The Impact of Globalization on Wheat Purchase Prices in Ukraine in 2005-2021

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Abstract

The main objective of the article is to assess the impact of globalization on wheat purchase prices in Ukraine. The following hypothesis was verified: the decisive factors shaping wheat purchase prices in Ukraine are the prices of this agricultural commodity in other countries. The research period covers the years 2005-2021. The variables were divided into two groups: (1) variables related to globalization (2) variables resulting from internal market functioning. At the first stage, Pearson's linear correlation was tested between wheat purchase prices in Ukraine and the assumed variables. Then, a multiple regression model was created to indicate which variables best explain the evolution of wheat purchase prices in Ukraine. The conducted research indicates that factors related to globalization are closely related to wheat purchase prices in Ukraine. Wheat purchase prices in Ukraine are best explained by the value of GDP per capita in Ukraine and the volume of wheat exports from Ukraine to third countries.

Keywords: price transmission, armed conflict, agriculture, foreign trade, GDP per capita

JEL classification: C50, E31, Q11

1. Introduction

Economic determinants affecting agriculture include purchase prices of agricultural raw materials. The level of prices determines the level of profitability of agricultural production, possibilities of accumulation, the standard of living of producers and consumers, as well as the possibilities and volume of foreign trade. In the essence of prices, their volatility is inscribed, which determines in what direction and over what period prices change (FAO 2010).

One of the most significant problems in modern economics is the rapidity of price changes and their unpredictability due to increasing uncertainty and the impossibility of forecasting them. Price instability of agricultural commodities is a phenomenon also observable in the modern economy, particularly as a result of Russia's war with Ukraine. The military action has led to problems related to foreign food trade, declining food availability, disrupted supply chains, or rising international prices for agri-food staples (Jagtap et al. 2022; Mbah and Wasum 2022; Ozili 2022; Abay et al. 2023; Arndt et al. 2023). Moreover, in a globalized world, it is not possible to narrow down armed conflict to one region. The consequences of the Russia-Ukraine war will also persist in other countries,

particularly those for which supplies from Russia and Ukraine were an important part of foreign trade (Frankowski 2023).

The described research context led the author to take up the topic of the impact of globalization on the formation of wheat purchase prices in Ukraine. The choice of the topic is not accidental. Firstly, price volatility depends on a number of factors of an economic nature. However, due to market linkages between countries, it is difficult to unambiguously identify the factors that shape these prices. Moreover, contemporary literature often refers only to determinants affecting the economies of developed countries, for a certain time slice, and these are usually theoretical considerations. In addition, for countries directly and indirectly affected by armed conflict, understanding the mechanism of agricultural commodity purchase prices is extremely important. This is because this mechanism illustrates which factors are most important in determining the level of agricultural commodity purchase prices. This is all the more important as Ukraine is one of the largest producers and exporters of wheat in the world (Zolotnytska and Kowalczyk 2022). Therefore, the main objective of the article was to assess the impact of globalization on the purchase prices of wheat in Ukraine. Accordingly, it was decided to verify the following hypothesis:

H1: the decisive factors shaping the purchase prices of wheat in Ukraine are the prices of this agricultural commodity in other countries.

The article is structured in several integral parts. In the first part, a literature search on the research of the impact of globalization on the formation of agricultural commodity purchase prices and the determinants influencing their level is made. The next section presents the research methodology, both the research methods and the variables considered. Next, the research results and discussion are presented. The last part of the article illustrates the final conclusions.

2. Literature review

Globalization is considered to be the close cooperation of countries and people in the world, which is the result of cost reduction, transport and telecommunications, as well as the abolition of artificial barriers to the flows of goods, services, capital, knowledge and people (McGrew 1992; Stiglitz 2004; Sobiecki 2007). This highlights the emphasis on causality and the consequences carried by the globalization process. In the contemporary economy, increasing accents of the globalization processes are noticeable, also in agriculture. In relation to this sector of the economy, globalization is understood as the integration of production and processing in agriculture and the food industry in an international setting, through markets, standardization, regulation and technology (von Braun and Mengistu 2007).

