Econometric Analysis of the Impact of Agricultural Policies on the Wheat Food Gap in Iraq during the Period 1990–2025

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ABSTRACT

This study analyzes the determinants of the wheat food gap in Iraq during the period (1990–2025) using modern econometric methods, particularly the Autoregressive Distributed Lag (ARDL) model. The analysis examines the impact of several explanatory variables, including domestic production, domestic price, world price, and the quantity available for consumption, on the size of the wheat food gap. The research problem arises from the widening gap between domestic production and consumption and the increasing dependence on wheat imports despite the availability of local production potential.The empirical results indicate the existence of a long-run equilibrium relationship among the studied variables. Domestic production shows a statistically significant negative effect on the food gap, indicating that increases in local production contribute to reducing the gap. In contrast, domestic price and the quantity available for consumption exhibit a positive relationship with the food gap, suggesting that increases in these variables lead to an expansion of the gap. The results also reveal that the world price does not have a statistically significant direct effect on the wheat food gap in the long run within the Iraqi economy.Furthermore, the estimated error correction coefficient reached (-0.26), reflecting the system's ability to adjust and return to its long-run equilibrium after short-term fluctuations. This indicates that about 26% of the short-run imbalance is corrected each year, meaning the system requires approximately 3.8 years to restore equilibrium. The study recommends promoting vertical expansion in wheat production and supporting agricultural inputs to reduce domestic production costs.

Keywords: Food Gap, Wheat Crop, ARDL Model, Iraq, Domestic and Border Prices, Consumption.

INTRODUCTION

Food security constitutes a fundamental pillar of economic and political stability in any country. In Iraq, this issue acquires particular importance due to the strategic role of wheat as the primary food crop and the main staple for the population. Despite the availability of agricultural resources and production potential, the wheat food gap—defined as the difference between domestic production and consumption requirements—continues to represent a structural challenge that places pressure on both the trade balance and the public budget.

The economic variables influencing this gap are characterized by complexity and strong interdependence. The interaction between supply and demand is shaped by several domestic and international factors, including the level of agricultural production, domestic pricing policies, fluctuations in international market prices, and the continuous growth in consumption levels. Accordingly, there is a clear need for a scientific assessment of these relationships using modern econometric techniques capable of providing reliable and policy-relevant results.

This study aims to analyze and measure the determinants of the wheat food gap in Iraq over the period 1990–2025 using the Autoregressive Distributed Lag (ARDL) model. The significance of the study lies in its ability to distinguish between the short-run and long-run effects of the explanatory variables—namely domestic production, domestic price, border price, and available supply for consumption—on the food gap. The research primarily seeks to identify structural weaknesses within Iraq's food security system and to provide an analytical framework that can assist policymakers in designing effective strategies to reduce the food gap and strengthen national self-reliance in the face of increasing economic and climatic challenges.

Research Problem

The research problem is reflected in the persistent expansion of the wheat food gap in Iraq, where the agricultural sector faces a dual challenge represented by the inability of domestic production to keep pace with the continuously increasing levels of consumption. This imbalance has contributed to a growing reliance on wheat imports, which in turn places additional pressure on the national economy and the country's food security system.

The core of the problem lies in the limited clarity regarding the relative influence of domestic factors—particularly domestic production and local prices—compared with external factors, such as international market prices, in shaping the magnitude of the wheat food gap. The interaction between these variables creates a complex economic environment that affects both the supply of wheat and the level of domestic availability for consumption.

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Accordingly, the study seeks to address the following main research question:

What are the most influential determinants of the wheat food gap in Iraq, and does short-run disequilibrium possess the capacity for self-adjustment toward long-run equilibrium?

Research Objectives

1. To examine and diagnose the status of the wheat food gap in Iraq during the period 1990–2025.
2. To measure and analyze the impact of key explanatory variables—namely domestic production, domestic price, border price, and consumption—on the magnitude of the wheat food gap.
3. To estimate the speed of adjustment of the wheat food gap in response to changes in the explanatory variables using the Error Correction Mechanism (ECM).
4. To provide evidence-based policy recommendations that may assist decision-makers in strengthening food security and improving the performance of the agricultural sector.

Research Significance

The significance of this study lies in its coverage of a long and comprehensive period of 35 years, during which Iraq experienced substantial political, economic, and climatic changes. This extended timeframe allows for a thorough understanding of the dynamics of food security in the country. The findings of the study are expected to provide valuable insights for policymakers, enabling them to design effective production and pricing strategies that enhance domestic wheat supply, reduce the food gap, and strengthen overall national food security.

Research Hypothesis

The study is based on the following main hypothesis:

There exists a long-run equilibrium (co-integration) relationship between the wheat food gap in Iraq and its key economic determinants, namely domestic production, domestic price, border price, and available supply for consumption. Furthermore, the model possesses the capacity for self-correction, allowing the food gap to return to equilibrium in the event of short-term deviations.

Concept of Agricultural Policy

Agricultural policy is defined as a set of government measures and interventions aimed at regulating agricultural activities to achieve food security, stabilize prices, improve farmers' incomes, and reduce dependence on food imports [9]. It provides the institutional

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framework governing the relationship between production, consumption, and agricultural trade, serving as a fundamental tool for addressing structural imbalances in the agricultural sector [13].

Objectives of Agricultural Policy

Economic literature indicates that agricultural policy seeks to achieve several objectives, most notably:

1. Ensuring food security by guaranteeing the local availability of strategic commodities [10].
2. Increasing domestic production while reducing reliance on imports [13].
3. Stabilizing agricultural prices to protect both producers and consumers [12].
4. Improving farmers' income levels and ensuring the sustainability of agricultural activities [3].
5. Managing strategic reserves to mitigate the effects of external shocks [1].

Achieving relative self-sufficiency represents a central goal of agricultural policy due to its strategic importance for national food security [8].

