ECONOMIC EFFICIENCY OF WHEAT PRODUCTION IN AGRICULTURE AND ITS IMPACT ON MACROECONOMIC INDICATORS

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Abstract. *The article discusses the economic importance of wheat production in agriculture and its role in the national economy. The relationship between wheat production indicators and inflation rate has been analyzed, as well as their impact on economic processes. Modern econometric methods were used to assess the economic efficiency of wheat production, and the obtained results are scientifically grounded. The results of the study are of significant importance for the development of agriculture, inflation control, and ensuring economic stability.*

Keywords: *wheat production, economic efficiency, inflation, agriculture, macroeconomic indicators, export volume, econometric analysis, ARDL model.*

Introduction. Wheat production in agriculture is not only a strategic direction ensuring food security but also a vital sector that directly impacts the macroeconomic stability of the country. Changes in wheat production volume reflect in national economic indicators through inflation, export revenues, domestic market supply, and the efficiency of agricultural resource use. In this regard, assessing the impact of various factors such as cereal crops, leguminous crops, wheat volume, and external trade on inflation using an econometric approach defines the scientific and practical importance of this study. This article analyzes the economic efficiency of wheat production and its impact on macroeconomic indicators, particularly the inflation rate, based on log-transformed indicators from the data of 2010–2024.

Literature Review. Local and foreign scholars have primarily studied the economic efficiency of wheat production in relation to resource usage, yield, and production costs. In particular, the research by Aziz A. Karimov and B. Sherzod highlights the issues of technical efficiency and rational resource use in wheat production. In local literature, B.B. Mirzaev emphasizes the need to reduce production costs and increase economic efficiency in wheat production. In foreign studies, K.H. Bezu and P.A. Dorosh have substantiated the economic significance of wheat production efficiency and the stability of food prices. Thus, this research, which evaluates the impact of wheat production on inflation using an econometric approach, complements existing scientific developments.

Methodology. The research employed econometric modeling methods to identify the factors influencing the inflation rate. The inflation coefficient was chosen as the dependent variable, and the sizes of grain crops, leguminous crops, external trade exports, and wheat production volume were selected as independent variables. In the modeling process, all indicators were log-transformed to determine the elasticity between variables and reduce statistical errors. Initially, a multiple linear regression model was constructed, and the short-term impact of factors was assessed using R-squared, F-statistics, and p-values. In the next phase, the ARDL model was used to identify the

dynamic relationship between variables, considering lagged values. The calculation results revealed the degree of impact of the factors on inflation, and the reliability of the model was statistically evaluated.

Analysis and Results. In this section of the study, initial statistical data for the inflation coefficient, grain crop volumes, leguminous crop volumes, export volumes, and wheat production volumes from 2010 to 2024 are presented. Based on this table, the dynamics and changing trends of the variables over the years were considered. Subsequently, to improve the accuracy of the econometric analysis and assess the relative relationship and elasticity between the variables, all indicators were converted to natural logarithms and expressed as lny, lnx1, lnx2, lnx3, and lnx4. Afterward, correlation pair analysis, multiple linear regression, and the ARDL model were applied using the log-transformed indicators to statistically evaluate the factors' impact on inflation. The obtained results scientifically interpreted the interrelation between the efficiency of wheat production in agriculture and macroeconomic indicators.

Table: List of Variables

Yil	Inflyatsiyakoeffitsentda	Barcha_toifalardagi_donli_ekinla	Barcha_toifalardagi_dukkakli_do	Tashqi_savdoda_eksport_hajmidol	Barcha_toifalardagi_bugdoy
2010	0.073	7504.300	38.700	1.30e+07	6745
2011	0.076	7140.700	38.700	1.50e+07	6527
2012	.07	7519.500	46.700	13599658	6612.200
2013	0.068	7807.700	62.400	1.43e+07	6842
2014	0.061	8050.500	70.700	13545746	6956.200
2015	0.056	8173.500	76.400	1.25e+07	6964.700
2016	0.057	8261.300	98.400	1.21e+07	6934.900
2017	0.144	7288.500	212.500	1.26e+07	6079.200
2018	0.143	6535.500	260	1.40e+07	5410.800
2019	0.152	7437.800	339.600	1.75e+07	6093.500
2020	0.111	7636	401.600	1.51e+07	6157.800
2021	.1	7634.600	439.800	1.67e+07	5984.800
2022	0.123	7990.500	469.500	1.97e+07	6270.100
2023	0.088	8453.400	511.400	2.49e+07	6471.500
2024	0.098	8877.700	555.100	2.73e+07	6729.400

Preliminary statistical analysis shows that from 2010 to 2024, the inflation coefficient fluctuated between 0.056 and 0.152, exhibiting significant variations over the period. The volume of grain crops across all categories decreased in some years, but overall, it increased from 7,504.3 thousand tons to 8,877.7 thousand tons. Wheat production also experienced some annual declines, but in 2024, this figure reached 6,729.4 thousand tons. The volume of leguminous crops consistently

increased from 38.7 thousand tons to 555.1 thousand tons. Additionally, the export volume in foreign trade grew from 13.0 million dollars to 27.3 million dollars, showing a stable growth trend.