The specific elements that will determine the effects of globalization in the case of agriculture will be the intensification of price competition for agricultural raw materials and related foreign trade, as well as the development of processes causing an increase in the bargaining power of entities processing agricultural raw materials. The ongoing processes of globalization simultaneously result in the occurrence of various factors influencing the price formation of agricultural raw materials (Hajdukiewicz 2013;

Borychowski and Czyżewski 2015; Hamulczuk and Stanko 2016; Billio et al. 2017, Zaród 2017; Wang et al. 2022).

The various factors determining the formation of agricultural commodity prices make it possible to divide them into internal factors, i.e. shaped by the state under study, and external factors - shaped by non-state factors (Figure 1).
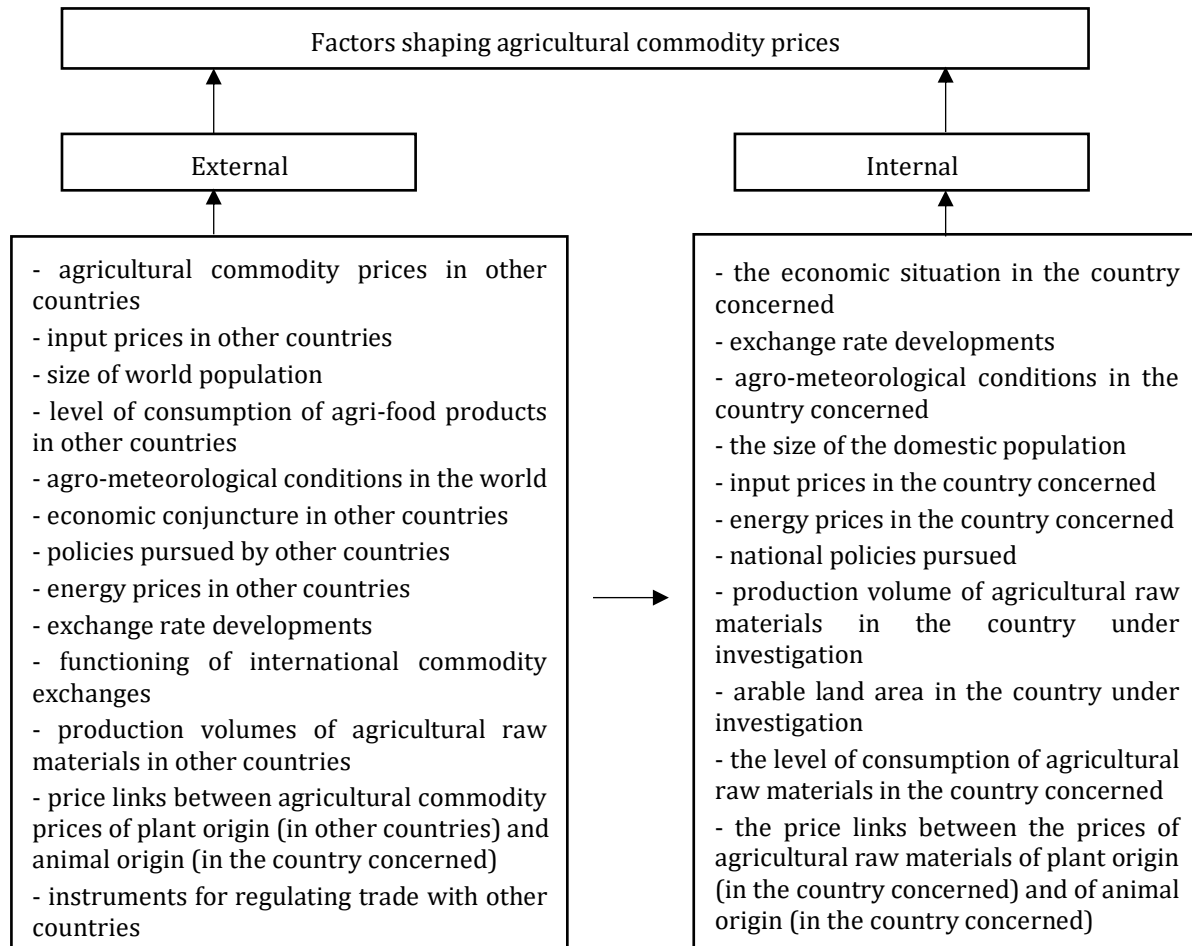