Significance of Agricultural Policy

The significance of agricultural policy can be summarized in several economic and developmental aspects [4]:

- Reducing exposure to global price volatility.
- Enhancing local production capacity.
- Supporting economic and social stability.
- Reducing pressure on the trade balance.

Concept of the Food Gap

The food gap is a key concept in agricultural economics and food security studies, reflecting the imbalance between domestic production capacity and the population's consumption needs. It arises when domestic production fails to meet the actual or projected demand for a given food commodity within a specific period.

Quantitatively, the food gap can be expressed as the difference between total consumption and domestic production, where a positive value indicates reliance on imports to cover the deficit, while a negative value reflects a production surplus , Beyond its numerical measure, the food gap serves as an indicator of external dependency and the level of risk associated with fluctuations in international markets [11].

The food gap is closely linked to the concept of food security, which emphasizes the continuous and reliable availability of food. The

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wider the food gap, the more vulnerable a country becomes to external shocks such as global price volatility or supply chain disruptions. Countries heavily dependent on grain imports are particularly exposed to food instability during international crises [13].

Objectives and Significance of Addressing the Food Gap

Addressing the food gap aims to achieve several objectives [5]:

1. Attaining relative self-sufficiency.
2. Reducing dependence on imports.
3. Enhancing long-term food stability.
4. Improving the efficiency of agricultural resource utilization.
5. Minimizing risks from external shocks.

The importance of addressing the food gap also lies in:

- Reducing deficits in the agricultural trade balance.
- Supporting economic stability.
- Mitigating political risks associated with food security.
- Protecting low-income groups from price fluctuations.

Domestic Production and Its Role in Reducing the Food Gap

Agricultural production is defined as the process of utilizing various production factors—land, labor, capital, and management—to produce agricultural commodities that meet domestic or external market needs. Agricultural production is closely linked to natural and seasonal factors, as well as climatic variations [7].

From an economic perspective, agricultural production represents the supply side of the market, determining the balance between supply and demand. Growth in production is not solely dependent on expanding cultivated areas but also on improving productivity and adopting modern technologies [7].

The food gap is a direct result of the imbalance between domestic production and consumption: the higher the domestic production relative to demand, the smaller the food gap; conversely, if production growth lags behind accelerating demand, the deficit widens and is compensated through imports.

Food Consumption

Food consumption refers to the actual quantities of food commodities consumed by the population over a given period to meet nutritional requirements [2]. Economically, consumption represents the demand side of the market and is a key determinant of the required production level to achieve equilibrium. Price stability

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also enhances producer confidence and stimulates agricultural investment [6].

International Prices and Exposure to External Shocks

Global prices represent an important external factor affecting domestic incentives. When international prices rise, countries may be encouraged to boost local production to reduce import dependence; conversely, price declines can lead to expanded imports and reduced local production incentives. Therefore, the relationship between global prices and the food gap largely depends on the agricultural policies in place [4].

Status of Wheat Consumption, Food Gap, and Self-Sufficiency Ratio in Iraq (1990–2025)

Table (1) presents the total wheat consumption in Iraq during the period 1990–2025. The overall average consumption was approximately 3,068,394.44 tons. Consumption exhibited significant fluctuations throughout the study period, reaching its lowest level in 1993 at 1,158,000 tons. This decline was closely linked to the exceptional economic conditions Iraq faced at the time, particularly the economic sanctions that restricted the country's import capacity. Consequently, the domestic availability of wheat decreased, and consumption relied more heavily on local production. Moreover, the deterioration of household purchasing power due to high inflation rates and the depreciation of the local currency altered food consumption patterns and reduced food waste, reflecting limited availability of essential food commodities.

In contrast, the highest level of consumption was recorded in 2024 at 5,223,000 tons, driven by several factors. The continuous population growth over recent years increased the demand for bread as a primary staple. Government subsidies on flour and bread further encouraged higher wheat consumption compared to other food products, such as meat and vegetables. Additionally, the expansion of food industries reliant on flour, including bakery products and pastries, and the increased consumption in local bakeries, contributed to the overall rise in wheat demand in the domestic market. Figure (1) illustrates the general trend of wheat consumption over the study period.

Regarding the wheat food gap, the average during the period amounted to approximately -651,477.97 tons, indicating a persistent deficit between domestic production and consumption. This gap varied, reaching its largest deficit in 2000 at -2,716,000 tons, mainly due to climatic factors and water scarcity that reduced cultivated areas, especially in rainfed regions of northern Iraq heavily dependent on

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rainfall. Additionally, weak price incentives in certain years discouraged some farmers from expanding wheat cultivation or encouraged a shift toward more profitable crops.

Conversely, the food gap reached its lowest level in 2022 at only -11 tons, reflecting the expansion of wheat cultivation areas due to government policies aimed at utilizing desert lands through well irrigation and enlarging the agricultural frontier. The government's price incentive policy, which involved purchasing wheat from farmers at supportive prices, also encouraged higher production and ensured that the entire harvest was marketed to governmental agencies, significantly reducing the wheat food gap.

The overall average self-sufficiency ratio for wheat during the study period was approximately 60.35%, which can be considered relatively acceptable given Iraq's economic and political conditions. This ratio fluctuated between a minimum of 18.12% in 2023 and a maximum of 99.32% in 2011.