Table: List of Variables

lny	lnx1	lnx2	lnx3	lnx4
-2.612	8.923	3.656	16.382	8.817
-2.572	8.874	3.656	16.525	8.784
-2.659	8.925	3.844	16.426	8.797
-2.688	8.963	4.134	16.477	8.831
-2.792	8.993	4.258	16.422	8.847
-2.882	9.009	4.336	16.342	8.849
-2.865	9.019	4.589	16.308	8.844
-1.938	8.894	5.359	16.346	8.713
-1.945	8.785	5.561	16.454	8.596
-1.884	8.914	5.828	16.675	8.715
-2.198	8.941	5.995	16.530	8.725
-2.303	8.940	6.086	16.629	8.697
-2.096	8.986	6.152	16.798	8.744
-2.430	9.042	6.237	17.029	8.775
-2.323	9.091	6.319	17.121	8.814

This table presents the log-transformed values of the key indicators used in the study, expressed as lny, lnx1, lnx2, lnx3, and lnx4, respectively. The main purpose of log-transforming the indicators is to reduce the quantitative differences between variables, mitigate the sharp dispersion of data, and enable a more accurate interpretation of the econometric model results from the perspective of relative changes and elasticity. This is particularly important when comparing

variables with large values, such as export volume, with other variables in the same model. The appearance of negative values for the lny indicator in the table is also methodologically natural, as the inflation coefficient is not presented in percentages but as a proportion, i.e., a number between 0 and 1. The natural logarithm of such numbers will mathematically be negative. Therefore, the negative value of lny is not an error but rather indicates that the data has been correctly transformed; this approach allows for more reliable subsequent correlation, regression, and ARDL analyses.

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lny	15	-2.412	.344	-2.882	-1.884
lnx1	15	8.953	.075	8.785	9.091
lnx2	15	5.067	1.024	3.656	6.319
lnx3	15	16.564	.247	16.308	17.121
lnx4	15	8.77	.071	8.596	8.849

The results of descriptive statistics allowed for determining the general characteristics of the variables used in the study, particularly their mean values, degree of dispersion, and minimum and maximum limits. The results show that the variables change within a relatively stable range, providing a sufficient statistical basis for model construction. Particularly, the low values of standard deviations indicate that the data is stable and changes without sharp fluctuations.

Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)
(1) lny	1.000				
(2) lnx1	-0.438	1.000			
	(0.103)				
(3) lnx2	0.698	0.217	1.000		
	(0.004)	(0.438)			
(4) lnx3	0.330	0.498	0.694	1.000	
	(0.229)	(0.059)	(0.004)		
(5) lnx4	-0.857	0.691	-0.546	-0.090	1.000
	(0.000)	(0.004)	(0.035)	(0.749)	

The results of the pairwise correlation analysis allowed for assessing the initial direction and strength of the relationship between the variables. According to the results, there is a strong negative correlation between lny and lnx4 (-0.857; p=0.000), indicating that an increase in wheat volume may reduce inflationary pressure. A significant positive correlation was observed between lny and lnx2 (0.698; p=0.004), meaning that the growth in leguminous crop volume moved in the same

direction as inflation. The relationship between lny and lnx1, as well as lnx3, is negative and positive, respectively, although their statistical significance appears relatively low. Furthermore, the significant correlation between some independent variables suggests the need for cautious interpretation of results in the subsequent regression analysis.