Figure 1. External and internal drivers of agricultural commodity prices
Source: own study based on Kubala (2022).

The basic factors shaping agricultural commodity prices include the demand and supply of these raw materials (Abbott et al. 2008; Byrne et al. 2011, Grzelak and Stępień 2011). The link between the volume of plant and animal production is important in this aspect. This is primarily due to the specific nature of livestock production, which makes extensive use of plant raw materials in the form of feed. This has an impact on the transmission of the prices of agricultural raw materials of plant origin to the prices of agricultural raw materials of animal origin. In recent years, an extremely important factor shaping the prices of agricultural raw materials is the growing demand for food (FAO 2011; Mpofu 2017). It is mainly manifested by changes in dietary patterns and a growing world population. Globalization processes are causing developing countries to change their consumption patterns of agri-food goods, targeting the eating habits of developed countries.

Among the factors affecting the supply of agricultural raw materials, researchers often include anomalies and extreme weather events (Tracy 1997; Tłuczak 2011). National air temperature, precipitation and sunshine levels can lead to the occurrence of economic losses in domestic production (Bański and Błazejczyk 2005). At the same time, the climatic conditions of other regions are important in the amount of harvested crops worldwide, which consequently affects the volume of foreign trade in these goods.

One of the most important issues related to globalization in the agricultural sector is the transmission of signals between markets. The spread of individual phenomena extends to the wider world, as was evident, for example, in the case of the financial and economic crisis (Brinkman et al. 2010). The development of a country is thus dependent on phenomena in other markets. Signal transmission also refers to technology flows as well as climatic effects, which can consequently shape agricultural commodity prices in particular regions (Szczepaniak 2018).

An important element of the globalization process is the foreign trade relations taking place (Kovárník and Hamplová 2020). A complex issue is the source of food, i.e. whether it is to be sourced domestically or imported. Internationally traded products are more likely to be fit to keep for a long period of time and standardized goods such as cereals or animal products. At the same time, trade restrictions within the framework of trade policy are of great importance in shaping agricultural commodity prices (Drabik and de Gorte 2012). The fluctuations in the markets that occur in this way may consequently lead to changes in their prices, for example by reducing supply as a result of export-restricting instruments. This situation has occurred in recent years, for example on the cereal market in Russia or Kazakhstan (Daszkowska 2008). Closely related to foreign trade-related factors are exchange rate fluctuations (Kretschmer et al. 2012). In the case of depreciation, agri-food goods are relatively cheaper in other currencies, which may consequently lead to an increase in agricultural commodity prices. However, some authors consider this factor to be insignificant (Gilbert 2010).

A frequently cited factor among researchers influencing the level of agricultural commodity prices is the economic situation, both at the national and global level (Hajdukiewicz 2013; Zaród 2017) and the prices of energy carriers (Trostle 2008; Baffes and Dennis 2013; Obadi and Korcek 2014). The second group of factors primarily includes oil prices and, to a lesser extent, natural gas prices. The impact of these sources on agricultural commodity prices is determined by the amount of energy consumption during farm production. Consequently, an increase in the prices of energy sources is associated with an increase in production costs, due to the increase in the price of fertilizers used in production or the price of fuel, among other factors. Closely related to the subject of oil prices are political factors. A significant part of oil reserves are located in the Middle East, i.e. in areas where there are numerous military activities.