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Table 1. Wheat Production, Available Supply, Food Gap, and Self-Sufficiency Ratio in Iraq (1990-2025)

Self-Sufficiency Ratio (%)	Food Gap (tons)	Available for Consumption (tons)	Production)tons(	Year
53.96	(1020000)	2215500	1195500	1990
83.67	(288000)	1764400	1476400	1991
83.65	(256000)	1566700	1310700	1992
78.67	(247000)	1158000	911000	1993
64.01	(480000)	1334000	854000	1994
86.86	(165000)	1256400	1091400	1995
67.09	(564000)	1714000	1150000	1996
41.14	(1354000)	2300700	946700	1997
57.81	(1076000)	2550900	1474900	1998
34.41	(2100000)	3201600	1101600	1999
27.69	(2716000)	3756300	1040300	2000
59.75	(1691000)	3910400	2219400	2001
65.31	(1375000)	3964500	2589500	2002
66.85	(1155000)	3484200	2329200	2003
75.02	(610000)	2442100	1832100	2004
88.31	(295000)	2523400	2228400	2005
56.88	(1733000)	4019300	2286300	2006
53.39	(1923000)	4125800	2202800	2007
42.62	(1689000)	2944000	1255000	2008
56.65	(1301000)	3001400	1700400	2009
97.44	(72000)	2820800	2748800	2010
99.32	(19000)	2827800	2808800	2011
99.31	(21000)	3083300	3062300	2012
98.93	(45000)	4223400	4178400	2013
96.78	(168000)	5223000	5055000	2014
98.11	(51000)	2696000	2645000	2015
22.89	(168.000)	5223000	1195500	2016
35.19	(45.000)	4196000	1476400	2017
44.58	210.000)(	2940000	1310700	2018
30.35	(190.000)	3001400	911000	2019
30.27	(72.000)	2829800	854000	2020
35.63	(30.000)	2827800	1091400	2021
26.48	(11.000)	3083300	1150000	2022
18.12	(45.000)	4334000	946700	2023

54.71	(168.000)	5223000	1474900	2024
40.86	(387000)	2696000	1101600	2025
60.35305556	- 651477.9714	3068394.444	1755725	المتوسط العام
99.32	-11	5223000	5055000	الحد الاعلى
18.12	-2716000	1158000	854000	الحد الادنى

Source: Ministry of Agriculture, IraqKFood Gap: Negative values (in parentheses) indicate a deficit between domestic production and consumption requirementsK Self-Sufficiency Ratio (%) = (Domestic Production ÷ Consumption Requirement) × 100.

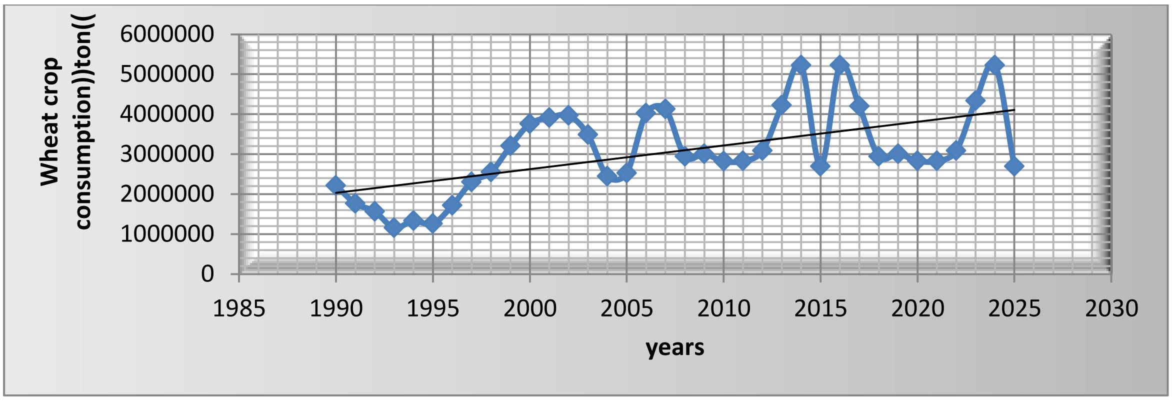

Figure 1. General Trend of Wheat Consumption in Iraq (1990–2025)

Source: Prepared by the researcher based on the data presented in Table 1.

Wheat Food Gap Model for the Period 1990–2025

In this econometric model, the wheat food gap is adopted as the dependent variable, while the independent variables include domestic wheat production, domestic wheat price, global wheat price, and the quantities available for consumption. These variables were incorporated to analyze their effects in explaining the variations in the wheat food gap over the study period.

The model is designed to capture both the short-term fluctuations and the long-term relationships between the food gap and its key economic determinants. By doing so, it provides a quantitative framework to assess the relative influence of production levels, price incentives, and consumption availability on the food gap, thereby offering valuable insights for policy formulation aimed at reducing the deficit and improving national food security.

Y = F (X1 , X2 , X3 , X4)

- Y = Wheat Food Gap (tons), the dependent variable.
- X1 = Domestic Wheat Production (tons).
- X2 = Domestic Wheat Price (IQD/ton).
- X3 = Global Wheat Price (IQD/ton).
- X4 = Quantity Available for Consumption (tons).

Time Series Stationarity Test for the Variables in Iraq (1990–2025)

Testing the stationarity of time series is a fundamental step before estimating econometric models, as non-stationary variables may lead to misleading results or spurious relationships among the variables. For this reason, researchers employ a set of statistical tests aimed at assessing the degree of stationarity of the time series. These tests can be broadly classified into two main types.

Graphical Method for Detecting Time Series Stationarity of the Variables in Iraq (1990–2025)

Before applying formal econometric tests, it is essential to visually represent the time series over time to examine their characteristics and initial behavior. Time series plots serve as a preliminary indicator, providing insights into the variable's behavior and whether it exhibits stability. For example, if a plot shows a clear upward or downward trend, this indicates that the series' mean changes over time, suggesting non-stationarity.

Figures (2) and (3) display the plots of the studied economic variables both at the level and at the first difference. From the graphical analysis, it is observed that variables X4,X3,andYwere stationary at the level (I(0)), as their trajectories were approximately horizontal without any clear upward or downward trend.This indicates that these time series are integrated of order zero.

After applying the first difference, variables X1, X2, X3, X4, and Y became stationary, exhibiting no unit root problem. Their trajectories fluctuated around a constant mean, indicating that these time series are integrated of order one (I(1)).

This graphical approach provides a preliminary understanding of the stationarity properties of the variables and serves as a foundation for subsequent formal unit root tests, ensuring the reliability of econometric model estimation.

