу, що можна використовувати як базу для розроблення підходів, методів і методик щодо підвищення рівня врожайності сільськогосподарських культур, або – ініціювання економічного розвитку країни за рахунок підвищення урожайності сільськогосподарських культур

Ключові слова: фінансові витрати, макроекономічні показники, валовий внутрішній продукт, внутрішні інвестиції, аграрний сектор