At the same time, it is worth noting the often ascribed high importance of commodity exchanges (Olszańska 2015). In the case of European countries, one of the most important agricultural commodity exchanges with international reach is the Marché à Terme International de France (MATIF) (Jerzak 2013; King 2014; Ahmed 2021). The most popular purchasable contracts on this exchange include selected cereal species, in particular wheat.

3. Methodology

The research period covers the years 2005-2021. The final year of the analysis marks the last year for which it is possible to obtain a set of annual frequency statistics. In the first stage of the conducted research, an analysis was made of the literature defining the factors that influence the purchase prices of agricultural raw materials. They were divided into two groups as proposed by Kubala (2022): (1) variables relating to globalization (2) variables resulting from the internal functioning of the market. The variables considered are included in Table 1.

Table 1. Variables considered to explain the evolution of wheat purchase prices in Ukraine

Explanation variable	Variable name
purchase price of wheat in Ukraine	cen_psz_UK
Explanatory variables relating to globalisation	Variable name
average opening prices for brent crude oil (in USD per barrel)	cen_rop_SW
US farm gate price for wheat (USD/tonne)	cen_psz_US
purchase price of wheat in Poland (USD/tonne)	cen_psz_PL
wheat procurement price in Germany (USD/tonne)	cen_psz_NI
wheat procurement price in Russia (USD/tonne)	cen_psz_RU
GDP per capita in the USA (in USD/person)	PKB_US
GDP per capita in China (in USD/person)	PKB_CH
GDP per capita in Russia (in USD/person)	PKB_RU
average prices of traded wheat futures on MATIF (in USD/tonne)	cen_psz_MA
global wheat production volume (in tonnes)	pro_psz_SW
volume of wheat imports into Ukraine from third countries (in tonnes)	imp_psz_UKKT
volume of wheat exports from Ukraine to third countries (in tonnes)	eks_psz_UKKT
volume of wheat imports into Ukraine from EU countries (in tonnes)	imp_psz_UKUE
volume of wheat exports from Ukraine to EU countries (in tonnes)	eks_psz_UKUE
Explanatory variables arising from the internal functioning of the state	Variable name
GDP per capita in Ukraine (in USD/person)	PKB_UK
volume of wheat production in Ukraine (in tonnes)	pro_psz_UK
wheat harvested area in Ukraine (in ha)	pow_psz_UK
population of Ukraine (in persons)	lud_UK

Source: own study.

In order to maintain the uniformity of the methodology, the values of the variables characterizing each research area were obtained exclusively from a single database. Accordingly, data relating to agriculture were obtained from FAOSTAT, data relating to foreign trade from the ITC database, data relating to GDP per capita and population from the World Bank database, and data relating to average prices for futures trading of consumer wheat on the MATIF exchange and average opening prices for brent crude oil from the investing.com website.

The next step of the analysis undertaken was to test Pearson's linear correlation between wheat purchase prices in Ukraine and the variables adopted. This was intended to show the strength of the association between the variables. Due to doubts arising as to whether the relationship of the studied characteristics is at least approximately linear, the natural

logarithms of the individual variables were tested. In addition, monetary data was reduced to constant 2005 prices in order to eliminate the impact of inflation and to illustrate in dynamic and structural terms the pure trend occurring in the analyzed phenomenon. In order to allow comparability of the financial variables considered, they were expressed in US dollar (USD) currency. Additionally, due to the possibility of time shifts in the impact of individual variables on the level of wheat purchase prices in Ukraine, explanatory variables lagged by one year (t-1) were included in the analysis.

In the final step, a multiple regression model was created. It aims to indicate which of the analyzed variables best explain the evolution of wheat procurement prices in Ukraine. The use of this method is dictated by the nature of the analyzed variables, the possibility of achieving similar results as in the case of more complex models (Billio et al. 2017) and the research problem posed, which is to indicate why the purchase price is at this level and not what the price will be in the future.

The model was constructed using annual data. An important advantage of analyzing annual data is the high possibility of using multiple variables, as some variables relevant to the calculations do not occur at quarterly or monthly frequencies, which would lead to unreliable final conclusions.