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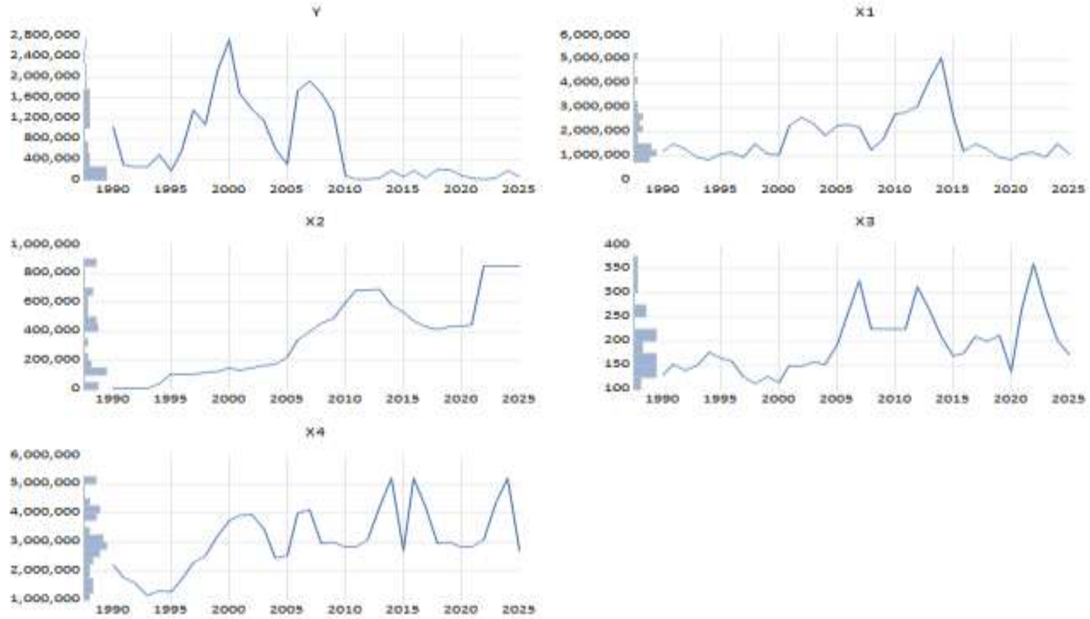

Figure 2. Graphical Method for Detecting Time Series Stationarity of the Variables in Iraq (1990–2025) at the Level
Source: Prepared by the researcher based on the outputs of EViews 12.

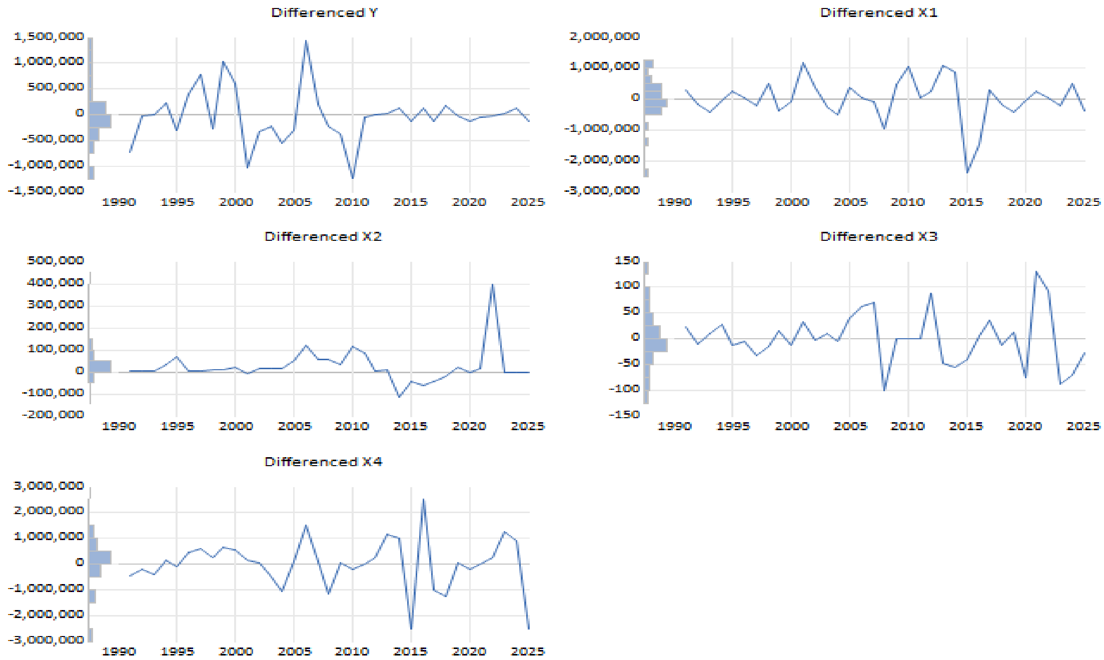

Figure 3. Graphical Method for Detecting Time Series Stationarity of the Variables in Iraq (1990–2025) at the First Difference
Source: Prepared by the researcher based on the outputs of EViews 12.

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Unit Root Test for Time Series Stationarity Using the Phillips–Perron (PP) Method

The unit root test is employed to examine the time series properties of the model's variables, assess their stability over time, and determine the integration order of each variable. Table 2 presents the results of the Phillips–Perron (PP) test applied to the variables included in the analyzed function.

The results indicate that variables X4 (Quantity Available for Consumption), X3 (Global Wheat Price), and Y (Wheat Food Gap) were stationary at the level at significance levels of 1% and 5%, suggesting that these series are integrated of order zero, I(0). Conversely, the results show that variables X1 (Domestic Wheat Production), X2 (Domestic Wheat Price), X3, X4, and Y became stationary after taking the first difference, indicating that they are integrated of order one, I(1), at a 5% significance level.

These findings imply that the studied variables do not share the same degree of stationarity, as they differ in their orders of integration.