Linear regression

lny	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnx1	-9.91	3.197	-3.10	.011	-17.033	-2.786	**
lnx2	.667	.2	3.34	.007	.222	1.112	***
lnx3	.261	.217	1.20	.257	-.223	.745	
lnx4	8.39	3.885	2.16	.056	-.266	17.045	*
Constant	5.03	8.294	0.61	.558	-13.451	23.51	

Mean dependent var	-2.412	SD dependent var	0.344
R-squared	0.905	Number of obs	15
F-test	23.952	Prob > F	0.000
Akaike crit. (AIC)	-15.823	Bayesian crit. (BIC)	-12.283

*** p<.01, ** p<.05, * p<.1

The results of the linear regression show that the model is statistically significant overall, with an R-squared value of 0.905, meaning that 90.5% of the changes in the dependent variable are explained by the factors included in the model, and the p-value for the F-test is 0.000. According to the results, the coefficient for lnx1 is negative and statistically significant (-9.91; p=0.011), indicating that an increase in the volume of grain crops has a deflationary effect on inflation. The coefficient for lnx2 is positive and highly significant (0.667; p=0.007), meaning that an increase in leguminous crop volume is associated with inflation. Although the coefficient for lnx3 is positive (0.261), its p-value of 0.257 means that no statistically significant effect was found. The coefficient for lnx4 is positive (8.39) and has borderline significance at the 10% level (p=0.056), indicating that the volume of wheat has an effect on inflation, but this effect is shaped in conjunction with more complex factors.

ARDL(1,0,1,0,0) regression

Sample: 2011 thru 2024 Number of obs = 14
F(6, 7) = 32.28
Prob > F = 0.0001
R-squared = 0.9651
Adj R-squared = 0.9352
Log likelihood = 18.727977 Root MSE = 0.0898

lny	Coefficient	Std.e	t	P>t	[95% conf. interval]

lny						
L1.	-0.154	0.169	-0.910	0.394	-0.555	0.247
lnx1	-9.425	2.683	-3.510	0.010	-15.770	-3.080
lnx2						
--.	1.007	0.191	5.270	0.001	0.555	1.459
L1.	-0.384	0.219	-1.750	0.124	-0.903	0.135
lnx3	0.530	0.180	2.940	0.022	0.104	0.956
lnx4	7.384	3.038	2.430	0.045	0.200	14.568
_cons	4.817	6.076	0.790	0.454	-9.549	19.184

The results of the ARDL model also indicate that the model is statistically significant at a high level, with an R-squared value of 0.9651 and Prob > F = 0.0001, suggesting that a large portion of the changes in inflation is explained by the selected factors. According to the results, the effect of lnx1 is negative and statistically significant (-9.425; p=0.010), confirming that an increase in the volume of grain crops is a factor that reduces inflation. lnx2 had a positive and highly significant effect in the current period (1.007; p=0.001), but its lagged value is not statistically significant (p=0.124). lnx3 also yielded a positive and significant result (0.530; p=0.022), indicating the dynamic effect of export volume on inflation. Additionally, lnx4 is positive and statistically significant (7.384; p=0.045), demonstrating that the impact of wheat volume on inflation is more clearly revealed when the time factor is considered.

Based on the obtained coefficients, the ARDL regression equation is as follows:

$$lnYt = 4.817 - 0.154lnYt-1 - 9.425lnX1t + 1.007lnX2t - 0.384lnX2t-1 + 0.530lnX3t + 7.384lnX4t + \varepsilon t$$

Here:

lnYt — natural logarithm of the inflation coefficient in the current period

lnYt-1 — natural logarithm of the inflation coefficient lagged by one period

lnX1t — natural logarithm of the volume of grain crops of all types

lnX2t — natural logarithm of the volume of leguminous crops of all types

lnX2t-1 — natural logarithm of the volume of leguminous crops lagged by one period

lnX3t — natural logarithm of the export volume in foreign trade

lnX4t — natural logarithm of the volume of wheat of all types

εt — random error term

Brief Economic Interpretation. According to this equation, the volume of grain crops of all types has a negative effect on inflation, meaning that an increase in this indicator could help reduce inflationary pressure. The volume of leguminous crops has a positive effect on inflation in the current period, but its lagged value shows a negative influence. The volume of exports and wheat volume positively affect inflation. The inflation value of the previous period is represented by a negative coefficient, indicating that current inflation is linked to its past state.

Conclusions and Recommendations. According to the analysis of the article, the data from 2010 to 2024 show that changes in the volume of wheat and other grain crops in agriculture are significantly related to the inflation rate, with this relationship statistically confirmed through

regression and ARDL results. The findings suggest that an increase in the volume of grain crops of all types helps reduce inflationary pressure, while the influence of wheat volume, exports, and some other factors is complex and multifactorial.

Based on this, the first recommendation is the need to implement modern agro-technologies to increase productivity, use quality seeds, and adopt water-saving methods in wheat production.

The second recommendation is to effectively manage wheat reserves to ensure price stability in the domestic market, improve logistics, and reduce disruptions between producers and consumers.

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