The Hellwig integral capacity method was used to select the explanatory variables in the model. In building the model, assumptions were made that the explanatory variables had a correlation level of less than 0.5 between them, and that the selected explanatory variables were at least significantly correlated (correlation level greater than or equal to 0.5) with the explanatory variable and statistically significant at the 5% level.

4. Results and discussions

The level of wheat purchase prices in Ukraine from 2005 to 2021 (at 2005 constant prices) is characterized by varying magnitudes (Figure 2). The smallest volume was recorded in 2019 - 28.67 USD/tonne, while the largest volume was recorded in 2007 - 128.24 USD/tonne. The average level of purchase prices for wheat in Ukraine during the period under review was: USD 63.25/tonne, while the median was equal to USD 66.39/tonne.

A significant role in the methodology for testing the interdependence of time series is their stationarity. Therefore, the variables adopted were subjected to stationarity testing through the KPSS test (with a test lag of 1). When analyzing the results of the conducted KPSS test, it should be pointed out that the following variables are characterized by non-stationarity: purchase prices of wheat in Ukraine, purchase prices of wheat in Russia, volume of wheat exports from Ukraine to third countries, volume of wheat production in the world, volume of wheat production in Ukraine, value of GDP per capita in the USA, value of GDP per capita in China, value of GDP per capita in Russia, value of GDP per capita in Ukraine, population in Ukraine (in year t and t-1), volume of wheat imports to Ukraine from European Union countries, average opening prices of brent crude oil (in year t). The remaining variables were found to be stationary (at a significance level of 5%). In situations where the time series was characterized by non-stationarity, first differences were calculated for it. After applying these to the variables that showed non-stationarity

in the time series, the KPSS test performed again indicated their stationarity. From then on, the calculated first differences were used for further analyses.
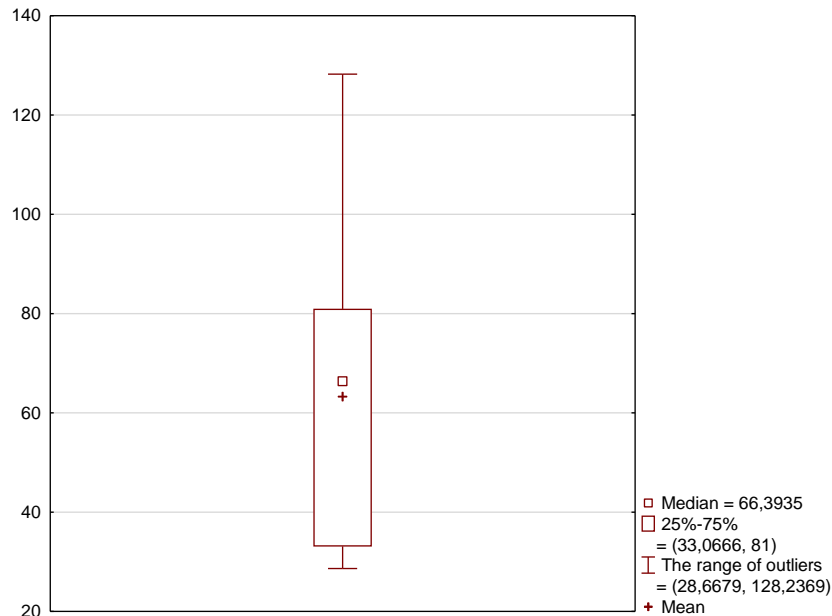

Figure 2. Basic statistics of wheat purchase prices in Ukraine in 2005-2021 (USD/tonne, at 2005 constant prices)
Source: own study based on FAO (2023).

In order to empirically verify the factors that shape wheat purchase prices in Ukraine, a Pearson's linear correlation analysis was performed between the volume of wheat purchase prices in Ukraine and the assumed variables. The study conducted focuses on obtaining answers as to which of the potential variables have a significant relationship with the explanatory variable. The results obtained are presented in Table 2.