Due to this variation in integration orders, applying the Ordinary Least Squares (OLS) method for model estimation is not appropriate, since OLS assumes that all variables are integrated of the same order, typically I(0). Ignoring this requirement may lead to spurious relationships and unreliable results.

Therefore, it is necessary to adopt an alternative estimation technique that accommodates variables with different integration orders. Consequently, the model will be estimated using the Autoregressive Distributed Lag (ARDL) approach, which is suitable for cases where the variables are a combination of I(0) and I(1) series.

Table 2. Unit Root Test for Time Series Stationarity of the Variables Using the Phillips–Perron (PP) Method

UNIT ROOT TEST RESULTS TABLE (PP)						
At Level		**Y**	**X1**	**X2**	**X3**	**X4**
With Constant	**t-Statistic**	**-1.9775**	**-2.1436**	**-0.4200**	**-2.7100**	**-2.9847**
	Prob.	**0.2949**	**0.2297**	**0.8948**	**0.0825**	**0.0462**
		n0	**n0**	**n0**	*****	******
With Constant & Trend	**t-Statistic**	**-3.2976**	**-2.0483**	**-1.8837**	**-3.0114**	**-3.6216**
	Prob.	**0.0848**	**0.5554**	**0.6415**	**0.1436**	**0.0423**
		*****	**n0**	**n0**	**n0**	******
Without Constant & Trend	**t-Statistic**	**-1.6910**	**-0.9995**	**1.1688**	**-0.6085**	**-0.8198**

ISSN 2072-3857

	Prob.	0.0856	0.2788	0.9344	0.4465	0.3536
		*	n0	n0	n0	n0
At First Difference		d(Y)	d(X1)	d(X2)	d(X3)	d(X4)
With Constant	t-Statistic	-4.0579	-5.7394	-4.9177	-5.6385	-6.9078
	Prob.	0.0037	0.0000	0.0003	0.0000	0.0000
		***	***	***	***	***
With Constant & Trend	t-Statistic	-4.0634	-5.7574	-4.8541	-5.5766	-6.7668
	Prob.	0.0167	0.0002	0.0022	0.0003	0.0000
		**	***	***	***	***
Without Constant & Trend	t-Statistic	-4.1166	-5.8331	-4.6044	-5.7275	-7.0055
	Prob.	0.0002	0.0000	0.0000	0.0000	0.0000
		***	***	***	***	***
(*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant						

Source: Prepared by the researcher based on the outputs of EViews 12.

Econometric Analysis of the Impact of Agricultural Policies on theWheat Food Gap in Iraq (1990–2025)

The impact of key variables on the wheat food gap in Iraq was estimated using the Autoregressive Distributed Lag (ARDL) model and the Error Correction Mechanism (ECM), following the steps outlined below:

1. Preliminary Estimation of the ARDL Model

After verifying the stationarity of the time series using unit root tests, the preliminary estimation of the model was performed. The ARDL model was estimated using EViews 12, incorporating the study’s independent variables to explain the variations in the wheat food gap.

The results, presented in Table 3, indicate that the Adjusted R^2 of the model is approximately 0.77, meaning that the included independent variables explain nearly 77% of the variations in the dependent variable. The remaining 23% is attributed to other factors not included in the model, reflected in the stochastic error term.

Regarding the overall significance of the model, the F-statistic is 13.30 with a probability value of 0.0000, which is well below the conventional significance levels of 0.05 and 0.01. This indicates that the estimated model is statistically highly significant, and its results can be relied upon for interpreting the relationships among the studied variables.

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Table (4) Co-integration test using boundary testing (bounds testing) for the effect of study variables on the variable of white meat prices for the period (2004-2024).

Null Hypothesis: No linear relationship		F-Bounds Test			
Test Statistic		Value	Signif.	I(0)	I(1)
F-statistic		1.919845		Asymptotic: n=1000	
k		4	10%	2.2	3.09
			5%	2.56	3.49
			2.5%	2.88	3.87
			1%	3.29	4.37

Source: Prepared by the researcher based on the outputs of the program. (Eviews12)

Wheat Food Gap in Iraq (1990–2025)

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Table 3. Preliminary Estimation of the Autoregressive Distributed Lag (ARDL) Model for the Impact of Study Variables on the Wheat Food Gap in Iraq (1990–2025)

Dependent Variable: Y				
Method: ARDL				
Date: 2/20/26 Time: 17:21				
Sample (adjusted): 1990 2025				
Included observations: 36 after adjustments				
Maximum dependent lags: 1 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (2 lags, automatic): X1 X2 X3 X4				
Fixed regressors: C				
Number of models evalulated: 81				
Selected Model: ARDL(1, 2, 0, 0, 2)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Y(-1)	0.735198	0.111788	6.576698	0.0000
X1	-0.458641	0.123090	-3.726068	0.0010
X1(-1)	0.558934	0.163888	3.410472	0.0023
X1(-2)	-0.284964	0.120617	-2.362545	0.0266
X2	-0956835	0.479152	-1.996932	0.0573
X3	1567.476	1505.657	1.041058	0.3082
X4	0.393204	0.090668	4.336722	0.0002
X4(-1)	-0.102681	0.099372	-1.033302	0.3118
X4(-2)	-0.145217	0.091619	-1.585003	0.1261
C	75382.40	343494.2	0.219458	0.8281
R-squared	0.833066	Mean dependent var		649882.4
Adjusted R-squared	0.770466	S.D. dependent var		760748.2
S.E. of regression	364472.0	Akaike info criterion		28.69022
Sum squared resid	3.19E+12	Schwarz criterion		29.13914
Log likelihood	-477.7337	Hannan-Quinn criter.		28.84331
F-statistic	13.30775	Durbin-Watson stat		1.725632
Prob(F-statistic)	0.000000			

Source: Prepared by the researcher based on the outputs of EViews 12.