Table 2. Pearson's linear correlation coefficient between wheat purchase prices in Ukraine and the assumed variables

Variable - time t	r	Test statistics	Variable - time t-1	r	Test statistics
cen_psz_PL	0,304	0,255	cen_psz_PLt-1	-0,522	0,046
cen_psz_NI	0,252	0,346	cen_psz_NIt-1	-0,519	0,047
d_cen_psz_RU	0,796	0,000	d_cen_psz_RUt-1	-0,006	0,984
cen_psz_US	0,254	0,343	cen_psz_USt-1	-0,422	0,117
cen_psz_MA	0,304	0,252	cen_psz_MAt-1	-0,486	0,067
d_eks_psz_UKKT	-0,594	0,015	d_eks_psz_UKKTt-1	-0,197	0,482
eks_psz_UKUE	-0,483	0,058	eks_psz_UKUEt-1	-0,036	0,899
imp_psz_UKKT	0,282	0,290	imp_psz_UKKTt-1	0,271	0,328
d_imp_psz_UKUE	0,219	0,415	imp_psz_UKUEt-1	-0,155	0,581
d_pro_psz_SW	-0,421	0,105	d_pro_psz_SWt-1	-0,290	0,294
d_pro_psz_UK	-0,299	0,261	d_pro_psz_UKt-1	-0,507	0,054
d_PKB_US	0,179	0,508	d_PKB_USt-1	-0,112	0,692
d_PKB_CH	0,347	0,187	d_PKB_CHt-1	-0,184	0,512
d_PKB_RU	0,793	0,000	d_PKB_RUt-1	0,054	0,848

d_PKB_UK	0,843	0,000	d_PKB_UKt-1	0,151	0,590
pow_psz_UK	-0,462	0,072	pow_psz_UKt-1	-0,030	0,914
d_lud_UK	-0,355	0,178	d_lud_UKt-1	-0,082	0,771
d_cen_rop_SW	0,620	0,011	cen_rop_SWt-1	-0,425	0,115

Source: own study.

Calculations of the Pearson correlation coefficient show significant variation in the results obtained. Wheat purchase prices in Ukraine are characterized by a high degree of correlation with the value of GDP per capita in Ukraine (r=0.843), wheat purchase prices in Russia (r=0.796) and the value of GDP per capita in Russia (r=0.793). On the other hand, a significant degree of correlation (statistically significant at the 5% level) was observed with the variables: average opening prices of brent crude oil (r=0.620), volume of wheat exports from Ukraine to third countries (r=-0.594) and wheat purchase prices in Poland and Germany in year t-1 (r=-0.522 and r=-0.519, respectively). With the other variables, wheat purchase prices in Ukraine are not statistically significant at the 5% level.

Due to doubts about the possibility of including individual variables when building a model explaining the impact of factors on wheat purchase prices in Ukraine, the selection of variables was verified based on the Hellwig integral capacity method. Seven explanatory variables were taken into account (those characterized by statistical significance of the existing correlation with wheat purchase prices in Ukraine). The method indicated that the variables: the value of GDP per capita in Ukraine (first increments) and the volume of wheat exports from Ukraine to third countries (first increments) should be taken into account when building the model. In addition, a correlation value greater than or equal to 0.5 was checked between the proposed variables. The value of the Pearson's linear correlation coefficient between the value of GDP per capita in Ukraine and the volume of wheat exports from Ukraine to third countries was equal to -0.292 with a p-value of 0.291. There is therefore no statistically significant correlation between these variables.

In the next step, a model was started to explain the impact of factors on wheat purchase prices in Ukraine. For the pre-estimated model, the results of the Doornik-Hansen test for the normality of the distribution of residuals indicate that the empirical distribution has a normal distribution (for an assumed significance level of 5%). The chi-square value was 1.193, with a p-value of 0.5506 (Figure 3).

In order to check for autocorrelation and possible modification of the variables, a Breusch-Godfrey test based on Lagrange multipliers was performed. The lag order for the test was 1. For all test statistics, the p-values are much greater than 5%, so that the null hypothesis that the model contains no autocorrelation should be accepted. Detailed results are included in Table 3.

In order to test for heteroskedasticity, the White test was performed. The absence of heteroskedasticity was taken as the null hypothesis in this test. In the test performed, the p-value was greater than the 0.05 significance level (table 4). Therefore, there are no grounds to reject the null hypothesis. There is no heteroskedasticity in the model.
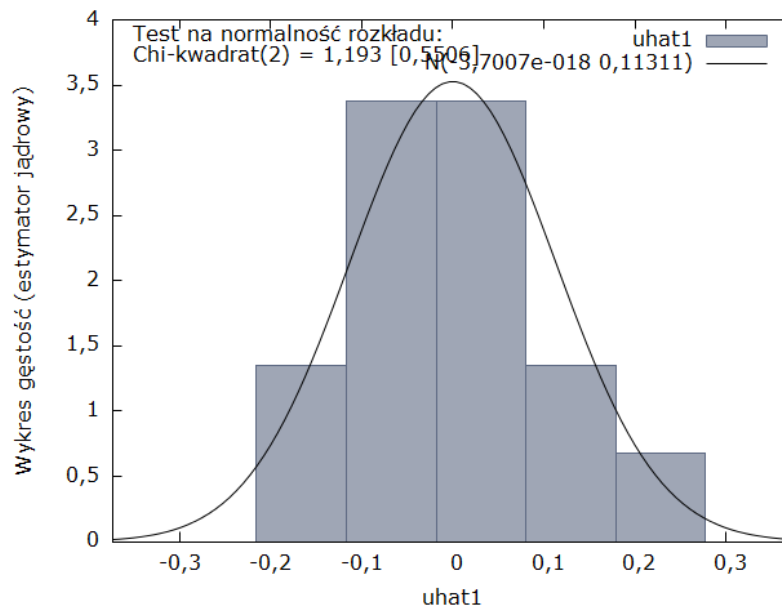
Figure 3. Results of the Doornik-Hansen test for the normality of the distribution of the residuals

Source: own study.

Table 3. The results of Breusch-Godfrey test based on Lagrange multipliers for order one autocorrelation

	Factor	Standard error	t-Student	p-value
Const	0,001	0,027	0,022	0,983
d_eks_psz_UKKT	−0,006	0,038	−0,168	0,870
d_PKB_UK	0,028	0,101	0,272	0,790
uhat_1	−0,517	0,269	−1,922	0,081
Coefficient of determination R-square = 0.251				

Source: own study.

Table 4. The results of White's test for heteroskedasticity of residuals

	Factor	Standard error	t-Student	p-value
Const	0,011	0,005	2,078	0,068
d_eks_psz_UKKT	0,008	0,007	1,077	0,310
d_PKB_UK	0,020	0,050	0,400	0,700
sq_ d_eks_psz_UKKT	-0,000	0,006	-0,089	0,931
X2_X3	0,033	0,045	0,724	0,488
sq_ d_PKB_UK	0,023	0,070	0,330	0,749

Coefficient of determination R-square = 0.330

Test statistic: $TR^2 = 4.943$

with p-value = P(Chi-square(5) > 4.944) = 0.423

Source: own study.

In order to test for collinearity between the variables, the VIF test was applied. The test shows that there is no collinearity in the model (the VIF value for both variables is equal

to 1.093, with the minimum possible value equal to 1.0). In the next step, the Ramsey RESET test was performed. The null hypothesis of this test was that the model in question is linear. The adopted version of the RESET test (square and cube of the variable) confirmed the functional validity of the model (Test statistic: F = 0.412, with p-value=0.673). Therefore, the model was accepted as final. At the same time, it should be noted that there is a coincidence phenomenon in the model.