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3. Cointegration Test Using the Bounds Testing Approach for the Impact of Study Variables on the Wheat Food Gap in Iraq (1990–2025)

The cointegration test is employed to detect the existence of a long-run equilibrium relationship between the model variables and the wheat food gap. To examine this, the Bounds Test was applied within the framework of the Autoregressive Distributed Lag (ARDL) model, which is a standard method for determining long-run relationships among economic variables.

The test is based on comparing the calculated F-statistic with the tabulated lower and upper bound critical values. The null hypothesis H0:β=0H_0: \beta = 0H0:β=0 assumes no cointegration among the variables, whereas the alternative hypothesis H1:β≠0H_1: \beta \neq 0H1:β□=0 indicates the presence of a long-run equilibrium relationship between the variables.

The results presented in Table 4 show that the computed F-statistic is 4.813, which exceeds the tabulated lower and upper bound critical values. This leads to the rejection of the null hypothesis and acceptance of the alternative hypothesis, confirming the existence of a long-run cointegration relationship among the variables included in the wheat food gap model.

Table 4. Cointegration Test Using the Bounds Testing Approach for the Impact of Study Variables on the Wheat Food Gap (1990–2025)

Null Hypothesis: No levels relationship		F-Bounds Test			
Test Statistic		Value	Signif.	I(0)	I(1)
F-statistic		4.813477		Asymptotic: n=1000	
k		4	10%	2.2	3.09
			5%	2.56	3.49
			2.5%	2.88	3.87
			1%	3.29	4.37

Source: Prepared by the researcher based on the outputs of the EViews 12.

4. Estimation and Interpretation of Short- and Long-Run Relationships Using the ARDL Model for the Impact of Study

Variables on the Wheat Food Gap (1990–2025)

The results presented in Table 5 illustrate the short- and long-run coefficients of the ARDL model for the wheat food gap in Iraq, Domestic Wheat Production (X1):Short-run coefficient: -0.45, indicating an inverse relationship between wheat production and the food gap. A 1% increase in domestic production reduces the food gap by 0.45%. This variable is statistically significant at the 5% level, consistent with economic theory, as higher local production helps reduce the food gap,Long-run coefficient: -0.69, confirming the persistence of the inverse relationship over time. A 1% increase in production leads to a 0.69% decrease in the wheat food gap, significant at the 5% level, highlighting the long-term importance of domestic production in narrowing the gap.

Domestic Wheat Price (X2):Short-run coefficient: -0.95, suggesting an inverse relationship between domestic price and the wheat food gap. A 1% increase in domestic price reduces the gap by 0.95%, significant at the 5% level, Long-run coefficient: -3.61, indicating the persistence of this negative effect over time and significance at the 5% level.

Global Wheat Price (X3):The coefficient is not statistically significant in both the short and long run, implying that global prices did not have a significant impact on the wheat food gap during the study period. This suggests that the main determinants of the gap are domestic production, domestic prices, and consumption.

Quantity Available for Consumption (X4):Short-run coefficient: 0.39, indicating a positive relationship with the food gap. A 1% increase in consumption increases the wheat food gap by 0.39%, significant at the 5% level, Long-run coefficient: 0.54, confirming the persistence of this direct relationship. A 1% increase in consumption leads to a 0.54% rise in the wheat food gap, These results demonstrate that domestic production and prices play a critical role in reducing the wheat food gap, while higher consumption tends to widen the gap.

ISSN 2072-3857

Table 5. Short- and Long-Run ARDL Estimates for the Impact of Study Variables on the Wheat Food Gap in Iraq (1990–2025)

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	75382.40	343494.2	0.219458	0.8281
Y(-1)*	-0.264802	0.111788	-2.368786	0.0262
X1(-1)	-0.184671	0.093396	-1.977277	0.0596
X2**	-0956835	0.479152	-1.996932	0.0573
X3**	1567.476	1505.657	1.041058	0.3082
X4(-1)	0.145306	0.120137	1.209504	0.2382
D(X1)	-0.458641	0.123090	-3.726068	0.0010
D(X1(-1))	0.284964	0.120617	2.362545	0.0266
D(X4)	0.393204	0.090668	4.336722	0.0002
D(X4(-1))	0.145217	0.091619	1.585003	0.1261
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
X1	-0.697390	0.416755	-1.673382	0.1072
X2	-3.613391	1.588059	-2.275350	0.0321
X3	5919.417	5874.931	1.007572	0.3237
X4	0.548732	0.391268	1.402446	0.1736
c	284674.1	1310883	0.217162	0.8299
EC = Y - (-0.6974*X1 - 3.6134*X2 + 5919.4172*X3 + 0.5487*X4+ 284674.0822)				

Source: Prepared by the researcher based on outputs from EViews 12.

It is evident from Table 6 that the error correction coefficient (ECMECMECM) is -0.26, which is statistically significant at the 1% level. This satisfies the necessary and sufficient condition for the short-run disequilibrium to adjust toward the long-run equilibrium.

The negative and significant ECM coefficient indicates that deviations from the long-run wheat food gap relationship are corrected over time. Specifically, the adjustment speed implies that it would take approximately 3.84 years (calculated as 1/0.26≈3.841/0.26 \approx 3.841/0.26≈3.84) for the wheat food gap to return to its long-run equilibrium following a short-run shock.

ISSN 2072-3857

Table 6. Error Correction Coefficient (ECM) for the ARDL Model: Impact of Study Variables on the Wheat Food Gap (1990–2025)

ARDL Error Correction Regression				
Dependent Variable: D(Y)				
Selected Model: ARDL(1, 2, 0, 0, 2)				
Case 2: Restricted Constant and No Trend				
Date: 2/20/26 Time: 17:23				
Sample: 1990 2025				
Included observations: 36				
ECM Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(X1)	-0.458641	0.096520	-4.751760	0.0001
D(X1(-1))	0.284964	0.097334	2.927703	0.0074
D(X4)	0.393204	0.069523	5.655746	0.0000
D(X4(-1))	0.145217	0.071533	2.030053	0.0536
CointEq(-1)*	-0.264802	0.073029	-3.625977	0.0013
R-squared	0.601035	Mean dependent var		-6970.588
Adjusted R-squared	0.546006	S.D. dependent var		492091.2
S.E. of regression	331566.6	Akaike info criterion		28.39610
Sum squared resid	3.19E+12	Schwarz criterion		28.62056
Log likelihood	-477.7337	Hannan-Quinn criter.		28.47265
Durbin-Watson stat	1.725632			

Source: Prepared by the researcher based on the outputs of the EViews 12

5-Diagnostic Tests for the Impact of Study Variables on the Wheat Food Gap (1990–2025)

After estimating both the short- and long-run relationships of the study variables on the wheat food gap using the ARDL model, the model's adequacy and reliability were evaluated through diagnostic tests(15). The results are summarized in Table 7.