The final model indicates that the relatively largest positive influence on wheat purchase prices in Ukraine has the value of GDP per capita in Ukraine. In contrast, the volume of wheat exports from Ukraine to third countries has a negative impact on the explanatory variable. The estimated model has a very good fit, with an R2 value of 83.8%. This means that the model explains as much as nearly 84% of the variation in the phenomenon. The most important estimation results of the model explaining the influence of factors on the explained variable are included in Table 5.

Table 5. Results of the estimated function of the model explaining the effect of factors on wheat purchase prices in Ukraine

	factor	Standard error	t-Student	p-value
const	-0,001	0,030	-0,047	0,964
d_eks_psz_UKKT	-0,136	0,042	-3,217	0,007
d_PKB_UK	0,659	0,111	5,951	0,000
Arithmetic mean of dependent variable	-0,061	Standard deviation of dependent variable		0,261
Determination coefficient R-square	0,838	Adjusted R-square		0,811
		The p-value for the F-test		0,000

Source: own study.

The studies conducted indicate that the export of this agricultural commodity is of great importance in shaping the purchase price of wheat in Ukraine. This is confirmed by the studies of Mottaleb et al. (2020), or Nezhyva and Mysiuk (2022). Annually - with the exception of 2005, 2008 and 2011 - more than 80% of the total volume of exports of this raw material goes from Ukraine to third countries, mainly to Egypt, Indonesia, Turkey, Pakistan and Bangladesh (ITC, 2023). At the same time, the important role of the economic climate in price formation is emphasized by Parlińska and Wielechowski (2009), or Elleby et al. (2020).

The occurrence of significant and strong interdependencies between particular factors and purchase prices of wheat in Ukraine is also reflected in the studies of other authors. The occurrence of strong correlations of wheat purchase prices between individual countries is indicated, among others, by Rembeza (2010) noting that price transmission occurs between the Polish market and markets in Germany, France and the USA, or by Hamulczuk (2015) and Kubala (2022) depicting strong price linkage of wheat between the Polish and German markets. Lohano et al. (2005), in turn, point out that the ongoing integration of agricultural commodity markets is extremely important in the development of individual countries. This is because information on the degree of market integration with other countries can be used by state authorities to develop strategies for the development of individual agricultural markets.

Among the globalization processes, a particularly high level of linkage to the Russian market can be observed in the Ukrainian wheat market, as confirmed by the work of Gruchelczyk and Niemczyk (2007). One of the main determinants of the linkage of these countries is the proximity of markets, which minimized the level of transport costs, as well as the delivery time of agricultural raw materials. At the same time, the significant influence of oil-related variables in the formation of agricultural commodity purchase prices is confirmed by Zhang et al. (2010), or Nazlioglu and Soyats (2012).

4. Conclusion

The research conducted indicates that globalization factors are closely linked to wheat purchase prices in Ukraine. In particular, a relatively strong correlation is observed with wheat purchase prices in other countries (Russia, Poland and Germany), the value of GDP per capita in Russia, average opening prices of brent crude oil and the volume of wheat exports from Ukraine to third countries. However, the highest level of correlation with wheat purchase prices in Ukraine is with the value of GDP per capita in that country.

On the basis of the created multiple regression model, the adopted research hypothesis indicating that the decisive factors shaping the purchase prices of wheat in Ukraine are the prices of this agricultural commodity in other countries was rejected. It turns out that the purchase prices of wheat in Ukraine are best explained by the value of GDP per capita in Ukraine and the volume of wheat exports from Ukraine to third countries.

The research conducted, and the conclusions formulated on its basis, can provide valuable information for farmers and global investors. The observed strong linkage of the Ukrainian wheat market with foreign markets makes it extremely important to understand the mechanisms of the formation of purchase prices of this agricultural commodity on these markets, as well as to constantly observe those variables that significantly affect their level. This is especially important due to the fact that nowadays it is difficult to assess future processes occurring in the economy. In particular, because of the strong link between the Russian and Ukrainian markets, as well as the significant role played by Ukrainian wheat exports to third countries.

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