Breusch-Godfrey Serial Correlation LM Test: This test detects the presence of serial correlation in the residuals, The F-statistic is 0.91 with a probability value of 0.41, which exceeds the 5% significance level, Therefore, the null hypothesis of no serial correlation is accepted, indicating that the model does not suffer from autocorrelation issues .

ARCH Heteroskedasticity Test: This test examines the homoscedasticity (constant variance) of the residuals, The F-statistic is 0.80 with a probability value of 0.61, which is above 5%, Hence, the null hypothesis of no heteroskedasticity is accepted, confirming that the model does not have variance instability.

Ramsey RESET Test: This test evaluates the functional form specification of the model to ensure it is correctly specified, The F-statistic is 2.50 with a probability value of 0.12, which is higher than 5%, Consequently, the null hypothesis that the model is correctly specified is accepted, indicating that the functional form is appropriate.

Table 7. Diagnostic Tests for the Impact of Study Variables on the Wheat Food Gap (1990–2025)

Breusch-Godfrey Serial Correlation LM Test:					
F-statistic		0.912763	Prob. F(2, 22)		0.4161
Obs*R-squared		2.605100	Prob. Chi-Square(2)		0.2718
Heteroskedasticity Test: Breusch-Pagan-Godfrey					
F-statistic		0.802435	) Prob. F(9,24		0.8481
Obs*R-squared		7.864514	Prob. Chi-Square(9)		0.5479
Ramsey RESET Test , Equation: UNTITLED					
	Value	df		Probability	
t-statistic	1.581830	23			0.1273
F-statistic	2.502187	(1, 23)			0.1273

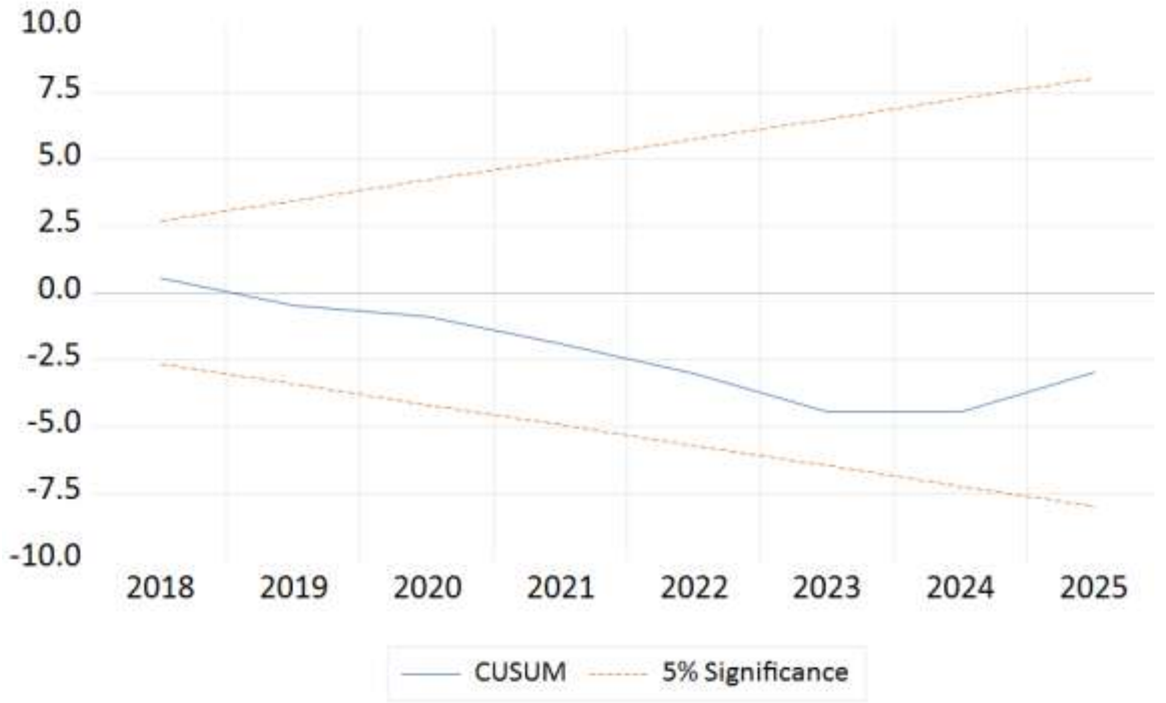
Source: Prepared by the researcher based on the outputs of the EViews 12

6. Stability Test of the Estimated Model Using CUSUM and CUSUM of Squares for the Impact of Study Variables on the Wheat Food Gap (1990–2025)

The structural stability of the estimated ARDL model for both short- and long-run relationships was assessed using the Cumulative Sum (CUSUM) test and the CUSUM of Squares (CUSUMSQ) test. These tests are essential for determining two key aspects:

1. Whether the data used in the study are free from structural breaks.
2. The consistency and stability of the short-run coefficients relative to the long-run coefficients (14).

Such tests are particularly relevant for the ARDL framework, as they ensure that the estimated parameters remain reliable over time, The CUSUM test results, illustrated in Figure 2, show that the cumulative sum of residuals lies entirely within the 5% critical bounds, indicating no structural breaks and confirming the consistency of short- and long-run parameters, The CUSUMSQ test, shown in Figure 3, demonstrates that the cumulative sum of squared residuals generally remains within the critical bounds over the study period. However, deviations beyond the 5% critical limits are observed in 2023 and 2024, suggesting the occurrence of structural changes in the wheat food gap during these years.



ISSN 2072-3857

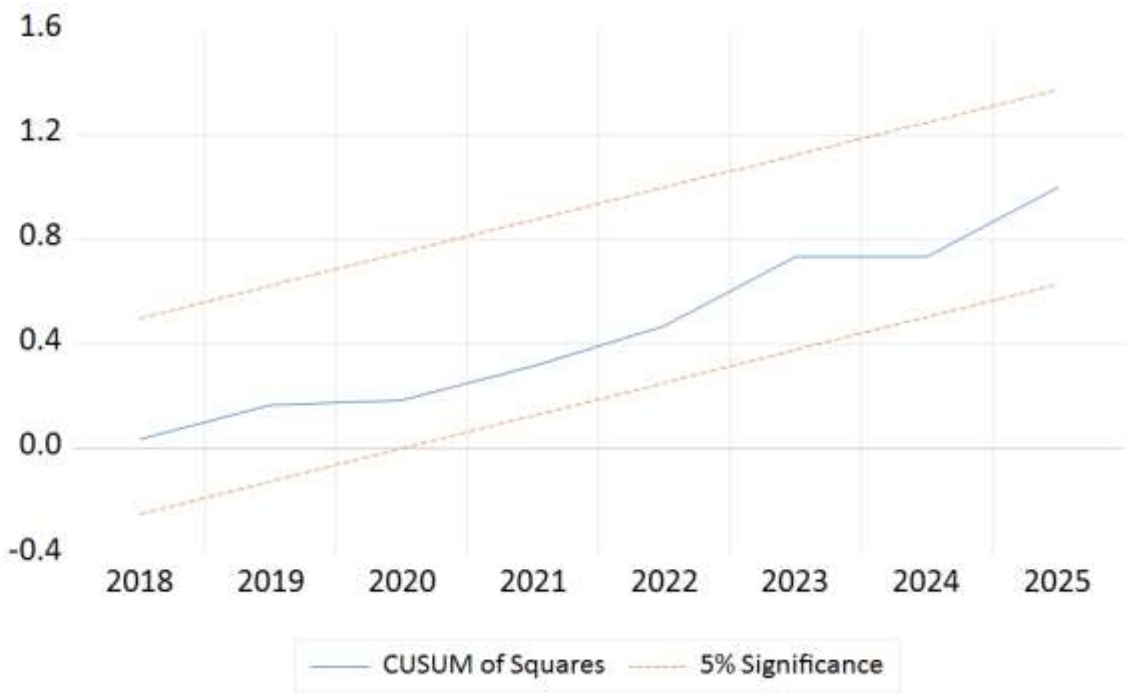


Figure 4. Stability Test of the Estimated ARDL Model Using CUSUM and CUSUM of Squares: Impact of Study Variables on the Wheat Food Gap (1990–2025)
Source: Prepared by the researcher based on outputs from EViews 12.

Conclusions and Recommendations

Conclusions

1. **Stability of Time Series: The Phillips–Perron (PP) test results indicated that all study variables were non-stationary at their original levels (I(0)) and became stationary at the first difference (I(1)). This variation in integration orders necessitated avoiding the Ordinary Least Squares (OLS) method and adopting the Autoregressive Distributed Lag (ARDL) model to prevent misleading results.**
2. **Pivotal Role of Domestic Production (X1): The econometric analysis confirmed a significant negative relationship between domestic wheat production and the food gap. A 1% increase in production reduces the food gap by 0.45% in the short run and 0.69% in the long run.**
3. **Sensitivity to Local Supported Prices (X2): Results revealed that the local price is a major driver of the food gap in the long run; a 1% increase in local prices leads to a 3.61%**

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increase in the wheat food gap.

4. **Neutral Effect of Global Prices (X3):** The coefficient of the border (global) wheat price was statistically insignificant in both short- and long-run analyses. This indicates that the wheat food gap in Iraq is influenced more by domestic structural factors than by international price fluctuations.
5. **Impact of Consumption Pattern (X4):** There is a positive and significant relationship between the available quantity for consumption and the food gap. A 1% increase in consumption raises the gap by 0.39% in the short run and 0.54% in the long run.
6. **Error Correction Mechanism (ECM):** The ECM coefficient was negative and significant (-0.26), implying that it takes approximately 3.84 years for the Iraqi wheat sector to correct short-term shocks and return to long-run equilibrium.

Recommendations

1. **Adopt a Vertical Expansion Strategy:** Given the strong impact of domestic production (X1) in reducing the gap, it is recommended to focus government investments on increasing yield per hectare through high-yield seed varieties and smart irrigation technologies, ensuring maximum reduction of the food gap with minimal land and water use.
2. **Restructure Price Support Policies:** Since the local price (X2) significantly contributes to widening the gap in the long run, support should be redirected towards production inputs (fertilizers, pesticides) rather than solely raising the purchase price, which may strain the budget without addressing the root cause.
3. **Rationalize Consumption and Manage Demand:** Given the positive effect of consumption (X4) on the food gap, it is recommended to develop a rationing system to reduce waste and promote value-added industries that improve flour utilization efficiency, mitigating the gap increase caused by population growth.
4. **Hedge Against Structural Shifts:**

Considering the structural instability detected in 2023 and 2024 (CUSUMSQ test), a early warning unit should be established to analyze shocks (climatic or economic) and implement preemptive strategies to secure strategic wheat reserves.

5. **Leverage Stability of Global Prices (X3):**
   As the global price is not statistically significant in the long run, the government can take advantage of global price flexibility by building large storage silos, allowing purchases during periods of low international prices and storing surplus during years of abundance to ensure local supply stability.

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